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HEAd '21

7th International Conference on Higher Education Advances

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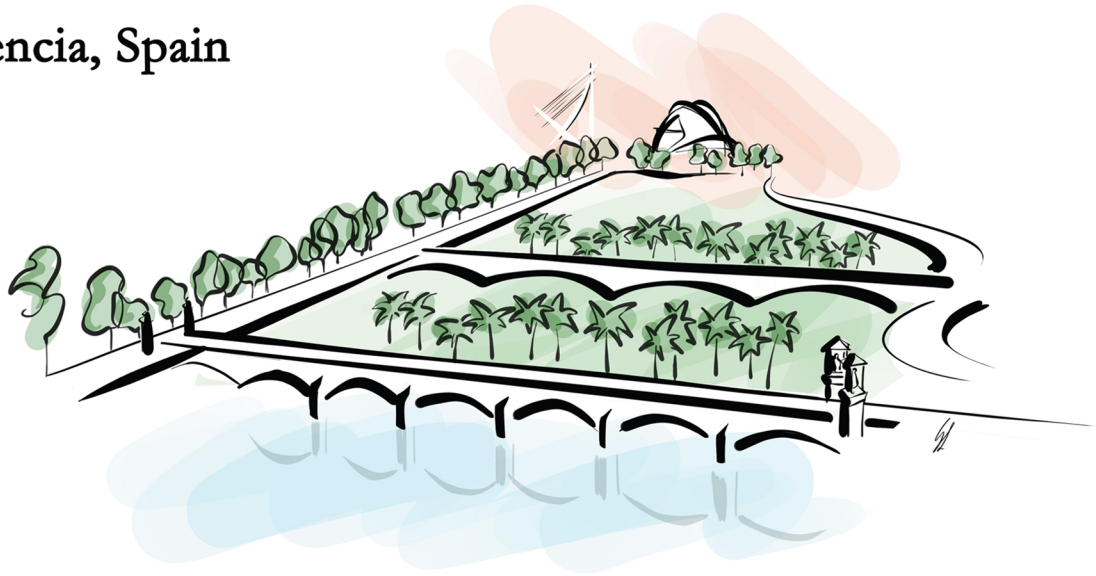

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Preface

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Abstract

The series of HEAd conferences have become a leading forum for researchers and practitioners to exchange ideas, experiences and research results relating to the preparation of students and the organization of higher educational systems. The seventh edition (HEAd'21) was celebrated during 22 and 23 June 2021. It was organized from Valencia, Spain; although held virtually because of the traveling restrictions after the COVID-19 outbreak. This preface gives an overview of the aims, objectives and scope of HEAd'21, as well as the main contents of the scientific program and the process followed to select them.

Keywords: *Higher education; innovative materials; educational technology; evaluation and assessment; globalization in education.*

1. Preface to HEAd'21

This volume contains the selected papers of the Seventh International Conference on Higher Education Advances (HEAd'21), which was virtually organized from Valencia, Spain on 22 and 23 June 2021. Despite the traveling restrictions due to the COVID-19 outbreak, this seventh edition was a great success of participation and consolidates the series of HEAd conferences as a leading forum for researchers and practitioners to exchange ideas, experiences and research results relating to the preparation of students and the organization of higher educational systems.

The selection of the scientific program was directed by Paloma Merello, who led a team of 217 program committee members representing 53 countries in all five continents. Following the call for papers, the conference received 351 full paper submissions with authors from 63 different countries. All the submitted papers were reviewed by at least two program committee members under a double blind review process. Finally, 78 papers were accepted as full papers for oral presentation during regular sessions. This represents an overall full paper acceptance rate of 22.2%, the most selective acceptance rate across all the editions. This selection ensures a high-quality program which is greatly valued by the research communities. Additionally, 83 submissions were accepted for short paper presentations, all of them receiving high review scores and published by UPV Press in this volume. The program committee chair congratulates all the authors for having their papers accepted in the proceedings of such a competitive conference.

HEAd'21 also featured two keynote speakers that overviewed important and actual topics: Harry Lappalainen (Turku University of Applied Sciences, Finland) talked about competition without losers, and how to implement this idea in a higher education context. The second keynote speech was delivered by Dr. Ana Zorio-Grima (Universitat de València, Spain) and dealt with the trends, challenges and opportunities of teaching innovation.

The main conference was followed by the third edition of the Symposium on Pedagogy for Higher Education Large Classes (PHELC). This virtual meeting, led by Ann Marie Farrell and Anna Logan, was a great platform for sharing practice, experience and expertise in large classes context.

Although virtually held, the conference was supported and hosted by the Faculty of Business Administration and Management of the Universitat Politècnica de València, which has been recently ranked as the best technical university in Spain by the Academic Ranking of World Universities (ARWU) 2020.

The organizing committee would like to thank all of those who made this year's HEAd a great success. Specifically, thanks are indebted to the invited speakers, authors, program committee members, reviewers, session chairs, presenters, sponsors, supporters and all the

attendees. Our final words of gratitude must go to the Faculty of Business Administration and Management of the Universitat Politècnica de València for supporting, once again, the HEAd conference, making it possible to become a great event.

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Effectiveness of Automatic Formative Assessment for learning Mathematics in Higher Education

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Abstract

The health emergency due to COVID-19 has highlighted the need of new and flexible digital methodologies for learning and teaching Mathematics, which can support the individual student's needs and help shape education. In this paper, we propose to use Automatic Formative Assessment (AFA) activities designed according to an innovative model, framed on the theories of formative assessment and feedback. The model includes: availability of the activities and multiple attempts; algorithmic questions; open mathematical answers; contextualized tasks; immediate and interactive feedback. We analyzed an experience using AFA in a blended module in Mathematics for 96 first-year students in Biotechnology. We collected data from the platform on grades and attempts of AFA activities and cross-checked them with the final exam grades. The results show that the feedback gained from AFA helped students improve their performance and supported them in the exam preparation. In light of these results, we can conclude that similar activities can be an effective solution to support students' self-study during and after the pandemic.

Keywords: *Automatic assessment; digital learning environment; formative assessment; higher education; interactive feedback; mathematics education.*

1. Introduction

Higher education didactics has been affected by the ongoing health emergency that we are living in these days, like every other aspect of our lives has. Since March 2020, most of the lessons have been moved online, and it is necessary to find innovative and flexible solutions to support students, which could be adopted also in a "new normal" situation, in order not to create discontinuity in the teaching models (Aristovnik et al., 2020). Learning technologies can be very helpful, especially when they support interactive and adaptive activities which can be tailored on the individual learning paths. It is essential to use formative assessment to monitor and activate students as owners of their learning, allowing them to self-assess their achievements. In this paper, we propose to adopt a model of Automatic Formative Assessment (AFA) activities for Mathematics, largely used in secondary schools (Barana, Conte, et al., 2019), and we adapt it to higher education. After introducing the model in the theoretical framework, we present an experience that makes use of AFA activities to support learning in a blended modality in a Mathematics module for first-year students of a scientific Bachelor degree. Analyzing and cross-checking data about the AFA activities and the results of the final exam, we show the effectiveness of the model for learning Mathematics.

2. Theoretical Framework

2.1. Formative Assessment and Feedback

For the construct of Formative Assessment (FA), we adopted the Black and Wiliam's definition (Black & Wiliam, 2009), which states that "*practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited."* Critical to this conception of FA is the collection of evidence, and the interpretation and use of the information gathered to act on learning. The mere collection of students' answers, without using them to alter and tailor their learning path, is not to be considered as formative (Wiliam, 2006). Among the strategies of FA, the provision of feedback is undoubtedly the most distinctive one and the object of in-depth studies. In the literature, results on feedback efficacy on learning are controversial (Azevedo & Bernard, 1995); for instance, from an outstanding review on feedback (Kluger & DeNisi, 1996), it emerges that in more than one-third of the 607 analyzed cases, feedback interventions reduced performance. This means that great attention should be paid to the feedback's design. Hattie and Timperley (2007) provided a model for constructing effective feedback. The purpose of feedback is to reduce the discrepancy between current and desired understanding. Effective feedback should indicate what the learning goals are; what progress is being made toward the goal; and what activities need to be undertaken to make better

progress. Moreover, feedback can work at four levels: at the task level, giving information about the task correctness; at the process level, adding details about the main steps needed to accomplish the task; at the self-regulation level, activating metacognitive processes; and at the self-level, adding personal evaluations about the learner. While the literature shows that the self-level is not effective, or even dangerous (Kluger & DeNisi, 1996), it seems that the only task-level feedback alone is not enough: many studies show that elaborated feedback are more useful than corrective ones to improve learning (Shute, 2008; Timmers & Veldkamp, 2011). The great part of elaborated feedback models that the literature proposes is static: students have to read them carefully and compare them with their results. Some studies also show that, more often than expected, students do not read them at all, especially if they perceive the task as too complicated or if they do not receive the feedback timely (Timmers & Veldkamp, 2011). It is clear that if the learners do not process feedback, the latter lose all their potentialities (Sadler, 1989).

2.2. Automatic Formative Assessment for Mathematics

When digital technologies are used to analyze the students' answers and to return feedback, we can integrate formative assessment and automatic assessment. We define Automatic Formative Assessment as the use of formative assessment in a Digital Learning Environment (DLE) through the automatic elaboration of students' answers and provision of feedback, where FA is intended as in the Black and Wiliam's definition (Barana et al., in press). In Mathematics, AFA is widely used to engage and motivate learners in online and blended courses. In this research, we adopted Möbius Assessment (previously known as Maple T.A.) as Automatic Assessment System (AAS), which, relying on Maple's mathematical engine, can process open-ended answers that are expressed in different registers from a mathematical perspective, and establish if they are equivalent to the correct solutions. This allows us to test different and complex cognitive processes. Moreover, it is possible to write algorithms to generate random parameters, formulas, graphics and even animated plots. Lastly, the AAS supports adaptive capabilities, so that the next question part depends on the previous answer.

Using this AAS, we developed a model to design AFA activities to enhance mathematical understanding (Barana, Conte, et al., 2019). It is based on the following six features: availability of assignments, which can be attempted in a self-paced way, without limitations in data, duration, and number of attempts; algorithm-based questions and answers, where random values or objects in the question text, answers and feedback appear different from student to student and at every attempt; open mathematical answers, graded through the advanced computing capabilities of the system; immediate feedback, shown to the students while they are still focused on the task; contextualization of the tasks in the real-world or interesting applications so that they can be relevant to students as well as for the discipline; interactive feedback, which is a step-by-step interactive guide to the resolution which appears just after attempting to autonomously answer the task. The Interactive Feedback (IF) is the

most original feature of our model (Barana et al., in press). In the IF, sub-questions investigate about prerequisites, simpler tasks or other representations of the initial problem, in order to guide students to a possible way to tackle the task. At each step, if they give the wrong answer, the correct one is shown to be used in the following steps. Moreover, they earn partial credits for the correctness of their answers in the step-by-step process (usually up to 75% of the question grade). These grades offer teachers and students more precise information about the learner's competence in a particular area. In AFA activities developed through our model, students can try the initial problem on their own and, in case of wrong answer, they have one or two more attempts available, so they are invited to try again and focus more on the task. If they fail, an IF shows a possible approach to the solution. This approach can help them identify their mistakes or give a different idea to solve the problem. Then, they can try the assignment again finding a similar problem, but with different data, so they have to repeat the whole process autonomously. Thus, the IF is a kind of elaborated feedback which acts at the process and self-regulation level, particularly relevant in making students process the feedback and use the information gained to improve their understanding.

3. Research Questions and Methodology

In previous studies, we have shown the effectiveness of our model of AFA activities and IF for learning Mathematics at secondary level (Barana, et al., 2019; Barana & Marchisio, 2020). In this paper, we are interested in measuring the effectiveness of our conception of AFA for learning Mathematics at university level, where the same model can be used to design activities. In particular, we try to answer to the following research questions: (RQ1) To what extent is the feedback obtained through our model of AFA useful to bridge the gap between current and reference performance in Mathematics in a scientific Bachelor? (RQ2) To what extent is the use of AFA activities designed according to our model useful to support the learning of Mathematics and preparation to the exam in a scientific Bachelor?

To investigate these research questions, we have analyzed data from a Mathematics module for the first-year students in Biotechnology at the University of Turin (Italy). The module was held in blended modality in the 2019/2020 a.y. It was not affected by the health emergency since lessons ended in January 2020; lessons were held in a classroom-based modality and support materials were available in a DLE for self-paced study, mainly in the form of interactive worksheets or AFA assignments (Marchisio et al., 2020). At the end of the module, the students took an exam, composed of a written part on the topics covered during the course and an oral discussion of an essay about a contextualized problem chosen and developed by the students. The online activities were not considered for the final grade, which was expressed on a scale from 18 (passing grade) to 31 (highest grade with honors). We drew several data from the AAS: for each student, the number of attempts to each assignment; the grade earned at their first attempt and at their last attempt to the tests (in

percentage); the number of students who attempted each test. From these data we computed several statistics: the rate of attempts per students, dividing the total number of attempts by the number of students who attempted the test; for each student, the average increase in the grades between the first and the last attempt; for each student, the total number of attempts to all the tests and the number of tests they attempted more than once. Moreover, we collected the exam grades and cross-checked them with data from AFA. We also analysed the answers to the questionnaire related to AFA. We used SPSS 26 for the analysis.

4. Results

Our analysis involved 96 students, of which 90 used the AFA activities and 73 took the final exam. 6 students took the exam without using any online assignment, while 23 students used the online activities but did not take the exam during the last academic year (a.y.). We started by analyzing the assignments on the AAS. The online course included 17 online tests designed according to our model. The assignments were attempted by a number of students ranging from 15 to 72 (average: 49.35). The total number of attempts per single test ranges from 29 to 453 (average: 184.94). The ratio of attempts per student ranges from 1.93 to 10.56 (average: 3.94). The last value was computed considering, for each assignment, only those students who made at least one attempt, since assignments were not mandatory. As a second step, we selected the students who made at least two attempts to one assignment (N=73) and we considered the average grade each student earned in their first assignment attempt and the average grade in their last attempt. Then, we compared the couple of variables through pairwise Student's t-tests. We found that students improved their grades by 12.27 points out of 100, and the increase is statistically significant ($p<0.001$). This value gives us an idea of the sharp increase of students' scores when they are engaged in AFA activities aimed at improving their understanding. In order to qualitatively appreciate this improvement, we show how one student's answers changed during repeated attempts to a question with interactive feedback (Figure 1).

In order to understand the value of AFA activities to support the students' preparation for the exam, we compared the final exam grade of the students who used the online tests with those who never logged in the AAS through ANOVA. We found that students of the first group (N=5) had a lower grade than the others (N=68): the average grades are respectively 22.00 (Standard Deviation: 1.41) for the first group and 25.87 (SD: 3.54) for the second one. The difference is statistically significant ($p=0.018$). Moreover, students who took the final exam used automatic assessment much more than students who did not take the exam; in particular, the first group made on average 38.60 attempts (SD: 45.94) to all the tests while the latter only 8.17 (SD: 16.65). The difference is statistically significant to the ANOVA test ($p=0.003$). These results show that AFA activities were used to prepare for the exam, and that they were effective for this aim.

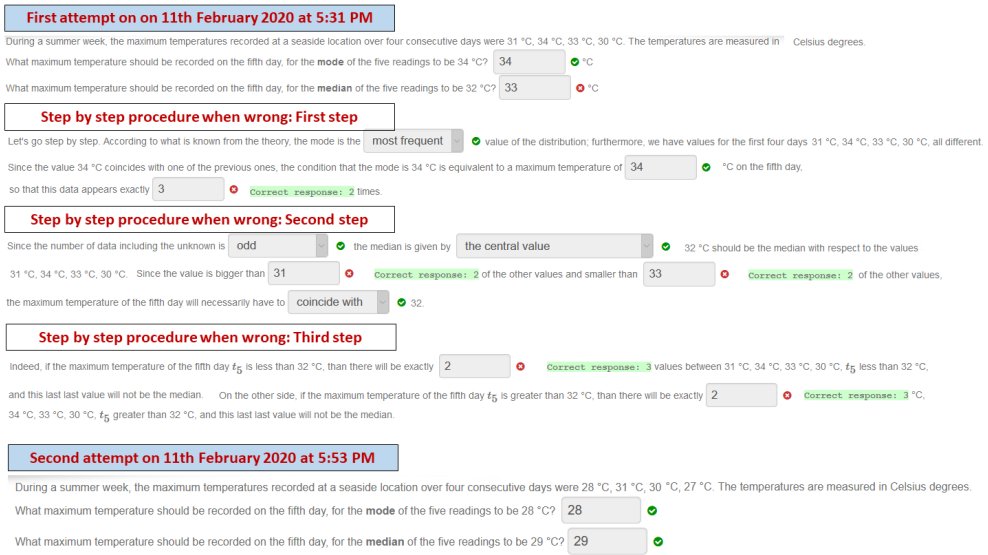

Figure 1. Two subsequent aptempts to one question about Statistics by the same student. He failed the first attempt and followed the interactive feedback, composed of 3 steps, which guided him in the solving process. Then, he tried the task again finding different values; he solved it autonomously and gave the correct answer.

To better understand the relation between the use of AFA activities and the exam results, we looked for a correlation between the number of attempts to all the assignments and the exam grade. However, these variables did not result to be correlated: the exam grades grow when the number of attempts grows from 0 to 50 (excellent students made on average 51 attempts to the online tests), while for un upper number of attempts, the exam grades average decreases. We believe that it is due to the fact that excellent students had a lower need to train for the exam, while students with more difficulties in Mathematics needed to repeat each assignment more times to understand the underlying concepts and to manage to solve problems. Thus, we looked for another variable which could explain the exam grades, and reveal the students' commitment with AFA activities without being affected by the individual amount of work each student needed in order to succeed. We came up with the number of assignments each student tried at least once. This variable does not focus on the number of attempts made for assignment, but reflects the number of tests on which students made some effort. In so doing, it measures the level of engagement generated by the AFA. This resulted to be positively correlated to the exam grades (N=73, squared-R=0.32, p=0.008). In particular, we can observe how the exam grades increase when this variable increases: data are shown in Table 2. These results show that the feedback obtained from the assignments designed according to the model of AFA activities, when used to bridge the gap between current and reference performance, helped acquire useful mathematical knowledge and competence, as demonstrated in the final exam.

Table 2. Average of the exam grades and increase in the assignments grades during multiple attempts depending on the number of repeated AFA assignments.

N. of repeated assignments	N	Exam grade (average)	Exam grade (SD)
0	5	22.80	2.95
1-4	16	24.75	3.26
5-9	17	25.94	2.88
10-17	30	26.93	3.77

5. Conclusions

Throuhg the data analysis and the results, it is possible to answer to the research questions. As regards (RQ1), it is possible to affirm that the feedback obtained through AFA activities helped students of a scientific Bachelor degree improve their performance in Mathematics. The feedback activated the students who generally repeated the tests to improve their performance; their average grades improved by 12.27 points out of 100 from the first to the last attempt. As regards (RQ2), the results show that the use of AFA activities was useful to support students' learning of Mathematics and their preparation to the final exam. It was observed that students used the online assignments to study for the exam and that the students who used the AFA activities earned a higher exam grade than those who never accessed them. Moreover, there is a significant correlation between the number of assignments that students repeated more than once and the exam grade. This variable measures the students' commitment and persistence in AFA activities, reducing the effects of the variability in the number of attempts to all the assignments due to the students' confidence, skills and need of repeating the activities many times to achieve good results. These results show that the model for designing AFA activities for Mathematics can be an effective methodology to support teaching and learning of Mathematics in blended and online modality in higher education. Probably, the feedback provided through these activities ensured that students with difficulties in Mathematics engaged in the tasks and better understood the solving process of the various problems, as well as the underlying mathematical concepts: in fact, the students who made the highest number of attempts were not the most brilliant ones. Thus, the AFA model can be a valid support for the weakest students even during the pandemic, since they might be the most damaged by the situation. These results cannot be generalized due to the low numbers included in this study. Moreover, the module adopted also other methodologies (such as problem solving) which could have influenced the results. As a further research it would be interesting to repeat similar analyses including higher numbers of students, even from different degree courses, and adding an entry test to check students' prior knowledge in Mathematics. The AFA materials developed for this module can be shared with other teachers in similar contexts and adopted on a larger scale, even in open online courses where students

are more autonomous but need timely feedback about their achievements. Further development of this study concerns Learning Analytics, developing solutions able to automatically detect problems or difficulties and help teachers make decisions to dynamically shape the path.

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Engaging Physics Tutoring: A didactical toolbox for teaching assistants (TAs)

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Abstract

In this paper we present a project dedicated to the development of a didactical toolbox of material for teaching assistants (TAs) supervising exercise classes for non-physics majors at ETH Zurich. With our material we were able to support TAs in preparing high-quality exercise sessions for their class which go beyond direct instruction and activate students intellectually and emotionally. The materials are developed for 13 exercise sessions and are presented in the form of an eBook. The materials were immediately used by several TAs in dedicated focus groups. The positive feedback of students and TAs suggests that our material helped to activate and engage the students, enhancing their learning - even in the challenging setting of online teaching.

Keywords: *Teaching tools; physics; eBook; student engagement; teacher training.*

1. Introduction

As a polytechnic university, ETH Zurich has compulsory introductory physics courses in almost all of its bachelor study programs. The Department of Physics is offering a total of 14 different physics courses which are all tailored to the specific needs of the non-physics major programs. In addition to a physics lecture, which typically adresses several hundred students, small-group exercice classes, comprising 25 to 30 students each, are an integral part of the educational offer. The main goal of these exercice classes is to train students in applying the concepts that have been discussed in the lecture. The exercise classes are run by more than 150 teaching assistants (TAs), most of them being PhD students.

In the past, the Department of Physics made a huge effort in reforming its introductory lectures according to well-established educational principles (Meredith & Redish, 2013; Crouch & Mazur, 2001). The exercise classes, however, remained almost out of focus. TAs are invited to attend teaching courses which are offered by the central support unit, but the general principles covered by those courses is of little help when TAs have to plan, organize and teach physics in their classes. How can we improve the learning success in physics exercise classes? Which strategies can help to step out of standard automatism such as pure exercise-solving and direct instruction? How can we "hook and hold" the students? With regards to those questions, we have developed a didactical toolbox including a wide range of tailored teaching material for our TAs.

The idea for the EPT (Engaging Physics Tutoring) project arose from our observation that in practice many TAs struggle to implement techniques which they have learnt in general basic teaching courses. Furthermore, the time it takes to prepare an engaging lesson usually exceeds the preparation time which TAs can invest in addition to further duties like correcting homework and managing their class. Therefore, in this project we developed a didactical toolbox of materials for physics TAs and published it as an eBook (Bondar *et al*., 2021). In 2020 we have used the toolbox as a pilot in 13 exercise classes and we reported how TAs have been using it for improving their instruction. Due to the Covid19 pandemic, half of the exercise classes were taught online.

2. Approach and developments

2.1. Structure of the developed materials

The toolbox consists of concept questions (Oliveira, 2013), advanced organizers (Gurlitt, 2012) and case-based calculation examples. Additionally, we included ideas for the "hit" of each lesson – which is based on an engaging phenomenon, that involves the students emotionally and fosters their active thinking in order to help them developing higher-level competences. Occasionally we also included "hands-on" experiments that are especially suitable for online performance and activation of the students.

Most of the material is based on real-life examples in order to motivate students, encourage them for active interaction and engage them emotionally. Figure 1 illustrates some examples of application ideas used in the materials.

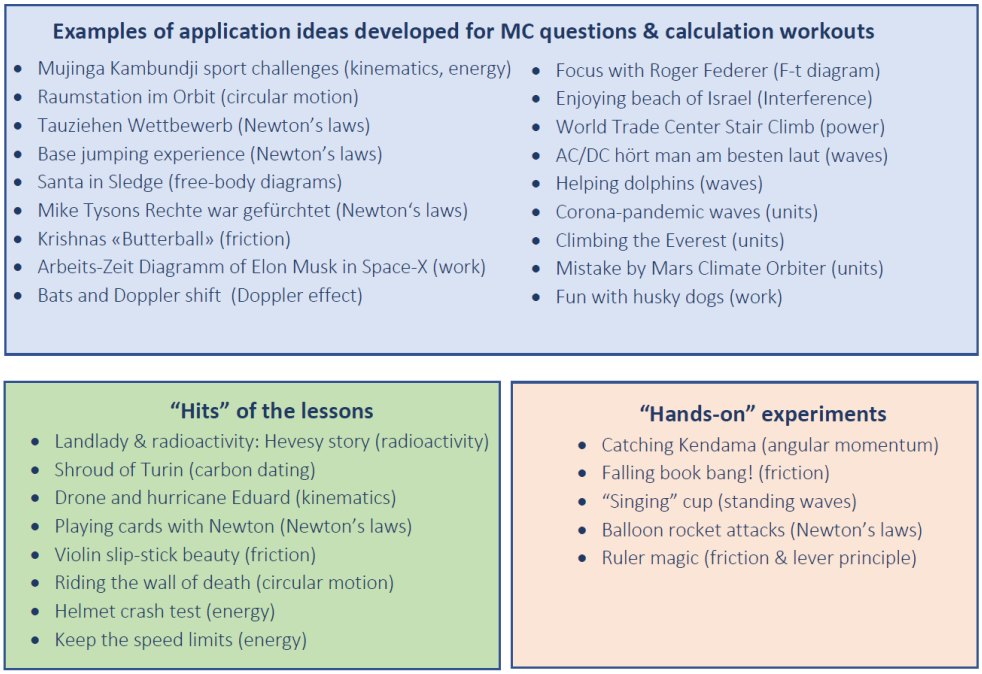

Figure 1. Real-life examples implemented in the materials; MC=Multiple Choice.

2.2. Didactical approach

With the toolbox at hand, we encouraged TAs to use our materials relying on a well-established approach in the design of their exercise class. Namely, they have to align their planning with specific learning goals of the course, which then define the teaching content and activities of their lessons. Assessment techniques should be applied to inform students and teachers whether a teaching goal has been achieved. This will ensure constructive alignment of all teaching and learning activities (Biggs & Tang, 2015).

The developed materials are aligned with learning objectives of the class and can serve as a basis for the design of learning activities and assessment tasks during the exercise session (see Figure 2). In addition to the traditional teaching approach, TAs can develop own activities based on the collaborative and highly interactive SCALE-UP approach (Feldman *et al*., 2019).

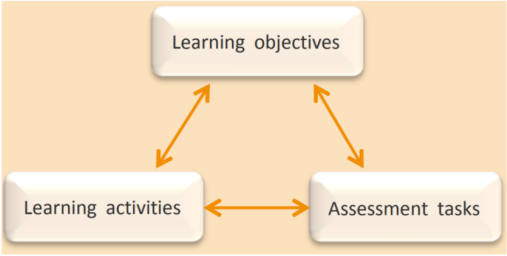

Figure 2. The materials can be used as a basis for the design of Learning activities and assessment tasks.

2.3. Some Examples

Here we give some examples of the developed materials; Figure 3 shows examples of real-life applications of the topics of units (Mars orbiter) and of friction (violin vs. squeaky door).

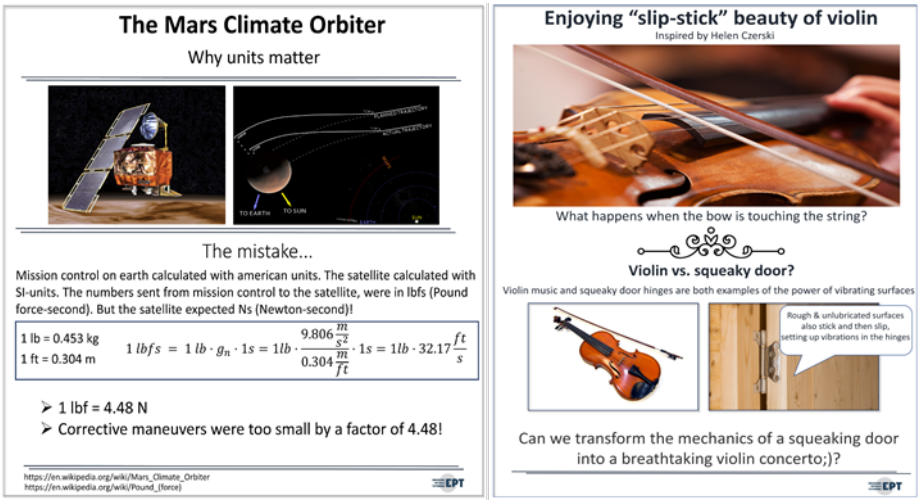

Figure 3. Examples of real-life applications of the topics of units (left) and friction (right).

For students it is also important to have a bird-view of the topics presented during the semester, as it enables them to create a network of knowledge. To help students following links between different topics as well as their common frameworks we also prepared mind maps. These schemes can serve as road-maps while working through the corresponding sub-topics. Figure 4 shows an example of a mind map dedicated to kinematics.

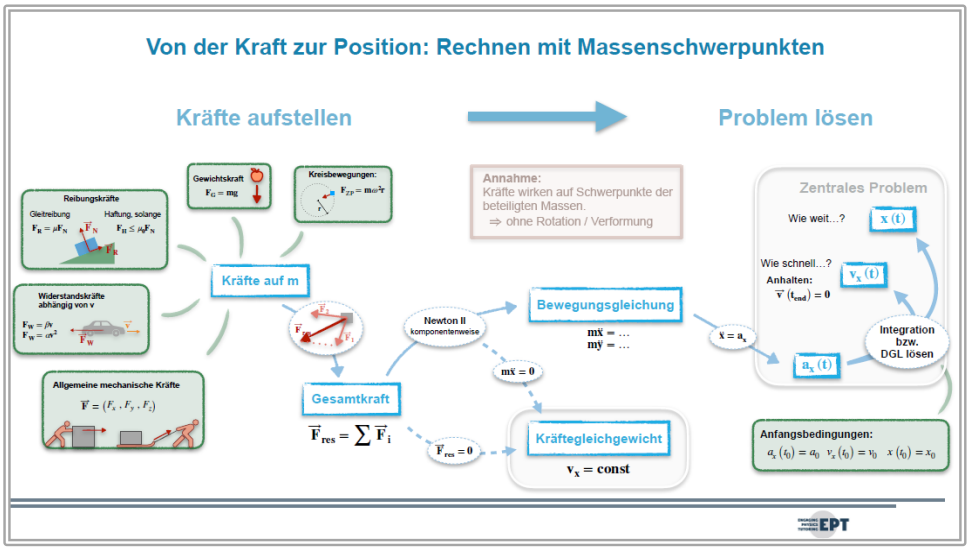

Figure 4. Example of a mind map on kinematics.

2.4. New developments

As a new method, we have developed a "2Q" system. At the beginning of each class, the students are asked to answer a set of two Multiple Choice (MC) questions which are closely related to learning objectives of the lesson. The answers are not yet revealed. At the end of the exercise class the students are asked to answer the same questions again, after which the correct answers are discussed. This system allows the TAs not only to assess the learning success in their lesson but also to outline key topics of the lesson and provide a road map for the students.

We got very positive feedback about this system from students (Figures 5, 6, 7, 8) as well as from the TAs (Figures 8 and 9). Furthermore, we observed that the questions activated and engaged the students right from the start of the lesson. Sets of suitable questions for each lesson are included in the toolbox.

3. Implementation and feedback

The materials were immediately used by 6 TAs. Namely, we had two dedicated focus groups almost entirely teaching their lessons with our material. Another four TAs were occasionally using the material as ideas / building blocks for the design of their lessons.

In order to estimate the success of the project, we used an online anonymous survey to collect student feedback. The survey was administered to one of our focus groups, where at least

90% of each lesson was based on our materials. Below you will find students' answers to some key questions. A total of 26 students responded to the survey.

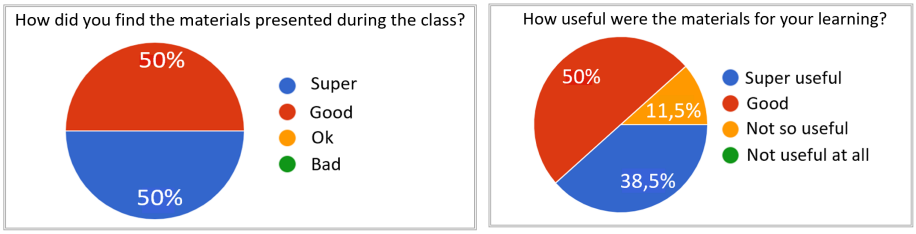

Figure 5. Results of student's feedback on usefulness of EPT materials in their learning (N=26).

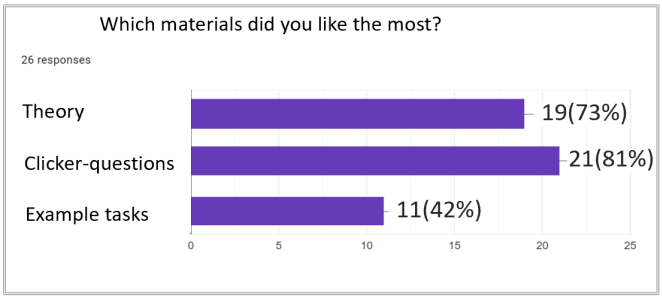

Figure 6. Results of students' feedback on favorite types of EPT material.

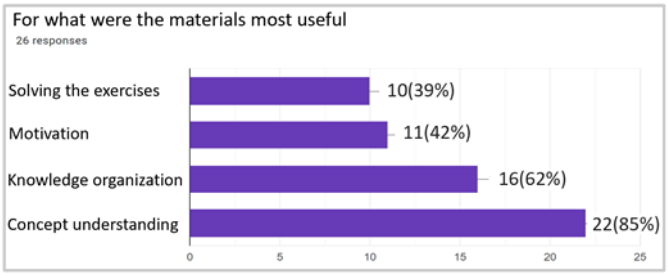

Figure 7. Results of students' feedback on the role of EPT materials in their own learning.

The positive feedback from students and from the TAs suggests that our material helped to activate and engage the students emotionally and to enhance their learning - even in the challenging setting of online teaching.

In particular, the results of the diagrams in Figures 6 and 7 show that on average the students rate the role of the materials for their conceptual understanding higher than for their problem-solving skills. This is particularly interesting since the example exercises were, most of the time, very close to the homework exercises, by using similar ideas and solution paths. The missing competence to transfer knowledge to specific problems is a common issue in the

learning process of non-experts (Rebello *et al*., 2007) and is therefore especially relevant for students of introductory courses. The performance of the TAs also plays an important role, which we neglected here. Our evaluated focus group was taught by an experienced TA.

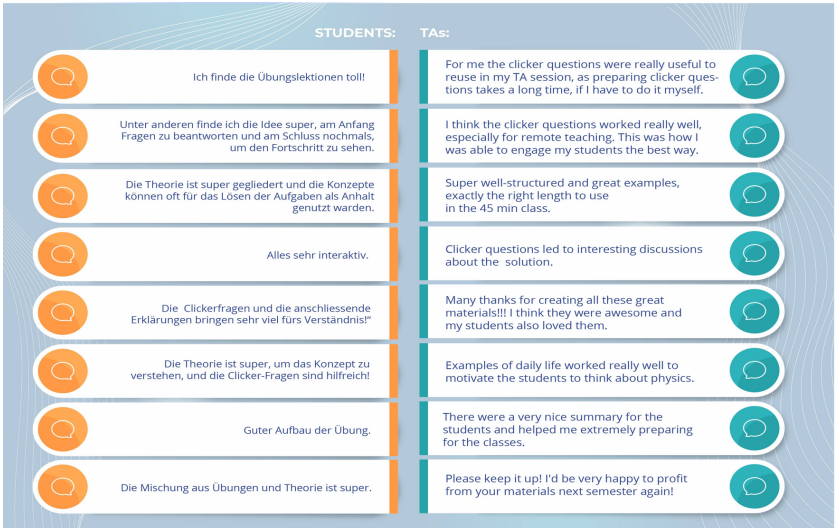

Figure 8. Further impressions from students and TAs.

> *I'm teaching a physics class at ETH, and first time I was able to profit from slides that were not mine. It's also the first time that the students were participating much more actively in the class; not only in the multiple choice but also already in the summary/theory slides. I'm convinced it's due to the much more quality material that I was able to use and present to them. Since I didn't need to spend a lot of time on preparing material for the class, I was able to spend more time on correcting the exercises more detailed, which the students appreciated as well. It's really a fantastic service you provided and it was extremely helpful, both to me and the students. I hope you are gonna continue with your team, I'm sure all the TAs and students would be extremely happy! Thanks a lot again for your effort!"*

Figure 9. Comment by a TA.

4. Summary and outlook

We have developed a didactical toolbox of material for TAs who are teaching exercise classes for non-physics majors. The material of the toolbox was used by several TAs and we collected feedback from students and TAs from one focus group. Based upon the positive feedback received, we conclude that our material helped to engage the students and to

enhance their learning. The toolbox played an important role in preparing high-quality exercise sessions, which both students and the TAs enjoyed together.

However, we realized that, besides providing teaching material, it is also paramount to establish a community of practice, where TAs can share and discuss their teaching experience. Fostering PCK (Pedagogical Content Knowledge) (Carlson *et al*., 2019) is as important as providing good teaching material.

This successful experience now has motivated us to continue the development of our material and to expand our focus to all of ETH Zurich exercise classes for introductory physics. In addition we will also focus on PCK and on social aspects in teaching.

Acknowlegements

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Verification of the measuring properties and content validity of a computer based MST test for the estimation of mathematics skills in Grade 10

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Abstract

The research is aimed at the construction of a multi-level adaptive test (MST), for the evaluation of the mathematical skills of Italian students of Grade 10, and was carried out in collaboration with Invalsi for a PhD study of "La Sapienza" University of Rome. The research started from the definition of the construct to be measured, taking into account both national and international references. A specific item bank was then built. The test was administered to a sample of 4132 students. The experiment confirmed the advantages of an MST model. Interesting results emerged by comparing the adaptive part of the main paths with a linear tests consisting of the same number of items and administered to a sample of pre-test students and comparing the MST test with a simulated linear test, built on the same item bank and with the same numer of item of MST test.

Keywords: *Adaptive test; multistage test; mathematical skills.*

1. Introduction

The introduction of computer-based administration has introduced many changes in large-scale educational assessments, but not all computer-based tests are created equal. The most common are computer-based linear tests, which generally administer a predefined set of items, and variable form tests, in which the computational and interactivity potential offered by the computer is used to administer a set of items that is determined when the test is carried out. CAT, Computer Adaptive Testing, and MST, Multistage Testing, fall into this last category. Many studies state that the adoption of adaptive tests would allow to overcome some of the limitations of the linear ones (Weiss, 1985; Weiss and Kingsbury, 1984; Hambleton, Swaminathan and Rogers, 1991).

The simple transition from paper to computer-based support in linear test maintains the problem that the evaluation carried out is very accurate for average levels of ability but not so much for the extreme levels, with a waste of time and resources in the administration of items to students for whom they are too easy or too difficult to have psychometric value. Only items whose level of difficulty is adequate can significantly contribute to the estimation of the student's ability. In a well-designed adaptive model, it is possible to make the student support mainly items that have a level of difficulty appropriate to his skill level.

Since Grade 10 students generally have a wide range of skills, the test must measure progress across a broad spectrum of outcomes and must be sensitive to small, but significant, academic progress. These two needs are best met by adaptive tests rather than by a linear test because the former adjust the difficulty of the test based on student achievement during the test itself (Hambleton, Zaal & Pieters, 1991; Sands, Waters & McBride, 1997; Sireci , 2004; Wainer, 2000).

2. CAT and MST

In CATs the adaptation of the test to the student's ability takes place after the administration of each item, often starting from a skill level estimated on the basis of other parameters. The design of a multistage test is characterized by the fact that each level is represented by a set of items, called module or testlet, of predefined difficulty; the adaptation of the test to the student's ability therefore takes place on the basis of the cumulative performance on a set of items rather than on the result obtained in each individual item, as in the CAT. In both cases, if the student is doing well, he will be given a more difficult item or set of items, vice versa, an easier item or set of items. A widespread risk of administering CAT tests is that they are not balanced in terms of content. To give an example with the estimation of mathematics ability, it could happen that one student was administered mainly items coming from a single domain, for example arithmetic, and another item coming mostly from another domain, such as geometry. Multi-level tests offer the advantage of greater control over the assembly of

forms and the validity of content compared to the item-by-item adaptive tests (*Hambleton*, Swaminathan e Rogers 1991; Hendrickson 2007; Vispoel 1998; Wainer, Lewis, Kaplan e Braswell 1990; Yen, 1993).

3. Framework

There are elements which characterize mathematical competence[1] that are not detectable by means of a standardized test. It was necessary to proceed with the identification of the aspects that could be effectively measured by a standardized computer-based test. It is possible to verify the ability to mathematically formulate a problematic situation or to understand the validity of argumentation but the inclination to use mathematical models of thought is not measurable. So in this test we assume that mathematical competencies are: knowledge and skills and the capacity to apply them to problem solving and to understanding and producing argumentation and reasoning.

The items belong to 4 different content categories, Algebra and arithmetic (AA), Uncertainty and Data (UD), Relationships and functions (RF), Space and shape (SS), and three cognitive domain Knowledge, Problem Solving and Reasoning, then articulated in general and specific learning objectives. The cognitive domains constitute a grouping of goals (learning outcomes), based on the idea that the mathematical activities essentially refer to either reasoning or solving problems and that these two dimensions are not independent of each other and require knowledge of concepts, formal language and procedures to be implemented. The semiotic dimension of representation is considered cross-cutting to the others and takes on different aspects in each of them.

4. The item bank

A specific item bank was built, by carrying out two distinct pre-test phases anchored together. Sampling of students, distributed throughout Italy and in various types of schools, was always carried out with random assignment of forms to students. In the first phase, 18 test forms (460 items) anchored together were administered to a sample of 4672 students. In the second phase, 11 test forms (403 items) were administered to a sample of 5797 students. These tests were anchored to each other and to those of the previous phase. In both phases of the bank construction, the items were selected by calibrating the difficulty of the items according to

[1]For the definition of the mathematics framework, the definition of mathematical competence adopted in the European framework of key competences and those currently present in Italian legislation were taken into consideration. The main reference was the INVALSI Framework, but we also compared ourselves with the main international references: the frameworks for mathematics of OECD PISA and NAEP and the Cambridge IGCSE Syllabus.

the 1-parameter Rasch model, verifying the unidimensionality of the construct with a specific EFA (Exploratory Factor Analysis), and considering: the format of the items, the proportion of correct answers (p > 0,10), discrimination of items (R > 0,20), defined as the biserial point correlation of one item with all others of the same test form, the main fit indices, such as the standardized residue (zResid not significant), Infit index and Outfit index, between 0,8 and 1,2. In each phase, for the calibration of the item bank, the method of concurrent calibration of all test forms was used since it allows to place the estimates of the item parameters and the ability estimates on the same scale without an additional linking procedure. Two factor analysis were carried out for each form: one before the calibration of the bank, to identify the items that did not have a good loading with the factor, and one after the calibration to verify that the unifactorial solution was acceptable. The analysis carried out confirms the hypothesis that the unifactorial solution is correct. The extraction of additional factors has not shown convincing solutions. To obtain a single bank, calibrated on a single scale, the two banks were linked using the Anchor-Test Design with the Robust Mean and Sigma Method (Hambleton, Swaminathan, Rogers, 1991 and Stocking & Lord, 1983), that is usually used to develop a common metric in the Item Response Theory. At the end of the linking process, the estimated values of b for all items are placed on the same scale and it was possible to perform a recalibration of the ability estimate of all students, to fixed values of b. The item bank was made up of 497 items, all on the same scale. Figure 1 illustrates the distribution of items in relation to the difficulty parameter b.

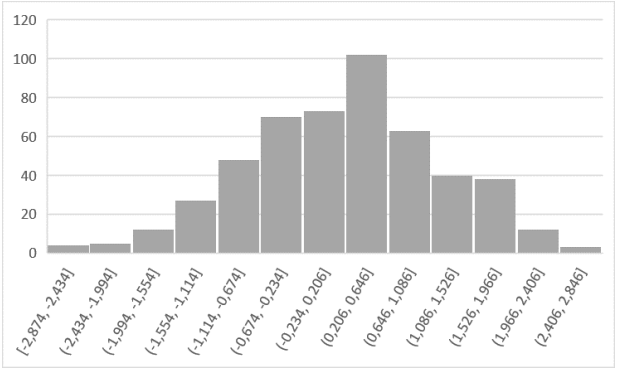

Figure 1. Distribution of items in relation to the difficulty parameter b.

5. The MST test: developing the MST 1-3-3 model

In order to develop an MST 1-3-3 model, like the one in Figure 2, three intervals have been identified along the continuity of the ability, with the central interval placed on the mean ability of the sample. Each range has an amplitude equal to one standard deviation. For Stage 1, a routing module (16 items) was designed. For Stage 2 and 3, two modules were designed

for each skill interval, consisting of 18 and 12 items. All modules focused on the average ability of the sample in the reference range (E, easy, M, medium, H hard). The selection of the items took place with an optimization process with the constraint of maximizing the information function I(θ) and balancing the modules in relation to the framework.

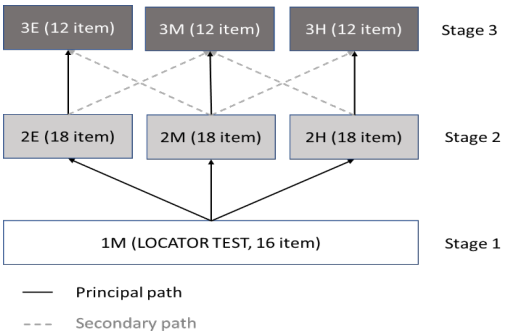

Figure 2. MST 1-3-3 model.

For the definition of the routing rules, the cut-off values of the ability, that identify the threshold for accessing the next module at the end of each module, were identified intersecting the information functions of the modules at stage 2 and 3 and converted into true score values (Luecht, Brumfield, Breithaupt, 2010). The test was administered to a sample of 4132 students equally distributed throughout the country and by field of study. The selection of the students took place with a two-stage sampling.

5.1. Content validity

During the test assembly it was possible to set and comply with stringent constraints covering the framework which guaranteed the validity of the test content. For each content area there are 26 or 27 items in the complete MST test. The distribution of items in each path is balanced with respect to the content areas as you can see in Table 1.

Table 1. Number of items for each path.

	Path	UD	AA	RF	SS
Path 1	1M+2E+3E	12	12	11	11
Path 2	1M+2E+3M	12	12	11	11
Path 3	1M+2M+3E	12	11	12	11
Path 4	1M+2M+3M	12	11	12	11
Path 5	1M+2M+3H	12	11	12	11
Path 6	1M+2H+3M	11	12	11	12
Path 7	1M+2H+3H	11	12	11	12

6. The comparison between the MST test and the linear tests

In order to verify, in terms of measurement accuracy, the actual improvement of the MST test compared to a non-adaptive test centered on the population average, it was decided to make two comparisons: the complete MST test with a linear test built from the same item bank and the adaptive part of the MST with one of the linear tests used to perform the pretest. To do this, it was necessary to choose a linear test with exactly the same number of items as the MST test, 46 items for the complete test and 30 items for the adaptive part of the MST test, because the information function is influenced by the number of items. The comparison is feasible because the items of the two tests are on the same scale, so difficulty and ability are directly comparable.

6.1. The adaptive part of the MST with one of the linear tests used to perform the pretest

Among those available, the linear test that showed the best psychometric characteristics was chosen. For this comparison, the estimation of the students' ability was used, carried out using only the items of the adaptive stages, 2 and 3. This was done to have comparable tests by number of items and to estimate the measurement capacity of the adaptive part of the test.There were two types of tests: a direct comparison of information functions and a t-test for independent samples on the average number of correct answers and on the average value of the SE in the estimate of the ability. For each module only those students who fell into the intervals into which the continuous of the ability in the construction phase of the test was divided, were considered. From the t-test it can be seen that the SE in estimating the ability of the MST test is always significantly lower than that of the linear test. It is also observed that in Path 1 the students respond on average to 6.950 items more than in the linear test, in Path 4 on average to 2.819 items more and in Path 7 on average to 2.441 items less. The MST test is therefore able to offer students with low abilities an adequate number of items to which

they are able to respond and those with high abilities items that are still challenging and able to investigate within the proximal development zone. Table 2 reports the values of the information function of the main paths of the MST test and of the Linear test of the pretest, with 30 items, at the extremes of the interval, θ = -2.243 and θ = +1.430, in the middle of the interval, θ = -0.406, and around the decision nodes, θ = -1.06 and θ = +0.21.

Table 2. Information function of MST path vs Linear 30.

θ	Path MST	Linear	MST – Linear
-2.243	6.49	2.49	4.00
-1.070	6.63	4.82	1.81
-0.406	7.34	6.02	1.32
+0.210	6.72	6.50	0.22
+1.430	6.71	5.15	1.56

6.2. The complete MST test vs a linear test built from the same item bank

In this case, a direct comparison was made between the information functions of the two tests.

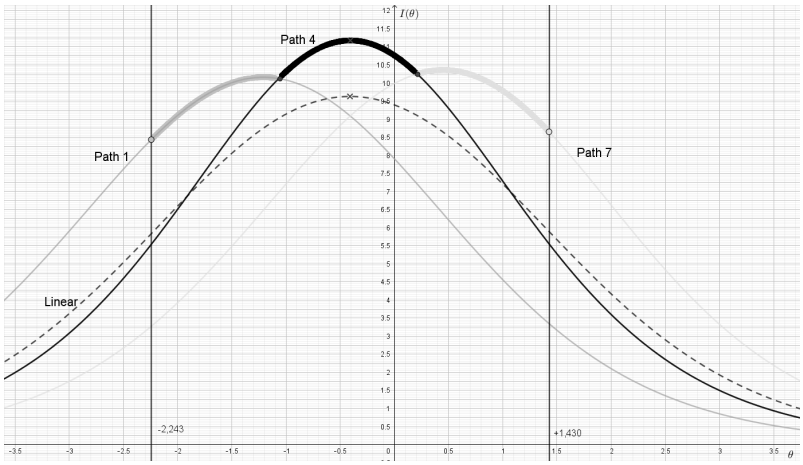

Figure 3. MST vs Linear 46.

Table 3 reports the values of the information function of the main paths of the MST test and of the Linear 46 test, at the extremes of the interval, θ = -2.243 and θ = +1.430, at the center of the interval, θ = -0.406, and around at the decision nodes, θ = -1.06 and θ = +0.21.

Table 3. Information function of MST path vs Linear 46.

θ	Path MST	Linear 46	MST – Linear 46
-2.243	8.43	5.54	2.89
-1.060	10.12	9.04	1.08
-0.406	11.12	9.63	1.49
+0.210	10.24	9.10	1.14
+1.430	8.64	5.54	3.1

7. Conclusions

The article shows that the limitations of linear and adaptive tests are overcome. The test turns out to be more informative than a linear test built on the same item bank and allows for more reliable estimates of student ability within a wide range of the continuum, improving estimates particularly for students at the extremes of the range. At the same time, the test succeeds in offering students with low ability a fair number of items that they are actually able to answer and students with very high ability items that are still challenging.

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A virtual co-creation collaboration between a university physics research group and school students

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Abstract

This work aims to inspire, ignite and engage school students to consider STEM at university, by collaborating between a university research group and school students. Learning resources will be co-created with students, based on what they have learnt and their new ideas. These resources will be used to teach future students, in a multiplying effect. We specifically target a widening participation school. Numerous engagement techniques have been used to sustain participation whilst teaching online. Breakout rooms have been used extensively, to provide close interactions between researchers and students. Both male and female researchers deliver the project, to provide role models in particular for the girls amongst the students, who are in the minority. Surveys are being employed before, during and after the project to evaluate the evolution of students' attitudes towards STEM. Given the projected success of this pilot, plans are in place for a national roll-out of virtual co-creation collaborations.

Keywords: *Teaching tools; educational technology; evaluation of student learning; science education; learning technology; co-creation.*

1. Introduction

At a time when many research outreach activities have been cancelled, our particle physics research group is providing an enriching activity for school students. We are pioneering an innovative online approach to teaching data analysis from the biggest particle physics experiment in the world (ATLAS Collaboration, 2008). The interface that students are met with is shown in Figure 1. Normally, this project would fit the blended learning model (Graham, 2006) - the intention was to meet face-to-face occasionally so students would be getting a rich experience. If possible, face-to-face-meetings will be pursued towards the end of the project. Ten 16–17-year-old students at a crucial stage of their learning, have been given the chance to enhance their extra-curricular activities (Eccles *et al*., 2003). The project is running over 6 months, providing an opportunity to scaffold the students' learning (Gibbons, 2002). The project is designed to be engaging and motivating, while giving students a safe yet challenging environment to tackle university-level material.

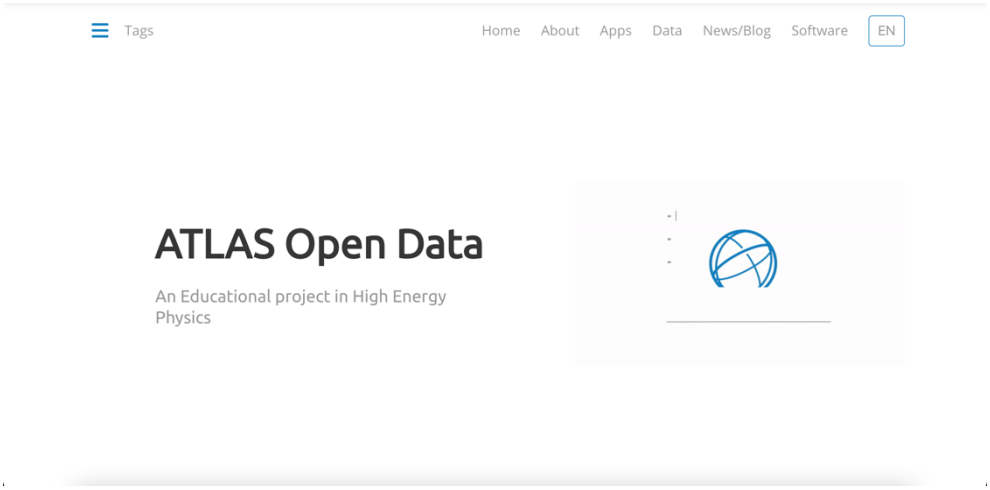

Figure 1. Homepage for the ATLAS Open Data website user interface.

2. Aims and Planning

The key objective of the project is to engage students with exciting, cutting-edge research. In doing so, we aim to motivate some to consider STEM at university (Carnevale et al, 2011). The project also hopes to address the widening gap between privileged and disadvantaged students. A key deliverable of the project is for the students to create a tailored online programme for students of similar ages to follow, giving a multiplying effect to our project in terms of students reached. This pilot programme is being used to co-create resources, establishing a partnership of discovery (Dollinger et al., 2018). Therefore, the research questions are two-fold:

1. Can we develop a curriculum with participants to attract future students to choose STEM?
2. Can we facilitate participants' attitudes towards STEM by engaging them in the co-creation of learning materials?

We specifically work with a widening participation school - a school whose students are from groups (socio-economic, ethnic background, etc) that are under-represented in higher education (Burke, 2013). Over half their intake qualify for at least one widening participation scheme within the school. Students were chosen according to interest in particle physics, regardless of demographics. Some characteristics of the students involved are given in Table 1. An online programme gives the chance to work with students that may not be able to attend after school in person, for whatever reason. The project is relevant to students not only because of their natural curiosity and interest in physics at university but also because it has overlap with the specification they are following at school - particle physics, units of energy, magnetic fields, accelerating particles and more.

Table 1. Some characteristics of the students involved, obtained from self-assessed anonymous survey data.

Profile characteristic	Detail
Age (years old)	16 (50%), 17 (50%)
Gender	8 male, 2 female
Subjects studied at school, other than physics and maths	Further Maths (5), Chemistry (5), Computing (2), Biology (1), Economics (1), Music (1) , Spanish (1)
Reasons for choosing physics	Interest and enjoyment (8), Need for further study (3), Knowledge/skills will help with further study/career (2), Help application for further study (1)
Decided what they want to do after school?	Yes (50%), An idea but still considering options (50%)
What do they hope to gain from working with us?	Insight into how scientists conduct research (8), Experience of research (8), Learn about the ATLAS experiment (8), Learn analysis skills (7), Opportunity to make unique contribution (5), To add to CV/applications (5), Opportunity to work with friends/peers on project outside school (5), Learn programming (4), Nice online hobbie (3)
Problem solving level	Above average (4), Average (3), Beginner (1), No knowledge (1)
Particle physics theory level	Above average (1), Average (2), Beginner (6)
Particle physics experiment knowledge	Above average (1), Average (3), Beginner (4), No knowledge (1)
Level in using histograms	Above average (6), Average (2), Beginner (1)
Level in evaluating uncertainties	Above average (2), Average (6), Beginner (1)
Knowledge level in C++ programming	Expert (1), Above average (2), Beginner (1), No knowledge (5)
Knowledge level in Python programming	Expert (2), Above average (2), Beginner (2), No knowledge (3)
Preference for independent or group work	Both (7), Independent (2)

3. Current approach

We use micro-talks (10-15 minutes) with key themes and educational messages to begin synchronous sessions, sometimes given to the students beforehand in a flipped-classroom style. Equipped with the key ideas, we want students to learn primarily through doing. We have used activities that encourage exploration, written in Table 2. With each activity, students were analysing proton-proton collision data, where information from the ATLAS experiment allows one to identify fundamental particles and measure their properties with associated uncertainties. Having worked through exploratory activities, students are co-designing the activities of Table 3 with us.

Table 2. Explanatory activities used during the project, along with their learning objectives.

Exploratory activity	**Learning objective**
HYPATIA event display (Kourkoumelis & Vourakis, 2014)	Particle identification using the ATLAS detector
Histogram Analyser (ATLAS Collaboration, 2021)	Optimising for signal vs background
Jupyter notebook (Kluyver et al., 2016)	Learning to code

Table 3. Activities co-developed with and for the students.

Activity developed	**Learning objective**
Summary table of histogram analysis	Connection between tabular and graphical data
Analysis flowchart design	Understanding of steps in particle physics analysis
Real data measurement	Build upon skills learnt with simulated data
Question design	Ability to give student voice in written documentation
Curriculum link research	Connection between school and extra-curricular study
Documentation writing	Experience of preparing scientific documents
Documentation review	Experience of peer-review process in research
Explore with Excel	Develop skills in a common data analysis tool
How to rediscover the Higgs	Use computer programming to rediscover a particle
New-physics research	Review theories being actively researched by scientists

Adapting to an online environment has been challenging, but a learning process. Quality two-way engagement is maintained by various interactions through Microsoft Teams, a known

pedagogical tool (Martin & Tapp, 2019). Kahoot quizzes continue to be an effective participation tool (Wang & Tahir, 2020). To give students more ownership over their learning, we ask them to design questions, see Figure 2. We also provide opportunities for students to present, helping them develop public-speaking skills. Altogether, this builds a low-threat-high-challenge climate, where students respond to challenges when they do not feel under pressure from teachers or peers. We do this in our project with offline research and collaboration between students. This technique is used by teachers in their lessons.

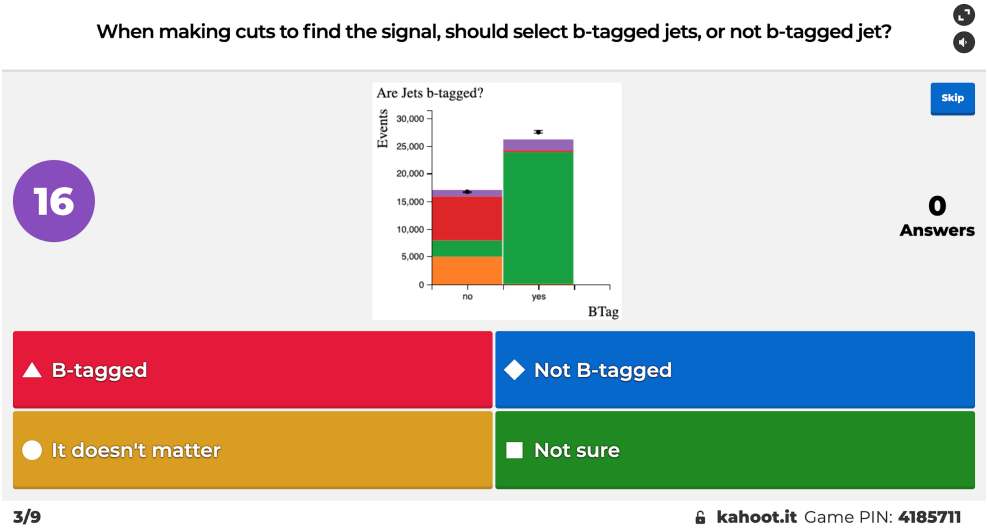

Figure 2. Example of a Kahoot quiz question asked to students as a starter activity during a live online session.

Breakout rooms have been key. Grouping two or three students and one researcher encourages peer-to-peer-learning, providing a supportive environment where students feel safe to share ideas and help develop confidence in group situations. It has been an invaluable experience for students to have close interactions with working researchers, while the learning is student-centred. Delivering via a variety of interaction techniques has also meant that we have been providing teacher Continuing Professional Development (CPD). The two teachers involved have learnt quite a bit from this activity and they report that it has given them some ideas for teaching next year and maybe using the resources themselves.

Since girls are in the minority among the students (2/10), we engage our target audience by showing female role models. Female researchers have led parts of the project throughout. We also engaged a university student, to enthuse the school students about university. We specifically employed a female student that excelled in laboratory modules at university. The Institute of Physics (IOP) showed that a good teacher was more important than a teacher of the same gender - i.e., a good male teacher who encourages girls into physics and is supportive can be very successful (Murphy & Whitelegg, 2006). Even if all eight boys go

onto STEM degrees at university, but neither girl does, the project would still be a success! Another point to add is that the most senior researcher is female. This is beneficial as projects where the senior people are male and gender balance is only achieved at junior level give less confidence to female students and reinforces the wrong idea that "men are leaders, women take part".

4. Future evaluation

Seeing students' evolution of attitudes towards STEM (before, during and after) will be helpful, although the sample size is relatively small. Pre-project, we surveyed the students' attitudes towards STEM. The project places an emphasis on skills, so we asked what skills they were expecting to learn, see Figure 3. A future longitudinal evaluation may indicate if we positively influenced students' choices of studying STEM. Surveys have been conducted in Google Forms, a proven platform for use in education (Brown & Hocutt, 2015). Since this study is in progress, only the participants' attitude towards STEM before the project has been measured. The impact of the project will be evaluated in future.

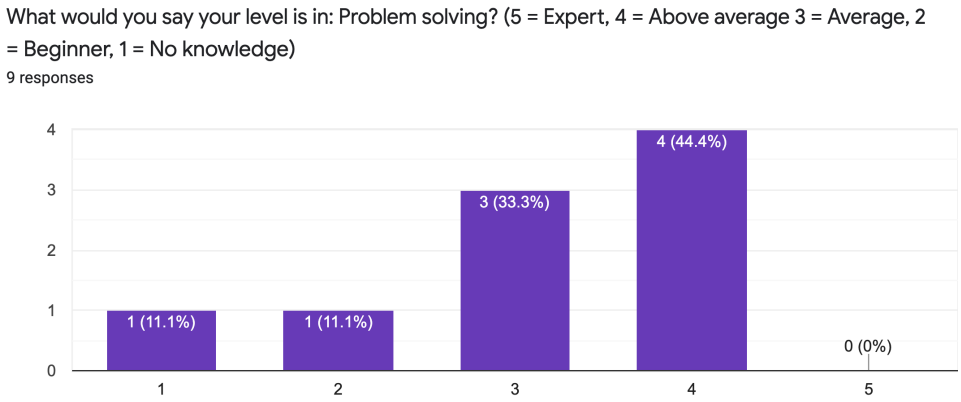

Figure 3. Histogram of responses to a question from the evaluation survey given to students before starting.

4.1. Future expansion

Magnification of the project is planned. Post-pilot, we aim to hold an event where the students can advertise their work to their whole school. This could include posters and talks, similar to a conference, which would be a valuable opportunity and responsibility for the students. Such an event would empower learners and educate them in the possibilities of their future. Giving students challenging research level data can be intimidating, but when they understand things not even master's students have done and can teach this to their fellow students and teachers, they are empowered with their potential and abilities.

5. Conclusion

We have successfully developed and delivered a novel, engaging online pilot programme co-creating learning resources with students at a widening participation school, during a pandemic. The main benefits identified as a result of the project have been:

- Designing learning resources to enhance the possibility for students to choose STEM at university
- Connecting students with researchers
- Providing an interesting and innovative experience to students.

We are still waiting for the final conclusion, based on the results of the student surveys to get some hard data. Given the success of this project from student and teacher feedback, we have plans to apply for funding, permitting a wider roll-out, building up to a national project involving numerous universities.

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Exploring Formative Assessment Possibilities: Building a 'Teamwork Discourse' with First-Year Engineering Students Online

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Abstract

Effective teamwork is one of the Engineering Council of South Africa's (ECSA) exit-level outcomes. To achieve this outcome, one has to learn specific discourses and behaviours related to teamwork. Professional Orientation is a first-year engineering module offered in an extended engineering degree programme at a residential university in South Africa. This module assists students in developing a 'teamwork discourse', using engineering-based projects that follow the CDIO framework. In 2020, these projects transitioned fully to a virtual environment due to Covid-19 restrictions. The iPeer Learning Management System tool for peer- and self-assessment was used in this research to investigate whether first-year students were able to apply the teamwork discourses taught to them when completing the projects online. A quantitative analysis of the iPeer results reflected that while 54% of the students remained consistent in the two projects, 16% showed an improvement, and 30% showed a decrease. The reasons for these results could be varied. Thus, a qualitative analysis of the students' comments for increased and decreased marks was also conducted to assess how the relevant teamwork discourses were applied and to what extent. These findings confirmed that teamwork discourses could effectively be applied by a smaller percentage of first-year students.

Keywords: *Teamwork; engineering; projects; first-year; formative assessment.*

1. Introduction

1.1. Background

The University of Pretoria, South Africa, offers a five-year extended engineering degree programme. In the first-year of this programme a skills- and practices-based module titled Professional Orientation is offered to students. The aim of this module is to provide students with the foundations on which to build the relevant academic, IT, reading, writing and problem-solving literacies needed to succeed in their studies and later in the workplace. One of the academic literacies taught in the module is teamwork, both because it is outlined as an exit-level outcome by ECSA (2020) and because it helps students to develop the situated and transformed social practices, theorized in New Literacies Studies (Cope & Kalantzis, 2000) that will aid them in their personal and professional development.

Teamwork involves a complex mix of verbal and non-verbal communication behaviours, or discourses, to be achieved successfully. Consequently, this aspect of Professional Orientation is scaffolded to help students first understand and then apply knowledge and skills to projects that represent an engineering environment in microcosm. In the first semester, students participate in workshops on teamwork, effective communication, conflict management, collaborative learning, and CDIO[1]. These offer the students a theoretical understanding of how to work effectively in teams. In the second semester, students apply what they engaged with in semester one to projects that follow the CDIO framework. The first is the GoGreen project, where students are put into pre-selected teams, from a variety of different engineering disciplines, to practice applying the teamwork discourses they were taught in the first semester for the first time. The second project is the capstone project titled 'LEGO', where students are put into new pre-selected teams, still from different engineering disciplines, to reinforce the teamwork discourses they have learnt and practiced in a multidisciplinary environment that more closely emulates a workplace environment.

At the middle and end of each project, students use the iPeer Learning Management System (LMS) tool to grade the performances of each of the team members for assessment 'as learning'. This allows students to reflect on their own learning and to offer useful feedback to their teammates with the aim of improving their teamwork as they go along.

1.2. Rationale

Educators and scholars generally recognise that high levels of teamwork are necessary to be successful in today's workplace. Although also highly valued by organisations that need cooperation between members in order to achieve their objectives, engineering programmes

[1] CDIO is a project framework used by engineers that subdivides the lifecycle of a project from conception to completion into four categories: Conceive, Design, Implement, and Operate.

seldom pay explicit attention to "helping students develop teamwork and project management skills" (Smith, 2000). Limited instruction is provided on how to communicate and function effectively as a member of a team. Often engineering education focuses on individual contributions rather than on managed group efforts, although such groups are the norm in industry. It is therefore important that students studying engineering "learn skills for working effectively as members of groups" (Denning, 1992). However, Lingard (2010) acknowledges that most engineering students are ill prepared to function effectively in teams before being required to do so as part of a course, which aligns with the researchers' experience.

Furthermore, the National Academy of Engineering (2020) in the United States (recognized by the University of Pretoria because of its affiliation with the Washington accord) notes that only 40 to 60% of entering engineering students persist and successfully complete an engineering degree. To address this issue, it is becoming increasingly recognised that it is important to introduce engineering activities, including team-based design projects and community service projects, early in the undergraduate experience alongside basic science and maths courses so that students begin to develop an understanding of the essence of engineering as soon as possible. Curricular approaches that engage students in team activities in team design courses, and in courses that connect engineering design and solutions to real-world problems so that the social relevance of engineering is apparent, appear to be successful in retaining students. However, the design of such approaches and assessment of their effectiveness in terms of how to evaluate individual student performance are still not well rooted in rigorous investigation.

Finding effective teaching strategies and meaningful ways of assessing teamwork are further challenging tasks, according to Lingard (2010). Thus, the researchers elected to additionally focus on the formative feedback in self- and peer-assessment to determine if this might contribute to an improvement in teamwork and engagement amongst first-year engineering students.

1.3. Aims and Objectives

Due to the Covid-19 pandemic in 2020, the GoGreen and LEGO projects took place virtually using computer-based tools. The study that is reported and discussed in this paper investigated whether first-year engineering students were able to:

- use the iPeer LMS tool to reflect on their peer and their own application of knowledge and understanding of teamwork discourses first to the GoGreen project.
- reinforce and improve their knowledge, understanding, and experience of teamwork discourses, again using iPeer, in the capstone LEGO project.

2. The Projects

The GoGreen and LEGO projects that are offered in the second semester of Professional Orientation were adapted to accommodate the online learning environment. A description of these projects and an explanation of how they were adapted is offered in this sub-section.

2.1 GoGreen

The GoGreen project runs throughout the second semester of Professional Orientation. The aim of this project is for students to work in teams to create a project, product, or game out of a recyclable material that can be used to encourage a community to reduce, reuse, and recycle. In previous years, teams were peer-selected and comprised four students so that they could practice their teamwork in a comfortable and familiar environment. Teams were also told which material they would work with (for example, plastic, electronic waste, or tin cans) and to actively engage with a community to spread awareness. In 2020 these aspects of the project were amended as follows:

1. Students worked in teams of three, rather than four.
2. Students were pre-assigned teammates by the lecturers in the module.
3. Each team could select the material they would like to work with, based on what they had available at home.
4. The teams were encouraged to spread awareness online, rather than through active engagement with a community.

It was decided that smaller teams would make the teamwork aspect of the project more manageable, and that the teams would need to be pre-assigned to ensure that students would neither be advantaged nor disadvantaged by their access to resources. Additionally, students needed to have access to the material they would work with and they would need to limit their contact with people as much as possible, due to the pandemic. Outside of these changes, the project lifecycle and assessments remained the same.

2.2 LEGO

The LEGO project is introduced to the students during the implementation phase of the GoGreen project. Students are expected to manage their time around these projects and apply their experience from the GoGreen project to the LEGO project. Historically, the LEGO project takes place face-to-face. This project requires students to design and build a crane out of LEGO pieces that can lift the maximum amount of weight 10 cm in 90 seconds. The teams are required to conduct research, complete a design defence, build and test their crane, and report back on their final design. However, the building and testing element of the project

had to be adapted to accommodate the online learning environment. Thus, the following changes were made:

1. Students worked in teams of three, rather than four.
2. The emphasis of the project shifted from manufacturing to design.

As a replacement for the building and testing phase of the project, the students used Mecabricks free online software to develop the concept that they had established as a team – Mecabricks is an online LEGO brick software that allows one to develop one's concept into a 3D LEGO design. In the design phase of the project, the students defended their initial hand drawn concept, including calculations, to a team of peers and panelists from the module. Then, they used the feedback to develop their design further in Mecabricks – a document specifying the number of pieces and types of pieces the students could use was provided at the start of the project. Once the designs were finalized, each team was given access to all of the designs and asked to compare their team's design to another team's design by taking the specifications and calculations into consideration. In this way, the students were forced to think critically about their design work.

3. Method

A total of four iPeer assessments were completed in the two projects. These assessments were done after the conceive and design phase of each project, and again after the implement and operate phases of the projects. iPeer is an anonymous online LMS tool whereby students receive a rubric (created by the lecturer to assess select aspects of teamwork). The students then award their teammates a mark and offer a comment to support the mark. At the end of the rubric, a general comment is required. Comments are compulsory, and the system prevents students from submitting incomplete evaluations.

Because these iPeer evaluations are subjective and used to evoke honest, reflective responses, the results were used to identify the students who showed an increased performance / achievement or a decreased performance / achievement from the GoGreen to the LEGO project. Once these students were identified, the comments were used to ascertain why there was an improvement or a drop in the result, and if this could suggest that the students had started to apply the teamwork discourses they were taught in workshops in the first semester to their practical teamwork experience in the second semester, and to identify if this application improved from GoGreen to LEGO based on the assessment 'as learning' from themselves and their peers.

After organizing the comments received by the identified students into documents titled: GoGreen increases, GoGreen decreases, LEGO increases, and LEGO decreases, codes based on the areas assessed in the rubrics were identified. The two researchers then did solo coding

using the CAQDAS software program Atlas.ti for qualitative analysis and in a second round of coding worked collaboratively to compare results and ensure intercoder agreement. Thereafter, the codes were organized thematically based on the teamwork discourses taught in the first semester. These themes were identified as: communication, time management, personal contribution, openness and understanding, commitment to the team goal, and personal insight. The results are discussed in the section that follows.

4. Results and Discussion

4.1. Preliminary Observations and Participant Selection

Overall, the students' iPeer scores were inflated compared to the overall results for each project. Table 1 shows the percentage difference between the overall and iPeer averages for the GoGreen and LEGO projects.

Table 1. GoGreen and LEGO differences.

	GoGreen (%)	LEGO (%)
iPeer average	94	90
Overall project average	62	67
Percentage difference	32	23

These results are not unusual as students tend to inflate their own and their peers results due to concern that it might negatively impact the module mark. A limited understanding of the importance of teamwork discourses both at university and in a professional environment might also lead to inflated results. Although, it is interesting to note that the overall LEGO project average, the more challenging capstone project, was 5% higher than the GoGreen project average, and that the GoGreen iPeer average was 4% higher than the LEGO iPeer average. This could suggest that, on average, the students' teamwork improved from the first to the second project and that the students began to apply their understanding of the importance of teamwork discourses to their iPeer results, resulting in a drop in the average. However, this is not a conclusive finding and further analysis of quantitative data is planned in later stages of this longitudinal study.

Of the 99 students who qualified for the study, 54% stayed within a 5% range from GoGreen to LEGO, 16% increased by more than 5%, and 30% decreased by more than 5%. Clear-cut assumptions regarding the increases and decreases in these results could not be made as an improvement would not strictly suggest better implementation of teamwork discourses and a decrease or drop may not suggest a diminishment in one's application of the teamwork discourses taught to them. In fact, an improved score could point to less critical and more general feedback (negative) and a decreased score could suggest more nuanced self- or peer-

reflection (positive). To establish the possible reasons for the increase and decrease in results, a qualitative analysis of the relevant students' self- and peer-assessment comments was conducted. The most pertinent findings are discussed in the sub-section that follows.

4.2 Qualitative Analysis

The majority of the responses to each of the six categories, namely: communication, time management, personal contribution, openness and understanding, commitment to the team goal, and personal insight, become more positive in the increases and negative in the decreases from GoGreen to LEGO. This indicates that there is alignment between the results the students give themselves and their peers and their comments.

In the increases, time management is the only category that shows a small discrepancy between negative and positive comments (more negative than positive), which could be interpreted as students generally finding time management a challenge early in their university studies, sparking greater awareness and criticism. The virtual environment and flexible deadlines may have made this a greater challenge for students as well, as teams may have had difficulty arranging meeting times that were suitable to all participants. This is also apparent in the decreases as there was a 16% increase in negative comments for time management, also signifying that the challenges mentioned previously may be true.

With regard to communication, the negative and positive comments are relatively balanced in the students who show an improvement and the students who show a decrease — the largest range was in the LEGO decreases (35 % positive and 65% negative), suggesting that communication is a challenge for many students. This may be because they are still learning how to communicate effectively and work in teams. Moreover, the virtual environment would have made it more challenging for students to communicate as they had to rely on virtual platforms to contact one another and participate equally in the project.

Openness and understanding and commitment to the team goal result in no negative feedback in the LEGO project increases, showing that these students demonstrate growth in their willingness to work with diverse groups of people, especially since they were put into pre-selected teams by their lecturers, and a willingness to work toward a collective goal. However, there is a decrease in openness and understanding and commitment to the team goal when it comes to the decreases. Although the results are still overly inflated (83% positive and 17% negative and 91% positive and 9% negative, respectively), this may be a sign of poor input or someone 'taking over' the project as a result of ongoing communication challenges.

In terms of personal insight, many students tended to offer a self-reflection that was representative of their peer feedback, an indicator of good insight and personal reflection. However, a portion of the students were still unable or unwilling to reflect on themselves as

part of a team, a finding that is linked to student maturity. It was interesting to note that the students who showed a decrease in results from GoGreen to LEGO offered more positive personal insight than the students who showed an increase. This could suggest recognition of one's limitations as a teammate.

5. Conclusion

The students' formative feedback indicates that time management and communication remain areas of need, despite workshop interventions in the first semester. This suggests that practical experience and formative feedback that highlight these aspects of teamwork are valuable. Furthermore, the results indicate that first-year students can be exposed to teamwork early in their studies. Although teamwork results are inflated, students are able to identify how effectively teamwork discourses have been implemented by themselves and their peers. This emphasizes the need to actively teach these discourses and to use formative assessments to bring greater awareness to what it means to be an effective team member.

The transition from a face-to-face environment to a virtual environment was a challenging one for both the lecturers and students in Professional Orientation, and the finding that teamwork can be taught and can develop in this space is encouraging for the future. Thus, the researchers of the study at hand intend to extend their investigation on teamwork in first-year engineering students to include the possible impact of other non-cognitive factors, such as personality, on teamwork.

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Students' Behaviours in using Learning Resources in Higher Education: How do behaviours reflect success in Programming Education?

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Abstract

Programming education traditionally has been an important part of Information Technology-related degrees but, more recently, it is also becoming essential in many STEM domains as well. Despite this, drop-out rates in programming courses in higher education institutions are considerable and cannot be ignored. At the same time, analysing learning behaviours has been reported to be an effective way to support the improvement of teaching and learning quality. This article aims to deliver an in-depth analysis of students' learning behaviours when using course material items. We analyse an introductory programming course at a University in Dublin. The dataset is extracted from automatically logged learning data from a bespoke online learning system. The analysis makes use of the power of Principal Component Analysis and Random Matrix Theory to reduce dimensionality in, and to extract information from, the data, verifying the results with rigorous statistical tests. Overall, we found that all the students follow a common learning pattern in accessing all given learning items. However, there is a noticeable difference between higher and lower-performing cohorts of students when using practical and theoretical learning items. The high performing students have been consistently active in practice during the study progress. On the other hand, the students who failed the exam have more recorded activities in reading lecture notes and appear to become discouraged and unmotivated from the practical activities, especially in the later stage of the semester.

Keywords: *Programming education; learning behaviours; principal component analysis (PCA); random matrix theory (RMT); educational data mining.*

1. Introduction

Due to the growth in demand for Information Technology (IT)-related job markets, Education in Computer Programming and related domains has received increasing attention. Furthermore, STEM fields (science, technology, engineering, and mathematics) also require essential programming skills and knowledge, making these types of skills an integral part of any STEM sub-discipline (e.g., Artificial Intelligence, Bioinformatics, Statistics etc.). However, despite the necessity of these skills, there have been considerable drop-out rates in introductory programming courses reported from many studies (Kinnunen & Malmi, 2006). In a recent study using data from 161 universities around the world, the failure rate in introductory programming modules has been reported to be 28% on average, with a huge variation from 0% to 91% (Bennedsen & Caspersen, Michael, 2019).

Results from previous research efforts have concluded that learning behaviours tend to be correlated with students' performance in programming education (Carter & Hundhausen, 2017). 'At risk' students will follow this correlation in their learning behaviours (Na & Tasir, 2017). Many researchers have reported that participation frequencies in various learning sessions have positive effects on learning performance (Al-Shabandar *et al*., 2017). It has also been shown that *practice* is essential for improving students' programming skills and students should be given opportunities to practice and receive constructive feedback (Ben-Ari, 2001; Höök & Eckerdal, 2015). The effect of the diversity of learning styles on learning scores and satisfaction has also been validated, using the data from an online forum (Shaw, 2012). Furthermore, thanks to the development in educational technology, advanced learning systems now enable us to automatically record a large amount of data, such as on interaction, at fine-grained levels, e.g., at the level of mouse and keyboard events. Based on such data, several studies have revealed that there are great variations in accessing online learning tools, which significantly affect student performances (Li & Tsai, 2017; Lust *et al*., 2012).

On the other hand, novice programming students typically study both theoretical concepts and practical skills through course material items such as lecture notes, lab instructions and exercises. Studies have also reported that students tend to have difficulties in either understanding concepts or in acquiring practical skills (Qian & Lehman, 2017; Whalley *et al*., 2006). Although much research efforts have been carried out to study the learning behaviours and their relationship with students' outcomes, the learning behaviours in using material items, however, has not been commonly investigated (Li & Tsai, 2017).

In this paper, we focus on the analysis of students' learning behaviours in using course material items between the higher and lower-performing student cohorts. The data are collected from a bespoke online learning system, developed in our computing department, and analysed by a range of techniques including *Principal Component Analysis* (PCA), *Random Matrix Theory* (RMT) and statistical tests.

The rest of the paper is organized as follows. Section 2 briefly describes the context of the study, datasets and methods used for analysis. Section 3 provides details about the results and discussions, followed by the conclusion in Section 4.

2. Research method

2.1. Context of the study and dataset

This research has been carried out based on a dataset representing the usage of *learning material items* of first-year Software Engineering students in a Medium-size Metropolitan University in Dublin. During the course, learning items are provided to the students weekly, including general information, lecture notes, labsheets and programming tasks. Course material items are delivered in the form of web pages on the bespoke online learning system. We formalise the course material items in this context depending on material type (i.e. *General, Lecture, Labsheet and Practice*) combined with the corresponding week, e.g. *Labsheet_1* refers to the labsheet used in week 1. For the general information items, we denote them as *General_0*. Students' interactive events with the items (e.g. mouse clicking or scrolling, highlighting a piece of texts, switching between two items or submitting codes) are logged on the system database. Based on the logged data, it is possible to extract a dataset containing features that indicate the number of user interactive events in every *course material item* for each student. The data have been collected automatically during the learning progress without any manual intervention from either educators or students.

When finishing the exam, students submit their codes to the online system for automatic grading and they receive the results immediately. A submission is considered "correct" if it passes all the test cases pre-defined by the instructors. Every task is given the same mark proportion and the overall mark is given to students after the exam is finished. A student whose overall grade is less than 40/100 is labelled as "*Lower-Performing*", otherwise, that student is considered as "*Higher-Performing*".

2.2. Analysis method

In this paper, the number of data features depends on the number of learning items, which might lead to "the curse of dimensionality", i.e. too many features in the dataset. We, therefore, utilise the power of the *Principal Component Analysis* (PCA) and *Random Matrix Theory* (RMT) to reduce the number of data dimensions, identifying the key components containing essential information. The results are also verified by a set of statistical tests to detect the important underlying factors in the students' learning behaviours. The detail of the analysis method is discussed below.

Let $m \times n$ matrix $\boldsymbol{D}$ be the extracted dataset from the logged data where m refers to the number of students (data rows), n refers to the number of learning items (data columns). Each value

$\boldsymbol{D}_{ij}$, where $1 \leq i \leq m$ and $1 \leq j \leq n$, refer to the number of learning events generated when the student *i* was interacting with the learning item *j*. First, we apply Z-score standardisation to the data, which converts $\boldsymbol{D}$ to $\boldsymbol{D}_{\text{normalised}}$. The correlation matrix $\boldsymbol{C}$ can be calculated from $\boldsymbol{D}_{\text{normalised}}$, followed by the spectrum properties of $\boldsymbol{C}$, i.e. empirical eigenvalues $\lambda_{1,2\ldots n}$ where $\lambda_1 \leq \lambda_2 \leq \ldots \leq \lambda_n$ and eigenvectors $U^{1,2\ldots n}$. According to RMT (de Prado, 2020), empirical eigenvalues can be compared with the distribution of eigenvalues from the same size random matrix. Particularly, let the thresholds: $\lambda_{\pm} = \sigma^2\left(1 \pm \sqrt{1/Q}\right)^2$ where $\sigma = 1$ due to $\boldsymbol{D}_{\text{normalised}}$ having an unit variance; $\boldsymbol{Q} = (m/n) \geq 1$; and $\lambda_{\pm}$ are the upper/lower bounds of theoretical eigenvalues distribution. Eigenvalues falling outside of the range $[\lambda_-, \lambda_+]$ are assumed to deviate from the expected values of RMT (Laloux *et al*., 2000). By comparing the distribution of the empirical eigenvalue with the thresholds, we can identify the key eigenvalues containing specific information in students' learning behaviours.

The eigenvalues and eigenvectors of $\boldsymbol{C}$ can be used to form *principal components* of $\boldsymbol{D}$. After analysing and identifying the key eigenvalues λ_k and eigenvectors U^k, it is possible to project the data on U^k, forming *principal components* (PCs) scores (Abdi & Williams, 2010). The eigenvector components corresponding to each PC can be seen as *loadings* of the PC, indicating how much the feature (i.e. the course material item) contributes to the PC. By testing the difference of the scores of principal components between "*Higher*" and "*Lower-Performing*" student cohorts using a *two-sample t-test* (Cressie & Whitford, 1986), we can verify if there is a difference in learning behaviours between the two cohorts.

Inverse Participation Ratio (IPR) is additionally used to assess the contribution of eigenvector components to the corresponding eigenvector, i.e. the contribution of course material items to the PCs. The IPR of the eigenvector U^k is given by $IPR^k = \sum_{l=1}^{n} \left(u_l^k\right)^4$ where u_l^k is a component of the eigenvector U^k. We focus on the value of $1/IPR^k$ which implies the number of eigenvector components significantly contributing to the *PCs*. Eigenvector components can be investigated to observe the common trend in students' behaviours as well as the difference in the behaviours between student cohorts.

3. Results and Discussion

From more than 2.5 million learning events logged in the system database, we extracted a dataset that contains information of 263 students and 37 learning items used in the programming module over the two academic years (2018 and 2019). The students are classified into two cohorts based on their exam results, i.e., "*Higher-performing*" (141 students) and "*Lower-performing*" (122 students). Applying the analysis method discussed above, we have an *m* x *n* data matrix $\boldsymbol{D}$ where $m = 263$; $n = 37$; $\boldsymbol{Q} = 7.1$; $\lambda_+ = 1.98$; $\lambda_- = 0.38$.

3.1. Select the key information part in the dataset

Figure 1 illustrates the probability distribution of empirical eigenvalues extracted from the dataset and the theoretical eigenvalues predicted by RMT. Overall, the majority of empirical eigenvalues (*91.9%*) falls within the range [$\lambda_- = 0.38$, $\lambda_+ = 1.98$], which are distributed within the black curve in Figure 1. This is in agreement with previous studies which have found that a large proportion of empirical eigenvalues were predicted by RMT (Daly *et al*., 2008). This finding indicates that there is a measure of randomness in the majority of the eigenvalues. That is to say, these eigenvalues are merely following a random pattern. The remaining eigenvalues, which are higher than the upper limit $\lambda_+ = 1.98$, are outside the noise area and contain key information about the data. i.e. learning behaviours of the students. As the result, the first three components, which correspond to the three largest eigenvalues (i.e., $\lambda_1 = 10.66$, $\lambda_2 = 4.79$, $\lambda_3 = 2.53$), are selected.

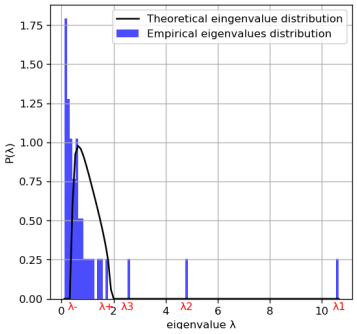

Figure 1. Distribution of empirical eigenvalues and theoretical eigenvalues predicted by RMT.

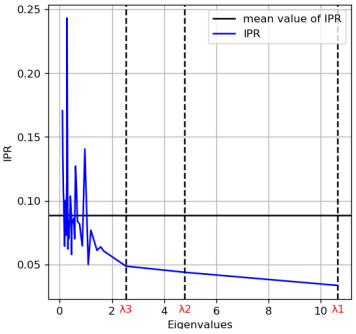

Figure 2. Inverse Participation Ratio of the empirical eigenvalues.

Figure 2 shows the IPR values for the eigenvalues of the correlation matrix $\boldsymbol{C}$. Based on the IPR values of the first three eigenvalues, it is possible to calculate the value $1/IPR$ for λ_1, λ_2 and λ_3. The number of eigenvector components which significantly contribute to the 1st, 2nd and 3rd component are 30, 23 and 23 out of 37, respectively. We note that each eigenvector component refers to a course learning item (e.g., *Labsheet_1, Lecture_2* etc.), indicating how much the learning item contributes to the PC. With the high number of learning items contributing to the principal components, the finding implies that the students appear to access and use most of the course material items delivered during the course.

3.2. Principal Component Analysis

Regarding the *first principal component* (PC1), all component loading values are positive. Such a positive value of a component indicates that the component is positively correlated with the corresponding principal component scores. Furthermore, there is no statistical difference between the *PC1* scores for the higher and lower-performing cohorts (*t-test p-value = 0.97 > 0.05*). The statistical testing illustrates the similarity in the learning behaviours

of students in the class. It indicates that almost all students have similar interactions with the course material items during most of the semester. They participated in learning activities and followed the instructions and requirements given by the lecturers. This finding reflects the fact that students were participating in a structured module, i.e., they mostly followed a designated timetable and a similar learning pathway in the class.

To detect dissimilarity between the two cohorts, we created a biplot, a visualisation technique displaying information on both samples and variables in the data matrix (Graffelman, 2014), which represents the 2nd and 3rd principal components (*PC2* and *PC3*) in Figure 3. Each green or red dot refers to a student in the dataset. The blue lines demonstrate the *loadings* of the *PC2* and *PC3,* where each loading line implies how much the corresponding learning item contributes to the *PC2* and *PC3 scores*.

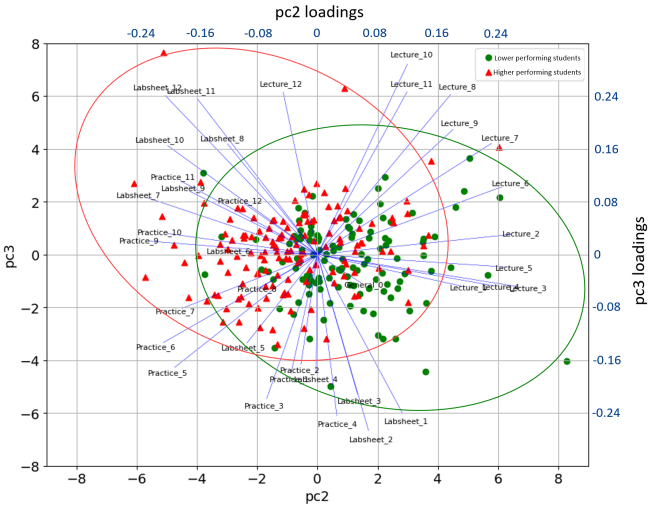

Figure 3. The biplot of the PC2 and PC3 extracted from the dataset.

Both *PC2* and *PC3* comprise either positive or negative component loadings. It is clearly noticeable from Figure 3 that there are clusters of student learning behaviours in the course material items. The majority of the lecture note items are plotted in the top-right quadrant of the graph. Conversely, the practical-related items delivered at the early stage of the study (e.g., labsheets and practices of week 1 to 7) are mostly distributed in the bottom-left quadrant while the remaining practical items which were delivered during the later phases of the course (week 8–12) can be found in the top-left quadrant of the graph. Furthermore, the *PC2* and *PC3* scores for all students are plotted separately from both sides of the two components, bounded by the red and green circles. We understand this finding to indicate the underlying difference in learning behaviours between the two cohorts. The data for the lower-performing cohort (green dots) are plotted on the right side of the graph, which is similar to the loadings of *lecture items*, indicating the positive correlation between them. Meanwhile, the higher-

performing cohort (red dots) has been found to be correlated with the loadings of the *practical* and *labsheet* items. We also notice a statistically significant difference between the two groups in the mean values of the *PC2* and *PC3* scores, with *t-test p-values = 0.00* and *0.007 < 0.05*, respectively. This distinction between the two principal components scores (*PC2 and PC3*) reflects the difference in the learning behaviours between the higher and lower-performing cohorts.

Based on these observations from Figure 3, it can be noticed that higher-performing students appear to pay more attention to the items related to practical activities such as navigating labsheets and doing programming tasks during the learning progress. Practising has been proved to be an effective way to improve programming skills (Ben-Ari, 2001) and higher-performing students have been reported to spend twice as much time on doing programming tasks as the students who failed the exam (Höök & Eckerdal, 2015). Meanwhile, lower-performing students seem to be more active in reading lecture notes than high achieving students. This finding has been in agreement with the conclusions from the previous studies that students who failed the exam spent more time reading the course books than the higher-grade students (Höök & Eckerdal, 2015). A possible reason is that, along with course books, higher-performing students tend to use alternative references from external sources such as consulting senior students and tutorials from the Internet to support their understanding (Rahmat *et al*., 2012). It is possible to conclude that lower-performing students might face difficulties in understanding new concepts. Therefore, they merely kept reading lecture notes while becoming discouraged and unmotivated to study and practice, especially in the later phase of the semester when the knowledge became more difficult to acquire effectively.

4. Conclusion

In this paper, we conduct an analysis of the learning behaviours of students in using course material items in the context of programming education. The analysis is based on a range of techniques. First, we collected data from a bespoke online learning system. Second, PCA and RMT have been utilised to analyse the data. Using RMT helps to remove random factors and keep the key information part of the dataset. Finally, we analyse principal components scores to find the similarity and difference in students' learning behaviours when they interact with course material items in the course. Overall, students interacted similarly with all course material items during the programming course. However, lower-performing students have been shown to have more activities in reading lecture notes than the higher-performing cohort. Additionally, regarding practical activities, the lower-performing students are found to be more active in practical-related course items including reading lab sheets and solving given programming tasks. Besides, while the higher-performing students consistently practised during the semester, the less achieved students appeared to have lost their focus and motivation in the later phase of the course in solving programming tasks.

There are several possible additions to our approach and research, which will be implemented in future work. The research is currently focusing on the number of interactions in material items. However, other attributes may contain useful information such as time duration spent on the items. Those attributes could enable more insightful analysis of learning processes.

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Exposing undergraduate students to research: A Condensed Matter Physics case study

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Abstract

In an effort to communicate major scientific breakthroughs to a vast audience, the media tends to present brief accounts of the findings and the process towards their discovery. While this may be sufficient for the layperson, it is certainly not enough for an undergraduate student in a scientific discipline. Moreover, the media will unlikely be able to judge the relevance of different breakthroughs and more emphasis will be put in those discoveries with more captivating titles. This is particularly worrying when it comes to actual students as it utterly biases their decisions when aiming to pursue a research career. The fact that syllabi tend to leave little to no room for introducing concepts that go beyond the standard curriculum leaves this problem unsolved. With the aim of tackling these issues, we have organized a workshop where experts from various institutions delivered lectures and even performed exhibitions of the phenomena being discussed. The initiative, named Recent Advances in Condensed Matter Physics, was aimed at undergraduate Physics students in their last two years at our University. In order to assess the strategies of our learning methodology, the experiment was carried out for three consecutive academic years and feedback from students was collected in the form of homework and surveys. The results show that introducing recent research discoveries in the curricula is a complex yet profitable strategy.

Keywords: *Learning methodologies; undergraduate initiation in research; student guidance; condensed matter physics.*

1. Introduction

The term Condensed Matter Physics (CMP) was coined by Philip Warren Anderson (Nobel Prize in Physics in 1977) and Volker Heine in 1967, when they were working at the Cavendish Laboratory, Cambridge. This subject deals with condensed phases of matter, namely, solids and liquids with many constituents (electrons and ions) under strong interactions between them and possibly subjected to external electromagnetic fields. According to the number of published papers, CMP is the most active sub-field of research in Physics nowadays (Sinatra 2015). Since the year 2000, the Royal Swedish Academy of Sciences has awarded the Nobel Prize in Physics six times to researchers working in areas related to CMP, including the last one in 2016. Besides the interest in fundamental aspects of Physics, CMP is a key area for the development of new technologies in a variety of niches (quantum and information technologies, data storage, energy harvesting and tailored materials for an endless series of applications, to name a few of them). A large number of scientists trained in CMP work in industry and found the training they received in University very rewarding.

The vast majority of undergraduate Physics degrees, if not all of them, offer subjects related to CMP, from introductory levels (mostly referred to as Solid State Physics courses) to advanced ones. However, these subjects' syllabi are often exceedingly dense and broad, with a large range of topics to be covered. As a result, there is usually very little time to present recent scientific discoveries. Such discoveries are often briefly accounted for in the media and sometimes may even go unnoticed for their not being sufficiently captivating. This asynchrony between the content delivered in the standard curriculum and the discoveries at the forefront of science leaves a considerable gap that students cannot overcome until attending graduate courses. By that time, students have already chosen a path to follow in their research without having had enough information about novel findings in different fields of the physical sciences.

Throughout the years, we have been able to observe how students perceive the aforementioned asynchrony between the concepts being taught in their lectures and the current research in fields such as CMP. A great example is that of graphene, a material which, since its experimental discovery in 2010, has led to a plethora of revolutionary discoveries. In contrast, students in their undergraduate courses will learn that graphene is a crystalline material with interesting properties but not much more. An excellent review on how to bridge the gap between teaching and research-based teaching can be found in Fraser et al. (2014). With this in mind, we decided to put the idea of drawing students closer to recent advances in CMP to the test, by bringing together their knowledge from their standard lectures and the most recent discoveries, as well as explaining how these have reshaped our modern world. In this work, we will present the initiatives and activities that were carried out during the academic years 2017/18, 2018/19 and 2019/20, along with the main results and conclusions.

2. Methodology and work plan

2.1. Objectives

Our work revolves around the workshop *Recent Advances in Condensed Matter Physics* (RACMP). All other activities and the data collection stem from the workshop. More specifically, our goals when designing this project have been:

- To make students familiar with the most recent and leading research topics in the area of CMP.
- To increase the interest in pursuing a research career and, in particular, to draw the students' attention to CMP.
- To statistically assess the students' response by means of surveys. In particular, we intended to find whether their being exposed to advances in CMP increased their awareness on the importance of CMP-related subjects within their degree.
- To show the results and conclusions to the academic authorities of our Department with the objective of introducing new methodologies inside the classroom.

2.2. Expected impact and indicators

The expected impact is very specific and easily quantifiable. On the one hand, there is a series of activities which will be discussed in detail later in the paper. Thus, the organization of the workshop, the seminars, the number of participants, the number of optional European Credit Transfer and Accumulation System (ECTS) credits, the speakers, etc. already provide indicators related to the statistical samples that have been used for the surveys. On the other hand, we have the actual surveys, the answers to which are found in Section 3. Finally, a White Book with specific proposals shown to the academic authorities in our Department is included in Section 4. We expect the impact to be immediate since the updates in the syllabi and the new methodologies are readily accessible for their introduction in the current curriculum.

2.3. Organization

The workshop RACMP took place during the second semester of each academic course, from February to May, during the academic courses 2017/18, 2018/19 and 2019/20. The students in mind were third- and fourth-year undergraduate students in Physics. Each session was 90 minutes long and they took place once a week during 10 weeks. Finding the right timing for the lectures was not straightforward since students in their last courses have a broad range of optional subjects, which massively overlap. Each session was delivered by experts in CMP, both from academia, research laboratories and scientific institutions (see Figure 1). The invited researchers were delighted with the idea and promptly accepted the proposal. The number of students who attended the workshop each academic year was above 60, much

higher than those attending the optional subjects in CMP. Most students attended the seminars regularly and received a certificate of participation and attendance. Students were also given the possibility to hand in a summary no longer than 1000 words related to one of the sessions of their own choosing. Those who did could apply for 1 optional ECTS credit.

Figure 1. Prof. María José Calderón, from Instituto de Ciencia de Materiales de Madrid (Consejo Superior de Investigaciones Científicas), in a classroom demonstration of the amazing physics of high-temperature superconductors.

2.4. Topics

The titles of the sessions in the academic year 2017/18 were the following

(1) Electronic correlation: From jellium to supercomputation.
(2) The quantum Hall effects.
(3) Topology at the service of condensed matter.
(4) Dirac materials based on graphene: CERN in miniature.
(5) Quantum dots: Manipulation and control of artificial atoms.
(6) Chiral molecules: Spintronics without magnets.
(7) Magnetic nanowires: A route towards new sensors.
(8) From Foucault's pendulum to Hofstadter's butterfly: creating synthetic gauges in condensed matter.
(9) Magnetic tunnel effect: Versatility of complex oxides.
(10) Exotic fluids and granular matter: From fundamental physics to silos.

The titles of the sessions in the academic year 2018/19 were the following

(1) The quantum Hall effects.
(2) Irreversibility and dissipation in microscopic engines.
(3) Chiral molecules: Spintronics without magnets.
(4) Superconductivity.
(5) Optical properties of semiconducting nanowires.
(6) Graphene nanostructures.

(7) Emergent phenomena: interfaces.
(8) Mechanical properties and friction at the nanoscale.
(9) Correlated oxides interfaces' based spintronics.
(10) Thermal transport at the nanoscale.

The titles of the sessions in the academic year 2019/20 were the following

(1) Chiral molecules: Spintronics without magnets.
(2) Topological insulators and topological semimetals.
(3) The quantum Hall effects.
(4) Twisted bilayer graphene: the magic of Moiré.
(5) Optical properties of semiconducting nanowires.
(6) Quantum dots: a versatile platform towards quantum computation and quantum simulation.
(7) Strengths and weaknesses of ab-initio calculations.
(8) Nanowires: a route towards efficient thermoelectric devices.
(9) Superconductivity.
(10) Thermal transport at the nanoscale.

Due to the Covid-19 crisis, the last five sessions of the course 2019/20 were delivered online.

3. Survey

3.1. Survey questions

At the end of the workshop, students were given anonymous surveys which contained the following questions:

(1) Have you taken or are currently taking Condensed Matter Physics in your undergraduate or graduate studies?
(2) Did you know what Condensed Matter Physics was before attending the workshop?
(3) After this workshop, has your interest in deepening your knowledge through other courses, activities or optional subjects on topics related to Condensed Matter Physics increased?
(4) Would you like to pursue a career in Condensed Matter Physics?
(5) If so, which aspects are you most interested in? Theoretical, experimental or both.
(6) Do you think that the number of subjects offered in Condensed Matter Physics is proportional to its relevance?
(7) Do you think that the workshop format, with specific talks on current research topics, is interesting and applicable to other subjects of your degree?
(8) Are you considering applying for the optional credit?
(9) If so, do you think the evaluation method to be appropriate?

(10) Would you attend the workshop again next year if new topics are introduced?
(11) Would you recommend your classmates the assistance to the workshop?
(12) Which topics did you miss in this year's workshop?

Data for the statistics: Male Female Other

3.2. Results

Table 1 presents a summary of the data retrieved from the survey.

Table 1. Statistics of answers to survey questions.

Question	Yes	No	DK/NA
1	18,5%	81,5%	0
2	70,4%	29,6%	0
3	88,9%	11,1%	0
4	48,2 %	40,8 %	11,0%
6	40,7%	59,3%	0
7	92,6%	7,4%	0
8	18,5%	81,6%	0
9	100,0%	0	0
10	92,6%	7,4%	0
11	96,3%	0	3,7%

Question 5 was a follow-up question to question 4 which, in case of the latter being affirmative, asked about the student's interest in theoretical or experimental aspects in CMP. The responses were the following

Table 2. Question 5.

Question	Theory	Experiment	Both	DK/NA
5	14,8%	33,3%	29,6%	22.3%

In response to question 12, students missed talks on plasmonics, social repercussions of CMP and their applications, as well as visits to research laboratories.

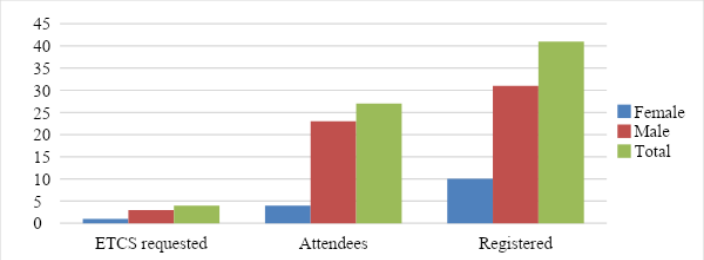

Figure 2. Gender of registered, attendees and ECTS requested to RACMP surveyed in 2018/19.

The data used for Figure 2 corresponds to the academic year 2018/19.

3.3. Analysis of results

From the results obtained in questions 1 and 2, regarding their knowing of CMP and their having taken courses on CMP before the seminars, most students replied that they did know of the existence of CMP although had not yet been enrolled in any subject related to it. This is very likely due to the fact that most students know that the syllabus of Solid State Physics encompasses topics that belong to the broader area of CMP. Question 3 shows that the workshop has fulfilled our objective of raising the student's interest on CMP since most students feel an urge to continue deepening their knowledge on the topics. Moreover, half of the attendees consider the possibility of pursuing a career in CMP (question 4), in a proportion that is even higher than the proportion of Physicists actually working in CMP. The interest in purely theoretical aspects is low, around a 15% (question 5) and, rather remarkably, all interested participants were male. In contrast, all participants who marked an interest in purely experimental aspects were female. It is interesting however to point out that about a third of the participants would like to pursue a mixed career, neither purely theoretical nor purely experimental. As question 6 shows, a large fraction of students, around 60%, considers that CMP is underrepresented in the current curriculum of the Department of Physics. The responses to question 7 show that most students believe this kind of activity to be applicable to other subjects. Although not a large number of students were willing to apply for the optional credit (question 8), all who did consider the evaluation method to be appropriate (question 9). Finally, we would like to stress the large number of students (above 90%) who would attend the following year's workshop and recommend it to their fellow classmates (questions 10 and 11).

In the optional comments, the attendees stress their interest in the proposed activity since it bring the researchers and their work closer to the students. Moreover, the low number of ECTS requests, even if the students consider the evaluation method to be appropriate (question 9), exhibits the genuine interest generated among the students by the CMP.

Regarding the gender of the students, the data reflects the gender participation in our University, with a proportion of 36% female (Nieto-Zayas 2013). On the other hand, the speakers where exactly half of them male and half female, in mean value spanning the three years of activity.

4. White book

From the results obtained in the surveys as well as from the experience gained by the organizers, we made the following recommendations to our Department:

- In the first subjects of the Degree in Physics where students start being exposed to the behaviour of solid matter, namely, Materials Physics and Solid State Physics, it is convenient to emphasize that CMP represents a third of the current research in modern Physics.
- Since true modifications of the syllabi can be rather complex, alternatives must be put forward so as to show students the relevance of CMP. The RACMP workshop proved to be an excellent platform to achieve this aim, although it is clearly not the only alternative that exists.
- Offering optional credits favours the participation, even if the student already had a motivation to attend the activity.
- The workshop has allowed for the analysis, synthesis and evaluation of the contents on CMP from the students' viewpoint.

5. Conclusions

The surveys show that the RACMP constituted an interesting activity for students to get to know research at the forefront of Physics and to increase their interest in the subject. The results were included in a white book with specific purposes which were then shown to the authorities in our Department. The expected result is that improvements will be included in the teaching methodologies as well as in the syllabi. Finally, taking into account the students' interest and the need for an enhancement of the role of CMP in the standard curriculum, a fact that is not exclusive to our University, we believe that the results presented herein will be of interest to other Universities.

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The relationship between self-efficacy and accounting students' academic performance at a South African university

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Abstract

Racial transformation is crucial for South African higher education institutions, the accounting profession and the country as a whole. Consequently, determinants of students' academic success must be at the forefront of accounting education research. Understanding these determinants will assist universities to better assist students with their learning. This study focused on self-efficacy in academic performance—a previously limited research area in South African accounting education. The aim was to determine the relationship between self-efficacy and academic performance amongst students registered in a second-year undergraduate course for an accounting degree at a South African university. It was found that self-efficacy was moderately positively correlated with academic performance. The findings indicate that it is worthwhile performing further empirical research on self-efficacy, especially while controlling for other significant factors affecting students' academic performance.

Keywords: *Self-efficacy; academic performance; accounting; South Africa; student; success.*

1. Introduction

South African higher education institutions have made significant progress with regards to transformation in recent years, including increased access, particularly for Black South Africans. However, this has not translated into equitable graduation rates. The accounting profession needs these students to succeed academically and start contributing to the economic stability of the country, thereby promoting equality and rectifying the injustices of the past.

Therefore, it is paramount to understand the factors affecting students' academic success to identify who needs the support, how best to offer it and when to do so. While prior accounting education research in South Africa has focused on demographic and academic factors affecting academic performance, there are other potential determinants of success identified in the literature of other disciplines as well as internationally. One of these determinants is self-efficacy.

The present research is motivated by two studies. Joynt and de Villiers (2019) found an association between self-efficacy and academic performance, while Shamsoodien and Carpenter (2020) identified the need to investigate the impact of self-efficacy on student academic performance while controlling for determinants of success.

Using Kendall's tau-b correlation coefficient, this study determined the relationship between self-efficacy and academic performance in students registered for a second-year undergraduate course in an accounting degree at a South African university.

2. Literature Review

Recent accounting education research has focused on factors affecting either academic performance or degree completion. However, this narrow approach of measuring student outcomes has led to an expansion of the explanatory variables, which now include students' personal development and integration into an institution's environment such as locus of control, student engagement, self-efficacy or institutional culture. It is paramount to first identify determinants of academic success before developing targeted interventions to improve graduation rates.

2.1. Biggs 3P Model

There are multiple factors affecting students' academic success in higher education institutions. The Biggs 3P model explains the three stages of student learning and the factors that could affect students' academic performance (Biggs, 1987). First, the *presage stage* includes personal factors (e.g. intelligence, background or demographics) and situational factors (e.g. subject content or course structure). Second, the *process stage* relates to the way in which the student goes about learning. Third, the *product stage* relates to student performance and

includes either cognitive factors (high-level informational or detail-oriented structures) or affective factors (how the student experiences learning) (Biggs, 1987).

The model has been used extensively in many fields, including accounting education (Davidson, 2002; Papageorgiou, 2017). While Biggs (1987) focused on students' learning approaches, it was acknowledged that presage factors assisted in developing the learning approach. Therefore, factors such as prior academic results, age, gender, race, language and potentially self-efficacy, determine students' learning approach, which subsequently affects their academic performance.

2.2. Academic and demographic factors affecting determinants of success

The single best predictor of academic performance at all levels for accounting students in South Africa is academic performance in the immediately preceding year of study, whether in undergraduate studies (Jansen & De Villiers, 2016; Papageorgiou & Halabi, 2014; Swart & Becker, 2014), postgraduate courses (Pullen et al., 2015; Steenkamp, 2014; Swart & Becker, 2014) or professional exams (van Wyk, 2011). This is likely due to the hierarchical knowledge structure of accounting studies (Myers, 2017).

Numerous South African studies report that students who took accounting as a subject in Grade 12 outperformed those who did not (Bokana & Tewari, 2014; Papageorgiou, 2017; Papageorgiou & Carpenter, 2019). However, any advantage gained is not sustained beyond the first year of undergraduate study (Jansen & De Villiers, 2016; Papageorgiou & Halabi, 2014). Overall, performance in Grade 12 is strongly correlated with academic success at all levels of tertiary education (Bokana & Tewari, 2014; Jansen & De Villiers, 2016; Pullen *et al*., 2015).

South African literature largely concludes that younger students outperform older students, whether at the undergraduate level (Bokana & Tewari, 2014; Jansen & De Villiers, 2016), postgraduate level (Steenkamp, 2014; Ungerer et al., 2013) or in professional exams (Roos, 2009; van Wyk, 2011). However, there is some research indicating the contrary, especially at the start of an undergraduate degree (Papageorgiou, 2017).

Due to contradictory findings in South Africa, there is inconclusive evidence on the impact of gender on accounting academic performance. Some studies indicate outperformance by males in undergraduate studies (Jansen & De Villiers, 2016), while others report females outperforming males in both undergraduate studies (Carpenter & Kunaka, 2018; Coetzee *et al.,* 2016) and professional exams (Roos, 2009). Yet other studies have found no correlation between gender and academic performance in undergraduate studies (Bokana & Tewari, 2014; Papageorgiou, 2017; Papageorgiou & Halabi, 2014; Steenkamp, 2014) or in professional exams (van Wyk, 2011).

South Africa has a history of institutionalised racial disparities in education and therefore it is to be expected that there would be significant differences between the academic performance

of White students and that of other racial groups (Bokana & Tewari, 2014; Papageorgiou, 2017; Sartorius & Sartorius, 2013; Ungerer *et al*., 2013). The literature is clear that White students outperform all other race groups, Black students are less likely to pass and Black African students fare the most poorly. While access to tertiary education and funding has widened, student attrition rates remain high, and will likely only change substantially once deficiencies in the secondary schooling system are addressed, and there are employment opportunities for graduates (Kaburise, 2014). Graduation rates and time-to-completion are also affected by funding and financial aid (Carpenter & Roos, 2020).

The impact of race on academic performance is linked to home language and the language of instruction. South Africa has 11 official languages; however, only two of them—English and Afrikaans—are offered as the language of instruction in tertiary institutions. The literature notes a strong positive correlation between academic success and assessment in one's first language (Bokana & Tewari, 2014; Papageorgiou, 2017; Steenkamp, 2014; Swart & Becker, 2014; Ungerer et al., 2013; van Wyk, 2011). In contrast, other research suggests that Grade 12 language marks are not correlated with academic success at university (Aboo, 2017; Jansen & de Villiers, 2016; van Rooy & Coetzee-van Rooy, 2015) and that multilinguism may contribute to academic success (Martirosyan et al., 2015; Papageorgiou, 2017).

2.3. Self-efficacy as a factor affecting determinants of success

Perceived self-efficacy is a person's belief in their capabilities to produce designated levels of performance. In academic performance literature, self-efficacy relates to the belief that one will achieve good marks in a particular subject. Most literature confirms that self-efficacy is positively correlated with academic performance. That said, there is limited research on self-efficacy in the field of accounting higher education in South Africa, and therefore international literature should first be investigated.

International studies on accounting students provide contradictory results. Some find evidence of an inverse relationship between pessimism and academic performance (Christensen *et al.*, 2002; Mooi, 2006). However, there seems to be more literature indicating a positive relationship between self-efficacy and academic performance (Beatson *et al*., 2020; Byrne *et al*., 2014; Gul & Fong, 1993). In particular, Beatson et al. (2020) note that self-efficacy trumps high school experience as the most powerful predictor of academic success.

In a South Africa, Joynt and de Villiers (2019) investigated the impact of a preparatory course on students' academic performance in a first-year Accounting course. They report a positive association between academic performance and self-efficacy. However, as there is scant research on this topic in South Africa, it is uncertain whether this finding is pervasive or whether the impact of self-efficacy on academic performance follows the contradictory international evidence in this field.

Therefore, it is worthwhile first exploring if there is a relationship between self-efficacy and academic performance in accounting studies in South Africa, and thereafter to investigate the extent and depth of that relationship.

3. Method

The objective of this study was to identify whether a relationship exists between self-efficacy and accounting students' academic performance. The students investigated were registered for Corporate Governance I, a second-year undergraduate course in an accounting degree at a South African university.

Self-efficacy was assessed by measuring students' responses to the survey statement, "I feel confident in my ability to achieve a grade that is above average" (McKenzie & Schweitzer, 2001) and responses were rated using a five-point Likert scale ranging from 1 = not confident at all to 5 = completely confident. Ethical clearance was obtained prior to the survey distribution. The use of a single statement to measure participants' self-efficacy is consistent with prior literature (McKenzie & Schweitzer, 2001). Academic performance was verified through students' final marks in the course, obtained from institutional student records.

The final number of students who completed the survey and for whom a full set of records was available amounted to 401, yielding an overall response rate of 70%. From a comparison of the sample to the population, there was representation and consequently, non-response bias was not expected (Nishimura et al., 2016).

The data comprised the ordinal variable related to self-efficacy and the continuous variable related to final marks. Therefore, a Kendall's tau-b (τ_b) correlation coefficient—a nonparametric measure of the strength and direction of association between self-efficacy and final marks—was calculated using IBM SPSS Statistics version 27.

4. Results and conclusion

Figure 1 shows the distribution of final marks for the self-efficacy scale. Graphically, it can be observed that students who selected 'completed confident' (i.e. scored 5 on the Likert scale) in their ability to achieve a grade that was above average performed well in the course, while students who scored 2 or 3 on the Likert scale did not necessarily perform better than their less confident peers.

A Kendall's tau-b (τ_b) correlation was run to determine the relationship between self-efficacy and academic performance amongst the 401 participants. There was a moderate positive correlation between self-efficacy and final marks, which was statistically significant (τ_b =.208, p =.000).

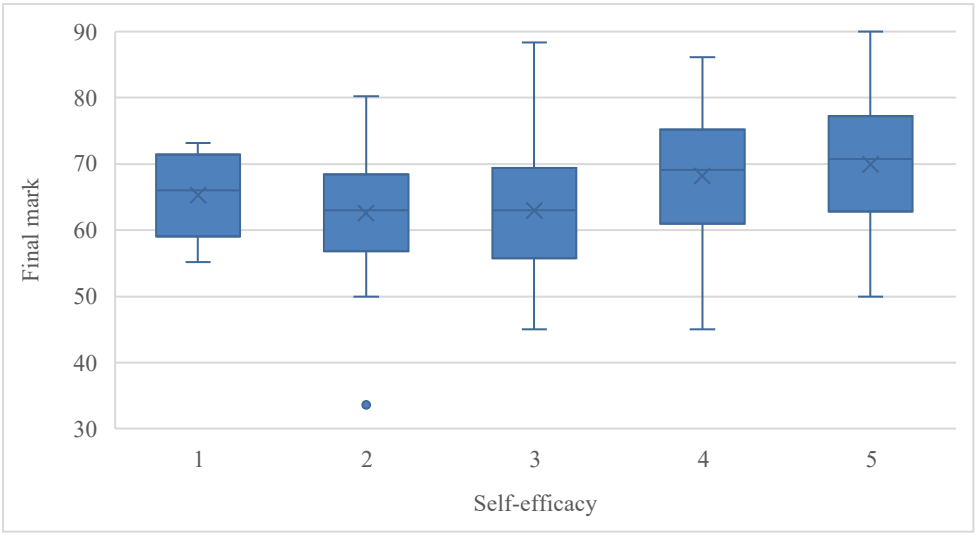

Figure 1. Final mark vs self-efficacy.

Therefore, given that self-efficacy is moderately positively correlated to academic performance, programmes should be developed to assist in fostering an environment where students are confident in their ability to perform well in a course.

It stands to reason that the next step should be to consider whether self-efficacy is significantly associated when controlling for factors identified in the literature. Further research could include a regression analysis, incorporating Grade 12 results, prior academic performance, age, gender, race and language. Another avenue would be to consider the impact of these variables in private tertiary education (Carpenter & Kraus, 2020).

It is important to understand all factors affecting accounting students' academic success in tertiary education. Cognisance of these factors will assist universities to help students develop effective learning approaches, which should then improve their academic performance (Biggs, 1987). The research on the impact of self-efficacy in accounting students in South Africa is still in its infancy. However, investigating it in conjunction with other factors that may affect academic performance may help universities provide innovative support programmes and additional directed assistance (financial and otherwise) that will assist students' academic success.

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Reverse Metadesign: Pedagogy and Learning Tools for Teaching The Fashion Collection Design Process Online

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Abstract

The present article discusses the experience of redesigning the pedagogy and learning tools of a pillar course at the School of Design of Politecnico di Milano, the Metadesign studio course. Metadesign is a design methodology that leads to the concept definition of a new product or service through a research process that synthesizes design goals, technological and productive constraints, market context, and consumption trends for a consumers' group of reference. It represents a unique methodological approach characterizing a design education as it provides a consolidated research practice able to support the design process. The course structure foresees the reconstruction in phases and the development of all the contextual elements—product, space, service, communication artifact, etc.—that come into relation with the to-be-designed object and influence its characteristics. This process enables creating the "abacus" of components to use in a design activity. Considering the ever-increasing need to reshape the whole education system because of the paradigmatic change pushed by digital transformation and the urgency for on-distance courses posed by the COVID-19 emergency, the article presents a renewed "reversed" course structure. It highlights strengths and opportunities for further improvements representing a solid base for innovating a fashion design education.

Keywords: *Metadesign; fashion design; learning-by-doing; reflection-in-action; deductive reflection; virtual learning environments.*

1. Introduction to Metadesign for Fashion: Pedagogical Principles and Approaches

Metadesign (Van Onck, 1964) is a methodological approach that aims to provide students with preliminary design skills to lead the concept definition of a new product or service considering a system of socio-cultural, production and market opportunities, and constraints. This methodology represents the core of design education at Politecnico di Milano. In the 2nd year of all the bachelor's degree programs at the Design School of Politecnico di Milano, a design studio focuses on it.

The Metadesign studio encompasses the entire design process, from research methods and tools for understanding the product system to the interpretative reading of the design context, up to the envision of a use scenario. Specifically, in the Fashion Design Program, Metadesign Studio aims to trace the entire design process that leads to the conceptualization of an apparel collection, covering the different phases, from research and analysis to concept generation, design, and presentation, towards methods and tools representative of the discipline.

The faculty team composition is interdisciplinary in terms of competencies, roles, and responsibilities. It includes both scholars, experts in managing the Metadesign process applied to the fashion design domain, and professionals skilled in all the phases concerning the development of an apparel collection, from research to design and production. This interdisciplinary composition guarantees the integration of an Academy-Industry perspective (Colombi & Vacca, 2016) by offering students, grouped in working teams, the opportunity to develop their own design skills through the experimentation of a real case study (Bertola et al., 2017).

The studio-based didactic experience is structured in two subsequent levels. The first one has a theoretical-analytical focus, and it is organized in theoretical lectures, instrumental lectures, and seminars with guest speakers. It mainly involves a creative and critical thinking approach (Crane, 1983; Anderson, 1990), encouraging learners to develop systemic and logical reasoning, frame market context, examine technological and productive constraints, and understand consumption trends linked to the very fashion product. The second one presents a conceptual focus on a reflection-in-action approach (Stewart & Colombi, 2015) characterized by two crucial pedagogical methods.

On the one hand, the learning-by-doing approach, where students' participation in practical activities, complemented by a critical and strategic thinking method, is preferred (Shön, 1983). On the other hand, the participatory learning approach, where learners are encouraged to actively participate within the working team and in constant dialogue and reflection with faculty, favoring a learning process based on sharing knowledge in the process and practice (Orr & Shreve, 2017). This second level provides for a team assignment throughout the semester. The assignment is divided into intermediate working phases and is partially

developed by students during the working hours in class and partially during at-home working hours. Therefore, the objective of this approach is to constantly monitor and train the different teams in the simulation of the professional activity of an actual design department.

2. Reverse Metadesign: Redesigning the Fashion Design Process

Until the 2019-2020 academic year, the Metadesign studio was almost entirely held in person. The in-person format included instrumental lectures taught by the faculty and seminars with guest experts in the field to offer detailed and timely contents for specific phases of the team assignment.

In line with the ever-increasing need to reshape the whole fashion education system through the paradigms of digital transformation and, more in general, to innovate the design education acquiring new pedagogical tools, already for the 2018-2019 academic year, the theoretical lectures related to the Metadesign theory were transferred into an ad-hoc designed Massive Online Open Course (MOOC), entitled "Introducing Metadesign." The MOOC provides fundamental definitions and references for the topic. It presents all the design phases/processes and activities, teaching students to shift from a basic problem solving to a problem setting and problem finding attitude to structure the pre-project research.

The proposed blended methodology introduced innovative teaching and learning approaches that were expanded on the following course components. According to a *reflection-in-action* path (Stewart & Colombi, 2015), a consistent number of hours of the in-person format were allocated to in-class activities to favor learners' understanding towards a participative approach and inductive exploration. In-class activities were meant to support teams in the concept development of a Spring-Summer womenswear collection for a Ready-to-Wear brand selected and assigned to each team by the faculty. For this purpose, the six months long assignment was divided into three different phases (Bertola et al., 2017).

The first one, *Scenario Design,* was grounded in between observation and reflection on the actual context. It dealt with a preliminary analysis of the assigned brand's values and stylistic identity to abstract in-depth iconographic research into three different perceptual scenarios (moodboards)—which define colors, shades, touches, and atmospheres—, and outlining the ideal consumer and her lifestyle.

The second one, *Product and Concept Design*, concerned the synthesis of the brand's distinctive stylistic into new and original design solutions thanks to the definition of the main features of the collection, such as cuts, constructions, volumes, lengths, fittings, details, etc.

In this phase, key-outfits designs, fabric customizations, graphic motifs development, embellishments experimentations were the core activities of the Metadesign studio required

and developed by students. The third and last phase, *Merchandise Planning*, covered the process of systematization, reflection, and abstraction on the outcomes of the previous steps, activating the second loop of a deeper understanding of the experienced process.

This phase materialized the ideal structure of a collection organized into three main occasions of use (work, leisure, special occasion) to complete an ideal wardrobe. The merchandising plan was then achieved, starting from developing key ideas and key items representing the three scenarios/lines defined in the first two phases. Students designed alternative or complementary typologies of items, complemented by color-fabric options, to offer a balanced mix of essential, fashionable, and carry-over items.

The learning process, structured as described above, adopted a methodological approach based on inductive practices, which, starting from a direct experience of the design practice, allow the student to reflect on the performed and then observed activities. This approach aims to abstract practices, and therefore to codify methodologies, leading to the acquisition of new knowledge. Due to the COVID-19 pandemic, the structure of the Metadesign studio needed a significant redesign by moving from in-person to on-distance learning.

The previous efforts of transferring theoretical contents into a MOOC format were not sufficient to guarantee a sustainable learning model for a design studio. The learning-by-doing approach needs to be experienced to learn a design methodology.

Therefore, it was necessary to reverse the methodological process of the team assignment, rethinking not only the structure and phases of the studio but completely redesigning the contents learning path. The "Reverse Metadesign" format proposed for the 2020-2021 academic year is based on a deductive process based on the assumption that the analysis and subsequent breakdown of a virtuous process already carried out would allow the students to understand and codify the design processes and then to replicate them.

The initial project phase, *Introducing the Brand,* focused both on analyzing an assigned RTW brand—aimed at investigating brand strategy, market position, and permanent stylistic codes—and on the reading and decoding of a specific apparel collection.

Through a process of *deductive reflection* of the actual product, this phase had the main objective of (i) recognizing the stories/lines of inspiration developed by the design team of the brand, recognizing the main visual elements, and translating them into moodboards; (ii) pinpointing the seasonal stylistic codes, such as colors, textures, shapes, finishes; and (iii) finally identifying the Stock Keeping Units (SKUs) of collection, organizing them by typologies.

The subsequent two phases of the project concerned the decoding of the brand identity and the design strategies activated by the very brand. Firstly, students, also in this case organized in teams, were asked to develop a critical analysis of the plan of the collection architecture

(*Reverse Merchandising* phase) based on the brand identity, values, positioning, ideal customer, etc. Secondly, they were asked to propose a product development strategy (*Product Design* phase) to complement the collection coherently with the brand's one. Students had to use and redesign colors, fabrics, and embellishments consistently with the brand identity, the product mix of the analyzed collection, and the lifestyles of the ideal consumer.

3. Interaction and Engagement in Distance Learning

An essential part of the learning happens in allowing interaction and engagement intended as *"the amount of physical and psychological energy that the student devotes to the academic experience"* (Astin, 1984) among student-teacher, student-student, and student-content to ensure a connected student experience (Moore 1989). While some studies have not found a clear relationship between engagement and learning outcomes (Axelson & Flick, 2010: 42), many researchers have argued that there are unequivocal links between engagement and students' learning and achievements (Kahn, 2014; Sinatra, Heddy, & Lombardi, 2015).

Engagement is much more important in on-distance, and online learning, where high students drop out, could be critical. The intellectual interaction with contents should be enhanced by student-teacher (e.g., stimulating, counseling, encouraging, coaching students) and student-student engagement (e.g., allowing interaction between peers, in pair or group, with or without the presence of the instructor).

Focusing on the iterative reciprocal interaction between cognitive, behavioral, and environmental aspects, the social learning pedagogical model by Albert Bandura (1997) emphasizes the importance of exploiting peer-to-peer learning to reach educational goals and to grow independence and higher personalized learning experiences (Bowen et al., 2014).

4. Creativity Management in Distance Learning

As part of the innovation processes and activities, creativity derives both from intra-individual components (e.g.task motivation, domain-relevant skills, and creative strategies) and also from the social environment components (e.g., collaboration activities and the communication pattern characteristics) (Amabile, 1996). With online education, digital environments should support students' creative design processes, particularly in the conceptual phase of design, to boost knowledge gathering, sharing, and integration toward the generation of creative ideas (Greene, 2002).

In this paper, we focus on digital environments enhancing social creativity related to social interaction allowed by collaborative digital tools that support brainstorming processes (e.g., accessing information and pieces of knowledge and sharing experiences, ideas, resources, or

responsibilities). In this regard, research states (Hulsheger et al., 2009) that creativity increases when there is a higher level of communication among the team members to support fruitful collaborative synchronous and asynchronous sessions for idea generation. Furthermore, these digital spaces allow users/groups to exchange contents and share materials via visual supports communication (e.g., mapping, images, diagrams) (Wang et al. 2010).

5. Virtual Learning Environments (VLEs) and Digital Tools

A combination of VLEs and digital tools supported the three levels of interaction and engagement toward creativity in the course. Digital tools were organized to handle a subset of learning management goals such as students' participation, interaction, and creative brainstorming to design digital fashion moodboards. For the sake of simplicity, we divided the tools (e.g., *course space repository, digital e-classrooms, and group e-rooms* and *collaboration tools for student teamwork*.) into distinct ones by presenting their affordances and limitations as separated. However, we acknowledge that their use will be not linear but mixed to help the digital learning experience positively.

5.1. Course space repository

Several VLEs allow lectures repository, archival, and fruition from students in remote digital modality. They also enable course management and are helpful to handle the logistical aspects of planning, scheduling, calendaring, and delivering content in a password-protected web environment. Besides, they support the traditional and prescriptive unidirectional communication between teacher and student through direct advisement, lecture, assignment sharing, and evaluation feedback communication.

5.2. Digital E-classrooms and groups e-rooms

These digital learning environments allow remote connection and synchronous interaction where both teaching and coaching can occur (teacher-student interaction) but student-centered interactive discussions (e.g., Microsoft Teams, Zoom, Cisco Webex). In addition to the plenary e-classroom, digital free spaces allow students to meet and work in groups autonomously and collaboratively. In these two virtual environments, the facilitation and management of effective communication among team members and faculty are ensured through virtual meetings, instant messaging, screen sharing, and voice/video conferencing.

A speed dating exercise was organized to allow the students to present their ID charts sharing personality traits (e.g., strengths and weaknesses), study and cultural interests, working habits, and teamwork preferences. Students introduced themselves in a one-minute pitch in front of their peers to show their expertise and build their team autonomously through those virtual platforms.

5.3. Collaboration tools for student teamwork

Collaboration tools aim to allow a collective space for students to co-create a shared and meaningful body of knowledge, to interact for brainstorming, and to creatively co-design a product/service/system (e.g., Miro, Mural, Conceptboard, Ziteboard, Stormboard). V

isual digital whiteboards are successfully used as project management tools to control the workflow of activities, as ideation tools to map and visualize ideas in early creative stages, and as co-design tools to allow groups to modify output and edit in real-time or asynchronously and to facilitate consensus building.

They are also management tools for resources, allowing archive project files that all group members can access. In place of online software for moodboards design (e.g., Pinterest, Moodzeer, Adobe Spark, Canva, GoMoodboard, Niice), groups of students used Miro as a white canvas to collaborate for brainstorming and visual storming toward the creation of the moodboards for each thematic line of the fashion brand they were assigned.

This co-generative process of moodboard making allows students to reflect on fashion-related thematic lines through the cultural, material, and chromatic aspects. They first reflect on abstract values, adjectives, themes, cultural references, and symbols to build a shared visual mental map of keywords. Later they choose iconographic materials (e.g., photographs, patterns, materials, objects, colors, textures) to be preparatory for designing digital fashion moodboards.

6. Conclusions

Although the Reverse Metadesign process succeeded from a formal point of view in transferring the students the methodological processes behind the development of a clothing collection, the on-distance learning certainly limited some aspects of knowledge better explored in the traditional pedagogical model. First and foremost, the process of fabric and its embellishment knowledge.

Despite the increasing application of digital technology in the haptic perception of fabrics, the visual and tactile perception was completely missing. At the same time, it remains fundamental to learning the matter potentiality in terms of comfort, functionality, and expressive content. Secondly, on-distance learning has restricted the design participation of students in the whole Metadesign studio activities, limiting the exchange between different teams and inevitably reducing the interaction with the faculty in favor of virtual participation that is not always fully integrated and stimulated.

However, as the comprehension of pre-project activities was successful, the new pedagogical structure tested and here discussed represents a good starting point to build other didactic experiences with three objectives: i) developing solutions to introduce a more direct

experience of fabrics, not only through haptic technological solutions but also with basic design exercises that stimulate perceptual understanding; ii) improving the structure of the product Development Phase to accompany the students' design activity better; iii) expanding further interactive and flipped activities for a more dynamic learning environment.

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The HTR Model for Well-Being in Educating Community

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Abstract

With the aim of enhancing human capital by bringing out talents, this paper offers a theoretical model for innovating teaching/learning methodological approaches. The Humor Talent Resilience (HTR) Model for Well-Being in Educating Community recognizes Humor as a pedagogical device that jointly feeds both Talent and Resilience. This nourishment triggers a dynamic process between Talent and Resilience of reciprocal and constant interdependence, while developing a mutual positive contamination in continuous evolution. This process is itself a "generator of Well-Being" but it will be able to fully convey its educational effectiveness only if it is supported by an Educating Community. While acknowledging the enhancement of all human potentials, including the high or very high potentials, the pedagogy of Well-Being must assume the educational responsibility of offering teaching/learning contexts that allow all students to reach their highest level of development. Three open reflections are presented: the concepts of justice and equity of educational policies and practices aimed at respecting and enhancing all human potentials; the virtual educating (or dis-educating) community; the need for specific training for teachers and more opportunities for international discussion in the field of gifted and talented education.

Keywords: *Humor; talent; resilience; well-being; educating community; higher education.*

1. Introduction

According to the Goal 4 of 2030 Agenda for Sustainable Development ("Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all") it is necessary to offer equitable and inclusive educational opportunities to all individuals, both children and young people in a "lack" situation (emotional, cognitive, linguistic, social, economic) but also to those defined as "gifted and talented", who have a greater potential for development, different from the others, following atypical evolutionary trajectories, at times decidedly deviant or dysfunctional. These characteristics often correspond to invisible, unrecognized needs and rights. The shared European objectives are also those of promoting employment and employability within the European Union and, in a context of economic crisis, enhance the development of talents as reported in the Opinion of the European Economic and Social Committee on "Unleashing the potential of children and young people with high intellectual abilities in the European Union" (Official Journal of the European Union 2013).

2. The HTR Model for Well-Being in Educating Community

With the aim of enhancing human capital by bringing out talents, this article offers a theoretical model for innovating teaching/learning processes. The Humor Talent Resilience (HTR) Model for Well-Being in the Educating Community presents Talent and Resilience in their relationship with Humor. Humor constitutes an effective "pedagogical device" (Bateson 1969), understood as a theoretical and operational interpretative category (Foucault 1997) which orients the pedagogical action for the education of human potential (Vygotskij 1987; Montessori 2007). Talent and Resilience are described by highlighting their multifactorial construct and their mutual influence (Cozolino 2008) which, within a systemic-ecological-social context (Bateson 1972; Bronfenbrenner 1979) founded on freedom of choices, contribute to generating Well-Being (Sen 1979) by promoting the values of justice and equity, improving the quality of life (Nussbaum 2007).

The HTR Model for Well-Being in Educating Community represented in Figure 1, recognizes Humor as a pedagogical device that jointly feeds both Talent and Resilience. This nourishment triggers a dynamic process between Talent and Resilience, of reciprocal and constant interdependence, of mutual positive contamination and in continuous evolution. This process is itself a "generator of Well-Being" but it will be able to fully convey its educational effectiveness only if it is supported by an Educating Community.

Specifically, the present theoretical model describes the constitutive characteristics of the pedagogical device of Humor and of the binomial Talent Resilience in their inter-poly-transdisciplinary dimensions (Morin 1999), in their generative potential for Well-Being and in their social connotations.

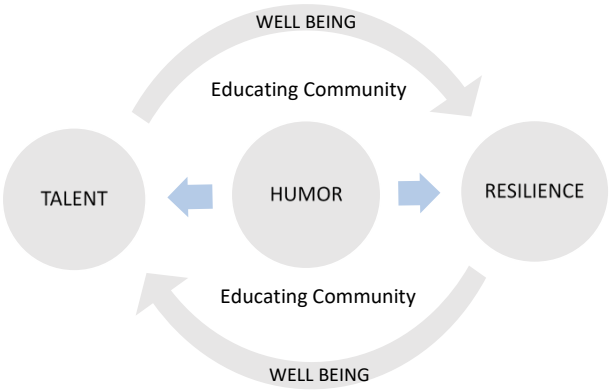

Figure 1. The HTR Model for Well-Being in Educating Community

Humor performs various social and pedagogical functions. Authors Ziv and Gadish (1990) investigated Humor among gifted adolescents and listed all the advantages that teachers can benefit from by using Humor as a teaching tool: reducing the psychological distance between teachers and students; creating a pleasant atmosphere in the classroom with the consequent lowering of psychological tension and conflict; promoting concentration and learning; strengthening the bonds of the group. By avoiding some expressions that offend and hurt (sarcasm and excessively ridiculous behavior), the pedagogical value of the humorous device in teaching/learning processes is easily understood due to its strategic function of enriching human potential, especially of gifted and talented students.

Nowadays, the Talent is described in its quantitative and qualitative connotation as a social product (cognitive, motor, psychological, anthropological), with some universal basic characteristics (biological, neurological and physiological endowment) but highly dependent on culture and experiential learning. In general, gifted and talented students show clearly superior performances to those of their peers already at an early age of development (Sternberg 2004) with strong asynchrony characterized by early and extensive language development, a high ability in abstract reasoning and problem solving, good and sustained attention span, broad interests and high levels of curiosity and intrinsic motivation to learn, intense reactions to frustration, high sensitivity and empathy, frequent use of fantasy and imagination and, in particular, a high sense of Humor.

Several studies (Pinderhughes, Zigler 1985) have confirmed that cognitive intelligence is related to a "sense of Humor". Thus, gifted and talented students have a high sense of Humor,

understand and appreciate jokes and other more complex forms of humorous stimuli, are able to make very advanced puns, witty ironic remarks and are able to use divergent thinking by capturing humorous aspects in critical and uncomfortable situations. This ability to interpret everyday experiences in a different way must be considered a resource, especially in the educational field, in order to use Humor as a valuable tool for the development of intellectual and creative potential. In this regard, Renzulli's theory of the three rings (2011) confirms the role of three central factors that foster talent: above-average cognitive abilities, creativity and the motivational characteristics of personalities that support commitment. The context plays an essential role in this theory as it is a background that supports, integrates and nourishes any expression of human potential.

Furthermore, the "sense of Humor" was identified by Pourtois *et al.* (2012) as one of the psychosocial needs among the major indicators of a resilient attitude. In fact, irony is primarily an attitude of the mind, a mode of consciousness, a highly evolved intellectual behavior. While the lack of an openness to irony is a characteristic of many psychopathological conditions as it denotes rigidity, lack of the versatility, restricted mentality and the inability of the subject to grasp the facets of the meanings and distance from itself, highlighting an excess of schematism and a propensity for dogmatism.

A concept of the psychology of emergency (Moran 2006) argues that it is not so much the things themselves that make us feel bad, but the way we perceive them. Therefore Humor, in its relationship with Resilience, offers itself as an effective resource for resizing the event that occurred and reacting more appropriately, since it allows to give alternative meanings to the stressful stimuli. In fact, the wittiest people are more able to enjoy the pleasant aspects of life and feel a sense of less suffering in the face of adversity. Like Talent, Resilience is also a complex construct, based on the interaction of biological, neurological, evolutionary, environmental and cultural factors. According to Rutter (2006) Resilience can be defined as a phenomenon manifested by subjects who carry out a good evolutionary path despite having experienced various forms of trauma, discomfort or stress that could have entailed a serious risk of negative consequences. In order to critically analyze Resilience in its educational forms, it is important to acquire a deconstructive pedagogical sight (Mariani 2008), through hermeneutic procedures of clarification, disambiguation, interpretation of that pedagogical value which, if correctly exercised, can contribute to enriching educational contexts.

In this regard, some authors (Cyrulnik, Malaguti 2005) have identified family and social protection factors (for example the possibility of having a "development tutor" with whom to establish a supportive relationship, a rich social network, a adequate school environment) which, by positively opposing to risk factors, play a decisive role in countering the negative effects of traumatic or stressful events. Furthermore, they identified some individual protection factors (for example, good intelligence, problem-solving-oriented coping, self-esteem, empathy). Among these factors, a fundamental one is knowing how to appreciate and

use the humorous approach in behavior, communication, relationships, situations. A good-humor base leads resilient people to appreciate and produce Humor, for the pleasure and Well-Being that it brings and for its power as a "social glue".

The relationship between Humor and Well-Being is very complex (Dijkstra *et al.* 2011) since Humor is a multidimensional phenomenon consisting of different aspects, uses and functions. Martin and his colleagues (2003) identified four styles of Humor. Two of these styles favor psychosocial Well-Being (affiliative and self-sustaining Humor), while the other two are dangerous and potentially deleterious (aggressive Humor and self-defeating Humor). Individuals who use affiliative and self-sustaining Humor reflect a generally positive outlook on life, a tendency to often be amused by life's inconsistencies and to maintain a humorous perspective even in spite of stress or adversity.

This type of Humor that generates Well-Being is expressed through the transmission "by contagion" of actions, emotions, moods. Some authors (Cozolino 2008) have shown that emotional states are transferred from one individual to another thanks to mirror neurons, involved in the perceptions of the emotions of others. Happy people naturally tend to be the center of their relational cluster, and this would confirm the role of evolution: since we are social animals, we put those who can bring us Well-Being at the center of our network. The conclusions are socially and pedagogically important, because they state that a key factor of our happiness is the happiness of those around us. Neuroscience, through the images obtained with new brain imaging techniques, has made it known that the structure of our brain makes it sociable, inevitably subject to a deep brain-brain bond every time we come into contact with another person. It follows that relationship's shape not only experience, but also biological functions, at the level of circuits and brain centers. It is clear that Well-Being arises from the result of the integration between the biological, psychic and social systems. Therefore, the pedagogy of talents (Falaschi 2019) invites us to focus on the Well-Being of the subject, in its entirety and in its relational networks, involving all the different social spheres in which it is inserted (Falaschi 2017).

Thus, the condition for the HTR Model for Well-Being to demonstrate its educational effectiveness is that it can be operated within an Educating Community, understood as a relational context that integrates and supports all the processes described by the Model. This social condition is necessary because gifted and talented students often report feelings of "high difference" arguing that the recognition of being gifted and talented interfered with full social acceptance implying that this situation can represent a social handicap. Some individuals have also stated that they hide or minimize their visibility as gifted students to others. In line with the true meaning of education, in order to provide equitable educational responses to diversity, it is necessary to provide all students with several and good opportunities on a cognitive, emotional and social plane, so that they can reach the maximum development of their potential.

The great Polish sociologist Bauman (2000) explores our current need of community, understood as an almost instinctual desire to recognize oneself and to belong to a community, to compensate for the underlying insecurity that is the paradigm of the globalized world. He argues that community membership is based on a mutually binding sentiment, the true and real strength that allows the citizens of the community to remain united despite the many factors of disintegration. Bauman recalls the concept of "hot circle" to identify the community in a sort of confident immersion in a world made of compactness and human solidarity, of pragmatic bonds of loyalty and fidelity that make "warm" the community circle.

In this direction and in the context of studies dedicated to situated learning and the enhancement of communities of practice (Lave, Wenger 1998), the concept of "resilient community" (Vanistendael, Lecomte 2000) can be interpreted as an educating and supporting community (which is recognized in the sense of belonging to the community, in the sharing of values and beliefs, in internal ties, in the construction of a collective identity, in social support) that constitutes an indispensable protective factor since it activates all the creative potentials and resources present in it. From an ecological perspective (Bronfenbrenner 1979), the assessment of the social resilience of a community must maintain a multidimensional and multi-professional approach (Milani, Ius 2010) and always place itself in different multi-perspective disciplinary levels (pedagogy, psychology, sociology, medicine).

3. Conclusions and discussion: three open reflections

The arguments presented to describe the HTR Model for Well-Being start from the assumption that a high sense of Humor is a "nourishing" characteristic of both Talent and Resilience and those are based on the demonstration that this combination is a "generator of Well-Being" that feeds itself. There are many contexts (and people) that represent the application of the HTR Model for Well-Being. Some examples: in the work (the charismatic founder of Apple, Steve Jobs), in the disability (the mathematician, physicist and cosmologist, Stephen Hawkins), in the children's literature (the swedish girl, Pippi Långstrump), in the animated films (the family members in *The Incredibles - A "normal" family of superheroes*). Humor (curiosity, optimism, smile) and Resilience (tenacity, flexibility, risk-taking) characterized these gifted and talented people, who have been able to express their high potential thanks to a state of Well-Being generated within their Educating Community. In compliance with the enhancement of all human potentials, the HTR Model for Well-Being suggests that teachers take the educational responsibility to offer teaching/learning contexts, understood as Educating Community within which the "humorous device" allows gifted and talented students to achieve their highest level of development.

However, three open questions remain. The first concerns the educational justice, the concept of equity of educational policies and practices aimed at respecting and enhancing all human potential, especially gifted and talented students'one. It is necessary to overcome a distorted conception of the term "equality" since it is not synonymous with "equity": the term equality (or inequality) simply describes a quantitative comparison, while the term equity (or inequity) refers to moral issues, the presence or absence of justice (Nussbaum 2007). Gifted and talented are generally denied educational justice if they fail to receive an education that adequately challenges them (Merry 2008). The core of the second reflection is addressed to the virtual educating (or dis-educating) community. An interesting research (Freeman 2016) examines the positive and negative implications, highlighting some possible effects of electronic social media on the intelligence and emotional development of gifted and talented. In particular, it emerges that social media have positive effects on the defense of talent, on the teaching/learning opportunities for exploration and research, but, at the same time, they imply the risk of encouraging superficial thinking and influencing negatively the personal relationships. Finally, the third reflection underlines the need for specific training for teachers and more opportunities for international discussion in the field of gifted and talented education. The question of "who should teach the gifted and talented" is still at the center of the pedagogical debate. Various studies (David 2011) investigate students' preferences for teachers behaviors. The qualities of teachers appreciated and considered effective by gifted students certainly refer to cognitive and intellectual traits (ability to successfully plan and implement differentiated lessons, apply critical thinking to problem solving) but pose much more importance to personal and social attributes (passionately loving teaching, being an interesting, enthusiastic, self-confident, friendly person, having a sense of humor).

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Analyzing the use of linking words in concept maps designed for pathophysiology learning in medicine

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Abstract
Pathophysiology at NOVA Medical School adopted the concept mapping methodology to promote the visual display of pathophysiological reasoning and learning, based on clinical vignettes. The objective of this project is to identify and label the linking words, in order to study their role in the structure and organization of the concept maps constructed by the students. We used an adopted classification of linking words, categorized in 5 groups: dynamic, static, illustrative, definition and clinical case information. At the end of the semester the concept maps related to the respiratory (mid-semester) and endocrine systems (end of semester) were analyzed and compared. We found linking words not included in any of the five categories, thus a group named "other" has been created. Statistically significant differences were found in dynamic and "other" categories (p=0,049 and p=0,011, respectively; Wilcoxon signed-rank test). The dynamic words were the most commonly used, probably reflecting students' need to better describe pathophysiological mechanisms, and the difference found was probably due an improvement in the learning process and concept maps building technic. It would be interesting next year to conduct a more detailed analysis, increasing the sample and ensuring a more robust dataset.

Keywords: *Concept maps; linking words; critical thinking; medical education; pathophysiology.*

1. Introduction

Pathophysiology teaching at NOVA Medical School (NMS) adopted the concept mapping methodology in 2002 (Rendas et al, 2006), to be used during the tutorial sessions, in order to promote the visual display of pathophysiological reasoning and learning, based on clinical vignettes. A concept map (CM) consists of nodes (conceptual words/phrases), connected by linking lines which are unidirectional arrows, with a linking word/phrase describing the semantic relationship between the nodes (Novak & Cañas, 2008). The use of linking words is one of the most important features of creating a concept map, since whatever linking words the student uses will change the relationship between the concepts and therefore the meaning portrayed on the map (Daley et al, 2016). In our case, the purpose is that these semantic relationships aim to reflect the understanding of mechanisms of disease, the pathophysiology, and their scientific fundamentals.

The objective of this project is to identify, and label, the linking words/phrases in order to study their role in the structure and organization of the CM. This approach was used for the first time in our curricula and started with developing a classification of the words/phrases in five groups, as will be described below, and analyzing their distribution and coherence in the maps.

This preliminary approach is part of our larger project aiming to develop a score methodology to assess concept maps in medical education, presented last year at HEAd'20 (Fonseca et al, 2020), wich did not address specifically the role of the linking words. In this context, we considered the use of appropriate linking words as an important scaffold to the display of the learning process and this facet was not considered in our initial classification. To reach this goal we opted to standardize the linking words and adopted the classification proposed by O'Donnell (O'Donnell et al, 2002), based on the main categories used by McCagg and Dansereau (McCagg & Dansereau, 1991). Furthermore, we added three new groups because of the context of medical education using clinical vignettes: *illustrative/examples*, *definitions* and *clinical case information*. This approach reflects our progressive awareness of the importance of using standardized steps inserted in the original methodology of concept mapping as proposed by Novak (Novak & Cañas, 2008) and Daley (Daley et al, 2016).

The purpose of this project is to analyze how linking word/phrases are applied during the construction of concept maps in the specific context of pathophysiology teaching and learning at NMS.

2. Material and Methods

2.1. General Information

The pathophysiology tutorial sessions are based on an organ/body system approach, covering five systems: digestion, respiration, circulation, renal and body fluids and endocrine (Fonseca et al, 2020), and lasts one semester of the second year of the curriculum. For each system, students received a clinical vignette (patient case) and eight mini-maps were constructed based on eight core concepts leading to the creation of a final CM (Figure 1). This report only addresses the analysis of two of the final CMs.

In the 2020-2021 academic year, the class was composed of 233 newly enrolled students, divided into 18 tutorial groups. Each tutorial group was attributed to one of the 14 pathophysiology tutors.

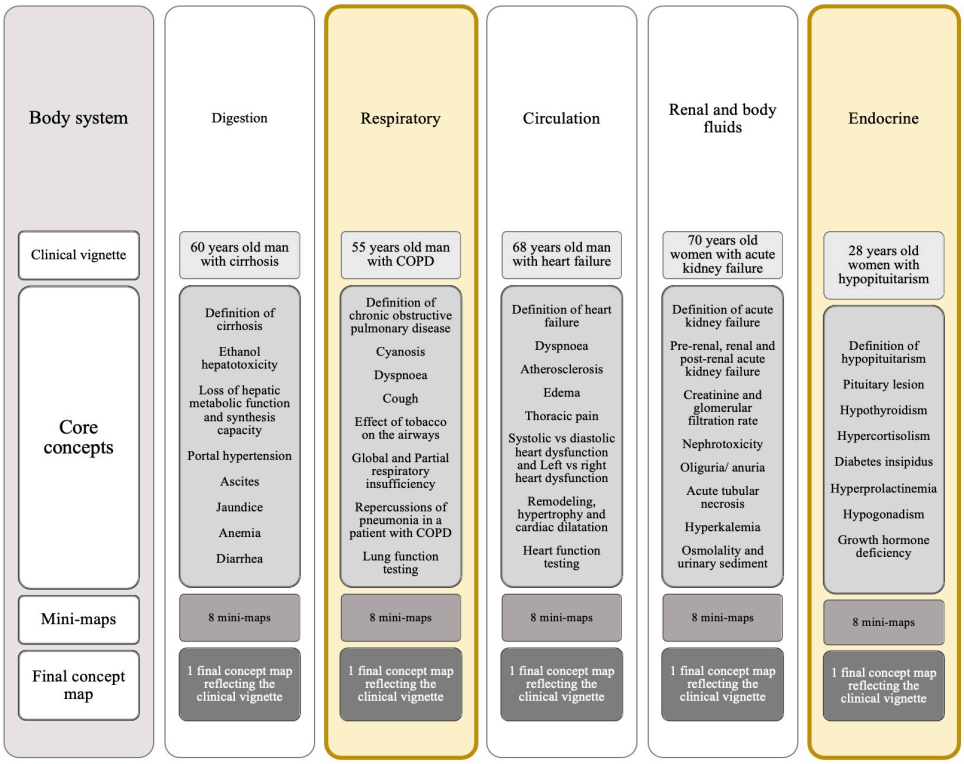

Figure 1. Organization of the pathophysiology tutorial sessions based on an organ/body system approach. For each system, students were asked to construct eight mini-maps, based on the identified core concepts, and a final concept map reflecting the clinical vignette. In this project we considered the respiratory and endocrine final concept maps. Source: the authors.

2.2. Concept maps' linking words in the 2020-2021 academic year

In the beginning of the current academic year, students were instructed to use a standardized group of linking words in the construction of their concept maps as stated in the introduction.

Our classification of the linking words (Table 1) was adopted from the work of O'Donnell (O'Donnell et al, 2002) as:

(i) *dynamic*: a link word/phrase, that represents a causal, a temporal, a quantified changing relation between nodes;

(ii) *static*, a link word/phrase, that represents a complementary or supplementary or clarifying relation between nodes with no direct cause-effect;

(iii) *illustrative*, a link word/phrase, that represents a single label connecting nodes;

(iv) *definition*, a link word/phrase, represents a consensual label, based on scientific knowledge connecting nodes;

(v) *clinical case information*, a word/phrase, that represents the information, displayed in the map which is provided in the clinical vignette.

Table 1. Classification and list of concept maps' linking words within each group.

Linking Words					
Dynamic		*Static*	*Illustrative*	*Definitions*	*Vignette information*
by means of causes compromises constrains culminates determines favors follow infuences	unhibits leads to promotes results in sequences stimulates though triggers	typifies includes characterizes charecterized by manifests itself present	analogies namely example dor example	is defined as	in the clinical case

At the end of the curricular unit, junior students from the third year of NMS, who had acted as mentors to assist the pathophysiology students in the construction of the maps, analyzed the final respiratory (mid-semester) and endocrine system CM (end of semester), by quantifying the linking words based on the above-mentioned classification. Their analysis was supervised by a senior student (final year), with a significant experience in scoring concept maps.

The prerequisites were as follows: only final CMs were analyzed, and students, juniors and senior, did not analyze the CMs they helped to construct.

2.3. Statistical analysis

An exploratory analysis of the linking words was carried out. The Wilcoxon signed-rank test was used to compare the number of linking words between final respiratory and endocrine system CMs constructed during the tutorial sessions, in each class. The level of significance considered was $\alpha = 0.05$. Data analysis was performed using STATA (StataCorp LP, Stata Statistical Software: Release 15; Texas, U.S.A.).

2.4. Pedagogical Council

These activities were approved by the Pedagogical Council of NMS, which is the board legally responsible for regulating all of the academic procedures. It also includes representatives of medical students.

3. Results

From the eighteen classes in the course, seventeen final CMs per body system were analyzed (one CM from a tutorial group was missed). Of these seventeen CMs per system, eight final respiratory and eight final endocrine systems CMs, belonging to the same tutorial groups, were analyzed. Table 2 presents the number of linking words found on each of the CMs, grouped into the five pre-specified categories (Table 1). In some CMs we found linking words that could not be included in any of the 5 categories, thus a group "other" has been created which should always be lower than the sum of the words from the five categories. Statistically significant differences were found in *dynamic* words and *other* categories (p=0,049 and p= 0,011, respectively; Wilcoxon signed-rank test).

The most commonly used words in both respiratory and endocrine system's CMs were *dynamic* words, with a median number of 60.5 (47.5; 79) and 77 (60; 94) words per CM, respectively. These were followed by *static* words (median 16 (12.5; 24.5) and 20 (10; 45)), *illustrative* words (median 6 (2; 8.5) and 4 (2.5; 12)) and *definitions* (median 2.5 (0.5; 6) and 2.5 (1; 6.5)).

4. Discussion and Conclusions

This work reflects the first analysis of our group performed on the CM's linking words. At the beginning of the semester, instructions were given to tutors and students with the list of linking words to use, as detailed in the body of this article. We found that, despite this preparation, a significant number of different words were used in all the CMs analyzed. This finding points to the need to further improve the initial list, reduce the heterogeneity of results between the tutors, and also to the potential benefit of dedicating more time in addressing the use of right terminology during the tutorial classes in the future academic years. This other category encompassed all the words that were not included in the pre-specified categories. It

is noteworthy that its use decreased from the respiratory to the endocrine system, which may reflect the impact of students' learning process translated in to a more careful and appropriate use of these words in the CMs.

Table 2. Number of linking words in the respiratory and endocrine final concept maps (per category).

	Concept map	Dynamic words (n)	Static words (n)	Illustrative words (n)	Definitions (n)	Vignette information (n)	Total (n)	Other (n)	Overall Total (n)*
Respiratory system	1	46	27	0	0	0	73	11	84
	2	58	13	0	1	36	108	37	145
	3	49	12	6	16	30	113	60	173
	4	44	22	10	5	16	97	12	109
	5	84	14	4	3	0	105	80	185
	6	63	9	6	7	18	103	37	140
	7	74	42	12	0	0	128	22	150
	8	89	18	7	2	0	116	81	197
	Total	*507*	*157*	*45*	*34*	*100*	*843*	*340*	*1183*
Endocrine system	1	78	44	2	8	12	144	2	146
	2	52	11	1	1	3	68	32	100
	3	98	20	13	15	18	164	34	198
	4	54	20	18	5	35	132	7	139
	5	155	46	11	2	0	214	73	287
	6	66	9	5	1	26	107	17	124
	7	76	47	3	1	0	127	15	142
	8	90	7	3	3	12	115	74	189
	Total	*669*	*204*	*56*	*36*	*106*	*1071*	*254*	*1325*
	p value[1]	0.049	0.361	0.528	0.943	0.618	0.049	0.011	0.652

[1] p value from the Wilcoxon signed-rank test (STATA 15).

* corresponds to the total sum of the *dynamic*, *static*, *illustrative*, *definitions*, *vignette information* and *other* linking words.

The selection of the eight final CMs per body system was made to avoid sample heterogeneity since, in the non-selected maps, the number of words in the *other* category exceeded the sum of the words used across the 5 pre-specified categories. This, once again, may reflect the need for further training of tutors to reduce their own heterogenous use of linking words, and for

increased attention to the correct use of pre-specified categories' words at the beginning of the curricular unit and during the whole semester.

Although the sample used was small, it was interesting to see that most of the words used are *dynamic*, and that their use has numerically increased ($p = 0.049$) from the respiratory map to the endocrine map (43% of the total overall in the respiratory and 51% in the endocrine). This fact may reflect students' need to use more of these words to better describe pathophysiological mechanisms, improving over the course of the semester due to the learning process for content and CM's building technic. The fact that these CMs are based on different pathologies (COPD and hypopituitarism, Figure 1), may also contribute for this difference. A numerical difference in the number of linking words used in both pathologies' CMs has been observed, althout it was not statistically significant (respiratory total = 1183, endocrine total = 1325; $p = 0.652$).

The difference found in the group *other* was statistically significant ($p = 0.011$), with a decrease in the use of these linking words from the respiratory to the endocrine system from 29% to 19%, respectively. This data may reflect more precision in its use, and a preference to use words from the pre-specified categories. Nevertheless, no detailed analysis was performed regarding the labelling of these *other* words according to our proposed classification. The linking words included in *statics*, *illustrations*, *definitions* and *vignette* categories were the least used and there were no significant differences in their use. Although less used, these words still were considered as being a structural part of the CM. Although there seems to be some preference in the use of *dynamic* words, all word's categories must be present in an CM. Their number and proportion still need to be further studied and evaluated in order to also be used as a potential parameter for a future scoring of CMs, a topic that our group has been actively working on.

It would be interesting next year, following more investment in training of tutors and students regarding the use of linking words, to conduct a more detailed analysis of all the CMs constructed by the students, increasing the sample and ensuring a more robust dataset.

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From Business Agile to Agile Education: a response to change in times of pandemic

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Abstract

The aim of this document is to present a new teaching model in higher education focus on the student. The model develops an iterative and incremental learning system based on the fundamentals of agility and the organization of agile work, improving learning performance and the benefit of students.

This model develops a system based on the Scrum methodology that allows continuous deliveries of value from the student to the teacher, adapted to the learning goals of the educational programs, approaching a cultural, organizational and structural change through the application of methods, Agile practices and dynamics within a framework that encourages innovation and continuous improvement of students.

Keywords: *Agile; higher education; scrum; innovation learning environments; teaching experience.*

1. Introduction and Background

The digital transformation and the increasing complexity of today's environments demand greater flexibility from all organizations that will adapt to an uncertain and increasingly volatile future. The relative effectiveness of current educational management and the demand for new competences for both students and teachers are the engine that must serve as the impetus for the transformation of teaching (Lembo and Vacca, 2012).

The University, due to its researcher character, is a source of novelty and, applying the basis of Agility to education implies formulating a new teaching model which puts the student in the center of the learning process, being quality the main axis thereof, from the beginning to the end of the training.

The objective of the model is a more efficient and effective learning, thus the design of the subjects by the teaching staff has been defined based on the organization of the Scrum work, so that the students develop teamwork skills, the motivation to learn and achieve better academic results (López-Alcarria *et al*., 2019).

The change means transforming the teacher-focused, individualistic and hierarchical education model through the master class, into a system with a more horizontal structure that allows continuous value delivery in an iterative and incremental way and in which teachers and students form a committed and cohesive team that shares common goals and values (Cathcart, *et al*., 2014). The team, following the Scrum´s style, become a project manager in which the objective of the final product is the learning of the students.

The theoretical foundations of the teaching-learning model take as reference the works of Salza *et al*., (2019), Stewart *et al*., (2009); Krehbiel *et al*., (2017) regarding the application of agile principles related to teamwork, transparency and communication, generating a change in the way that students acquire knowledge. In this way, a new work model is generated in which teachers actively collaborate with students sharing their knowledge, so that they develop certain valuable deliverables that reflect their learning in continuous cycles.

One of the supports of the model is the management of people as a source of agility. It is important to empower and involve students in their learning process to generate a motivating environment that encourages commitment, responsibility, collaboration and confidence, and that reveals the curiosity and creativity that will lead to improved results in the subjects.

The course is developed through a collaborative and cohesive team of students and teachers in a Scrum style, which can become a project manager and in which the objective of the final product is student learning. Student teams are structured and empowered so that they can self-manage their own work. They plan and determine their own activities and track progress. The teacher acquires a role of facilitator determining the assignments of activities, training and advising so that the students can achieve the objectives and overcome the subject.

Inspection, adaptation and transparency are key tools to achieve continuous improvement. Inspection manifests itself in mechanisms to examine the work that students are doing and especially how they are doing it. And adaptation is what will allow the student team to make decisions and take actions that improve results. There must be a clear communication that ensures that all the changes that are made are transparent, visible, understandable by the team and useful, in such a way that the quality of the results increases.

An incremental approach makes the students' knowledge build from its foundations, progressively, and in detail. The iterative approach means that in the short cycles the students deliver activities or completed tasks, to which already acquired knowledge is added.

2. Model Design and Methodology

To implement the model in the classrooms, a Scrum-based model is applied that allows adaptability, flexibility and innovation in any subject, it is even adaptable to adverse situations that require drastic changes in the way the subject is taught. This model is especially important not only in current situations such as pandemic, but in all situations that imply changes in methodologies, forms and tools of work.

The teaching model based on Scrum was implemented in the subjects of Project Management of the degrees in Science, Management and Service Engineering: Business Administration in the Digital Environment as well as in the degree of Architecture of the Rey Juan Carlos University.

The application of the model requires the definition of different roles, being the main ones:

- The Developers are teams of students who must create a plan for the Sprint. This will be developed through practices or tasks that the teacher can establish or leave to the free choice of the teams so that they can adapt their plan orienting it to the objective of the Sprint in a creative way. Student teams are self-managing, that is, they decide internally who does what, when and how. They are responsible for creating a valuable and useful Increment in each Sprint.
- The Scrum Master as teacher is responsible for establishing Scrum by helping students understand the theory and practice of both Scrum and the contents of the subject. The method used was the recording of training pills of the contents of the syllabus and associated deliverables according to the requirements in terms of skills and competencies to be acquired. The teacher should help student teams to focus on creating high-value Increments that meet the definition of Done (that is, the team deliverable demonstrates that knowledge has actually been acquired). The teacher must eliminate the impediments to the progress of the students, guiding and training the students, solving doubts and clearly explaining the objectives so that the students

understand how far they have to go to achieve a Finished Increment. For this, weekly remote work sessions were carried out through Blackboard Colaborate and Mural with the developers

On the other hand, the events are presented. The main ones are:

- The Sprint, of fixed duration and established by the teacher, determined by the teaching time for each of the lessons. In them the student teams develop certain tasks that comply the Sprint Objective. If Sprints are short, more learning cycles are generated, and the risk of misguided effort is limited to a shorter period of time. Each Sprint is considered a short project that teams have to carry out in collaboration with the teacher. In each of the sprints, a deliverable is finished that allows to place value on new skills and competences regarding the previous sprint.
- The Sprint Planning establishes the work to be done in the Sprint, and is created by the Developers. The teacher explains to the students how the activities or deliverables that finish in the Sprint have to be worthwhile and useful to the Sprint learning goal. Developers plan the work required to create an Increment that meets the Definition of Done. How to do it is at the sole discretion of the student teams. No one else tells them how to convert Product Backlog items into Value Increments, as the teacher is only there to guide. In the sprint planning the develpers will add their own user stories to those of the teacher and stakeholders in order to create the increment. In addition, the teams are given the planning poket cards and they are instructed in the use and analysis of the progress graphs.
- The Daily Scrum is a short meeting that is held between student teams to inspect progress toward the Sprint Goal and adapt the Sprint Backlog as needed. The Scrum Master can attend at any of these meetings if is actively working with student teams or have doubts about the Sprint Goal.
- The Sprint Review has the purpose of inspecting or evaluating the result of the Sprint. The student team present the results of their work to the teacher and the progress towards the final goal of the subject is discussed. What has been achieved by the students is reviewed and together with the teacher it is determined what to do or how to move forward next. During the implementation in the classroom, the teacher has met with all the teams in each of the sprint reviews.
- In the Sprint Retrospective the student team inspects how their last Sprint was with respect to people, interactions, processes, tools, and their Definition of Done. The assumptions that led them astray are identified and their origins explored. Developers must identify the most useful changes to improve their efficiency toward achieving the next Sprint Goal. Templates were provided to the teams to guide the process and structure continuous improvement in the process to instruct the effective use of retrospectives.

Moreover, the model describes some Scrum artifacts such as:

- The Product Backlog, where student teams must acquire, develop and demonstrate specific iterative knowledge, which at the end of the course will make up in a single document that will contain all the learnings from each Sprint. In this way the Product Backlog is an arranged list of what students need to learn to complete the course. The product backlog at least is defined by the set of competencies and skills necessary to pass the subject defined in the official memory of the degree.
- The Sprint Backlog is formed by the Sprint Objective (why) communicated by the teacher, the Product Backlog elements selected for the Sprint (what) also established by the teacher, and an action plan to deliver, the Increment (how) which is developed by student teams.
- The Increment is a concrete advance towards the total learning that students must have gained at the end of the subject. Each Increment is added to the previous deliverable as continuous evaluation. In this way, little by little, the final project that will demonstrate what the student teams have learned is built.

3. Result and Conclusions

3.1. Result

To measure the effect of the implementation of the teaching model based on Scrum, we have proceeded to analyze both the results in terms of qualifications and the evaluation rubrics of the teaching staff. First, we address student outcomes. An analysis of the qualifications indicates better results of the students in learning in terms of qualification since in the academic year 2020/2021 in a pandemic situation and with the methodological change, no students abandoned the course or failed compared to the 2019/2020 academic year in which 0.08% abandoned and 0.04% suspended. On the other hand, regarding those who obtained "Pass" and "Good" marks, while in the academic year 2019/2020 were 43.47% and 43.47% respectively, in the 2020/2021 only 19.63% passed the subject, being an 84.37% those who obtained a qualification of "Good".

Second, we undertake a comparative analysis of the students' responses to the teachers' evaluations in the last two years for the subjects being implemented. It is necessary to indicate that the evaluation of the students is from 0 to 5 points for each of the items surveyed. Specifically, regarding the evaluation of the students according to the rubics of the evaluation of the University teaching staff in the last two and that are shown in table 1, it is necessary to state that the professor 1 teaches in online degrees and the professor 2 in in-site degrees, being all the subjects of the first semester. The current pandemic situation and the lockdowns in Spain began in March, so the teaching of the year 2019/2020 was developed according to

the original modality and the teaching in the academic year 2020/2021 for the classroom subjects were developed in a model hybrid (on-site/online).

Table 1. Student Assessment.

Academic Course	Professor 1		Professor 2		Δ Medio
	20/21	19/20	20/21	19/20	
Planning and Organizing the subject					
Know the syllabus, competencies and skills	4,4	3,4	4,9	3,5	1,2
Reporting evaluation criteria	4,1	3,2	4,9	3,7	1,05
Compliance with formal obligations					
Communication and tutorship	4,2	3,4	4,9	4,2	1,5
Teacher availability	4,3	3,2	4,8	4,2	0,85
Adjust teaching activities to specific goals, content and methodologies	4,3	3,3	4,8	3,8	1,0
Adjusted assessment	4,3	3,3	4,9	3,8	1,05
Teaching methodology					
Clears up doubts adequately about the proposed activities	4,2	3,1	4,7	4,2	0,8
Use material that makes learning easier	4	3,2	4,9	4,2	0,75
The development of the subject allows a proper follow-up and learning	4,1	2,9	4,9	3,8	1,15
OVERALL RATING	**4,2**	**3,1**	**4,8**	**4,0**	**0,95**

Source: own elaboration

The results of the comparative analysis indicate an incremental improvement in all the items around one point, being in the case of the in-site modality (reflected in teacher 2) even greater. These results not only indicate the adequacy of the methodology to student learning, but also value its implementation in the current pandemic situation. The methodological change developed by innovation of the teaching team also allows us to affirm that the change in the teaching approach for an adaptation of the teaching has had greater effects in the in-site modality than in the online modality.

3.2. Conclusions

In conclusion, we can establish that once the model is implemented in the educational service, students get involved in real projects that provide them new social, professional and personal

skills. In this way, student teams practice active listening, respect, sincerity, analytical, critical and communication skills. Orienting teams of students to a specific goal through a quality final project, activates their motivation to learn and move forward with the syllabus in order to apply the knowledges in each Sprint developing high-value Increments. Besides to acquiring learnings in a dynamic and practical way, they do it more quickly and efficiently, therefore, the academic results are better.

In a nutshell, the teaching model based on business agility for the development of products and services is applicable to the educational context, enabling the necessary change and transformation driven by the current era of pandemic in which we have had to reinvent teaching to new contexts and collaborative and remote work methodologies.

The results obtained allow us to conclude that the application of Scrum in the non-software educational field is adequate, substantially increasing the learning results of the students and the assessment of teaching both online and in-site, but having a greater effect in the case of adapting teaching to the hybrid model in a pandemic situation.

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Autonomy in language learning: a case study with Italian as a second language

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Abstract

The aim of this paper is to investigate the development of autonomy in learning Italian as a second language (L2).

The analysis is based on the experience of the language advisor of the "Centro per l'Autoapprendimento" (CAP) of the Università Cattolica del Sacro Cuore (Milan) with sixteen foreign students.

In the introduction, the usefulness of university self-access centres (SAC) is briefly introduced, and the CAP is presented. The second part of the article concerns one of the case studies on sixteen foreign university students who participated in a didactic project on the development of the oral production skill that introduced them to the CAP, the language advisor, and the concept of autonomy in learning Italian.

The project ended with a final self-assessment questionnaire that allowed the learners to understand their strengths and weaknesses, and enabled the language advisor to verify the effectiveness of the activity.

Keywords: *Autonomy in language learning; Italian as a second language; language advising.*

1. Introduction

Autonomy in language learning is a widely studied concept and today represents one of the most discussed topics regarding new teaching methodologies (Benson, 2006). There is a growing trend that aims to promote the development of autonomy in school and university language courses (Hobbs & Dofs, 2017); this trend is evident from the fact that the learning to learn competence is one of the eight key competences of the European Reference Framework of Key Competences for Lifelong Learning1. Consequently, many universities, in Italy and abroad have already set up self-access centres (SAC) to promote autonomy in language study programmes2, and others are in the process of doing so (Choi, 2017). In the SACs, not only students can learn the most appropriate strategies to acquire or improve their language skills, but they can also take advantage of support activities for language courses, which consider the needs, rhythms and times of each student. It could be said that SACs have the function of integrating language learning with autonomous learning, allowing those who use them to improve both language and autonomy skills, providing adequate resources and ensuring the necessary support for learning (Reinders & Lázaro, 2007).

In the Italian context, among the potential users of university SACs there is a growing number of international students, to whom the attention of this paper is directed. As is common knowledge, there are more and more students involved in international mobility programmes, for example foreign students enrolled in undergraduate and master's degree courses or doctoral schools, or foreign students enrolled in double degree courses or participants in projects such as *Marco Polo* or *Erasmus*. This article deals with a case study carried out at the SAC of the Università Cattolica del Sacro Cuore (Milan), the *Centro per l'Autoapprendimento* (CAP), which involved sixteen foreign students.

The premise from which to start is that the development of autonomy in learning is useful for the growth of the person and for the development of multilingual competence, and this presupposes a high degree of maturity, awareness and responsibility in students—qualities that the University has to promote as an educational institution.

In this article, which is actually part of a broader study, a didactic project is described which involved an introductory path for the development of autonomy in learning Italian. In particular, the above-mentioned sixteen foreign students were offered an activity consisting of a cycle of meetings with the language advisor of Italian for foreigners of the CAP, aimed at preparing an oral presentation in Italian on a topic inherent to their specific academic

[1]For more information about the Eight Competences visit: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2018.189.01.0001.01.ENG&toc=OJ:C:2018:189:TOC (Last accessed: 21/02/2021).

[2]For further information and ongoing projects about university SACs visit: ALMS – Autonomous Language Learning Modules at the University of Helsinki (Last accessed: 11/05/2021).

training. With this activity, the advisor aimed to introduce international learners to the CAP and encourage autonomous learning and, at the same time, to promote the development of their oral production skills in Italian. The activity proposed to non-Italian-speaking learners is commented on through the analysis of the data collected through self-assessment questionnaires.

The final reflection includes a comment on the effectiveness of the project carried out, the effective role that the CAP has for international users, the results produced by the activities conceived by the language advisor and how it can still be improved in order to propose good practices useful for the development of autonomy in learning Italian as L2 in a university context.

2. Methodology

The methodology used in this research paper is the case study. In fact, it started with the observation of international learners of Italian L2 at the CAP, during the first semester of the academic year 2018/19, with the collection of data through questionnaires. In total, sixteen learners were involved, none of whom had any previous experience in the field of autonomy in language learning, and the language used was exclusively Italian. These were students attending two master's degree courses (Master in International Marketing Management and Master in Luxury goods Management) with extremely heterogeneous levels of knowledge of the Italian language (from A1 to B2 of the Common European Framework of Reference for Languages — CEFR). The master's degree courses are taught exclusively in English and, consequently, international students never have the opportunity to interact in Italian during the lessons. The only opportunity these students have to practice the Italian language at the University is provided by the Italian course[3].

The objective of this study was therefore on the one hand to promote the development of autonomy in learning Italian L2 by encouraging the students to attend the CAP, stimulating them to linguistic and metacognitive reflection, and on the other hand to help the students to be able to express themselves in Italian without fear of being judged.

We tried to find answers to the following questions:

1. How can international students approach the development of autonomy in language learning?
2. Can a path that provides the gradual approach of students to language advising be effective?

[3]All the students attended an Italian course with a teacher who proved to be very willing to contribute to the success of the didactic project described in this article.

3. What are the major difficulties that an international learner can identify in exercising his oral skills?

In order to try to answer these questions, the language advisor organized some meetings at the CAP in which, with her support, the learners participated and prepared an oral presentation in Italian to be presented to their classmates and the Italian teacher at the end of the learning stage.

We used one tool to evaluate the work done. It was a self-assessment form prepared by the language advisor so that the students' opinions about their presentations would be as objective as possible. It was decided to record the students' presentations and thus give them the opportunity to listen to themselves again and to self-evaluate: the purpose was to enable the students to reflect on their mistakes in order to stimulate the critical spirit and awareness of the level of preparation achieved, consequently encouraging also the development of autonomy. Needless to say, the self-assessment phase is absolutely essential for the ultimate pedagogical purpose that is autonomy in learning. The self-assessment form contained eleven sentences (for example: *I presented exactly the contents I had prepared*; *The grammatical structures were correct*; *The vocabulary was rich and appropriate*; *I am satisfied with my explanation in all respects*) to be evaluated on a scale that went from "not at all" to "a lot". It also allowed a reflection on the activity (*Did I like the activity? What kind of criticalities did I encounter?*), on the language learning path (*Was the activity useful for learning the Italian language? In which aspects of the language have I improved? And in which aspects would I still like to improve?*) and on the relationship with the language advisor (*Do I consider the activity carried out with the language advisor useful?*). The questionnaires were useful tools for evaluating the work carried out, and thanks to them it was possible to identify the strengths of the didactic project, define the task of the language advisor and highlight the critical issues and the greatest and most frequent difficulties encountered by the users, and suggest some ways to resolve them.

3. Data collection and analysis

The topics chosen by the students for the Italian presentations varied according to the fields of study and the level of knowledge of the language. Clearly, for students whose level was very low (A1-A2 of the CEFR), an easy topic was chosen, in agreement with the language advisor.

A very important aspect is that the activity was optional, not mandatory. Having established the themes and dates of the language advice sessions at the CAP, we specified that these were not mandatory either.

During the first session, the CAP was presented with its materials and digital resources; the didactic project was explained again, and examples of sources considered "authoritative" and

valid to be used for research at university level were shown. In addition to the presentation of the sources, a reflection was started on the linguistic weaknesses of each learner. From the first session, all the students managed to prepare a presentation schedule, despite the difficulties (*"it is difficult, but it is useful"*)—which were certainly due to the fact that they were not used to speaking in Italian. Some students found the activity *"moderately difficult",* some for the terminology, others for the oral interaction: *"Medium difficulty. The complexity is finding the right words in Italian".*

As we have already mentioned, the didactic project was designed precisely to stimulate learners not only to use the CAP materials and to discover the development of autonomy in learning, but also to allow students to practice their oral skills. The fact that many had reported great difficulty in expressing themselves in Italian (at least initially) led the advisor to reflect and, above all, prompted further dialogue with the students and among the students themselves to help them find solutions.

During the following advising session, the learners searched for videos in Italian on the chosen topic, to give them greater confidence with the subject and to learn new terms in Italian. Finally, during the last session, the students were asked to work in pairs to repeat their own presentations and listen to those of their classmates with the aim of developing both comprehension and speaking skills. The comparison activity between students seems to have been useful:

"It was difficult, but it is a useful activity because I learned lot of Italian words and I met new people".
"It is a bit difficult, but I found the whole project very useful. There are many useful materials for my study. It was useful to talk about the project with Emma because now I am less afraid of making mistakes".

The goal was to reassure students about the work done and to encourage them with regard to the presentation. On the day of the presentation, only 13 out of 16 students wanted to present their work to the class, although all of them had attended the advising sessions at the CAP. The presentations were recorded, and the students were asked to listen to themselves so that they could assess their own presentations.

Table 1 shows the data relating to student self-assessments. The main problem is related to nervousness: only 14% of the students felt "quite" or "very" relaxed during the presentation. Another issue to be noted concerns the correctness of grammatical structures: only 15% of students declared they were "very" satisfied after listening to their own recording.

Table 1. Students' self-assessments

	NO ANSWER	NOT AT ALL	A LITTLE	QUITE	VERY
I presented exactly the contents I had prepared	0%	7%	15%	53%	23%
I remembered everything I wanted to say	0%	7%	38%	38%	15%
I was relaxed	0%	38%	46%	7%	7%
My posture was correct for a presentation of this type	7%	0%	7%	69%	15%
My explanation was developed with a logical and coherent sequence	0%	0%	15%	31%	53%
I expressed the concepts clearly	0%	7%	31%	46%	15%
The grammatical structures were correct	0%	15%	46%	23%	15%
My pronunciation was good	7%	0%	46%	38%	15%
The lexicon was rich and appropriate	0%	15%	23%	53%	7%
My voice was calm and the volume was adequate	0%	7%	15%	53%	23%
I am satisfied with my account in all respects	7%	7%	23%	61%	0%

Table 1 demonstrates that the future work of the language advisor should aim to make students feel comfortable and confident in their abilities both at the CAP and in the classroom. Despite the difficulties due to the impact with the audience, formed by classmates and the teacher, the activity was appreciated by all students, in particular the opportunities to "*learn something new from the presentations of classmates*" and "*learn to overcome the fear of speaking Italian in front of other people*". One student admitted that she had worked on "emotion control" and had learned how to manage her emotions for presentation. Another student appreciated the work of the language advisor at the CAP as "*we found the best teaching approach for the group*". The main difficulty was remembering the new terms they had learned and concentrating on the grammatical structures while speaking; one student highlighted the "*transition from written text to oral text*" among the difficulties; however, those difficulties were the aspects of the language in which all students felt they had improved thanks to the project.

The contribution of the language advisor to the activity was defined as useful for helping in the organization of the presentation, correcting grammatical errors and finding suitable sources. Two students reported that the activity was not profitable for the purpose of learning Italian and three did not consider the activity with the language advisor to have been useful. Among the aspects of the language to be improved, oral skills are still significant, followed by "*grammar (verbs and connectives)*", "*vocabulary*" and "*sentence structure*".

Overall, the project proved to be effective both for learning Italian and for introducing the functions of the CAP and discovering the figure of the language advisor. The students who had identified weaknesses in oral production during the first session at the CAP have—through practice—learned to overcome their fear of presenting in Italian, thanks to this language advising activity.

4. Conclusion

This article aimed to demonstrate how a group of international students could be helped to be more autonomous learners of Italian L2 through a didactic project, the purpose of which was the development of oral skills through the discovery of the figure of the language advisor, the CAP and its materials.

Reflecting on the real effectiveness of the advising sessions, it appears that, during the meetings at the CAP, numerous learning strategies were developed through talking to the advisor and peers regarding the search for sources, the passage from written to oral text and the organization of the speech. The project therefore brought various benefits to the learners: firstly, by improving lexical and specialist vocabulary skills in L2 and developing oral skills, and secondly, it encouraged students to reflect on their knowledge of Italian and on what they would still like to improve, trying to find the tools suited to their needs, independently or with the help of the language advisor. At the CAP, the learners felt free to express their concerns without fear of being judged. Working with the language advisor, the students learned to ask questions, seize opportunities to clarify doubts, practice the language, manage their time more effectively and consult resources they did not know existed. Thanks to the self-assessment questionnaires, the need to investigate aspects of the language emerged which, in some cases, were subsequently taken up in the classroom by the Italian teacher.

Clearly, also critical issues emerged from such a project. The greatest was undoubtedly the difficulty encountered by learners with level A1-A2 of the CEFR; for these students, such an activity turned out to be very difficult. With regard to any further projects, it would be advisable not only to simplify the topics chosen for the presentation, but also to organize advising sessions and didactic activities exclusively for these students. That said, the greatest difficulty for all levels was practising the ability to speak, as seen from the analysis of the questionnaires; however, despite this difficulty, the activities of the project were appreciated

as, albeit not mandatory, all students participated in the meetings organized at the CAP and 81% presented the work to the rest of the class and to the Italian L2 teacher.

New proposals could be made to improve the language learning advising service at the university; for example, preliminary advising sessions could be organised to introduce the theme of the development of autonomy: raising awareness among students about the importance of becoming autonomous learners could be the first step towards more effective and lifelong learning.

A final consideration concerns the moment of uncertainty and change that we are experiencing; it will certainly be necessary to continue the research in the field of autonomy, in the light of the new educational needs, such as rethinking ways to make language advising effective for online learning.

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Curriculum transformation to address the Sustainable Development Goals: A holistic approach for embedding gender in higher education

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Abstract

To better prepare a new generation of practitioners and thought leaders to meet the complex challenges highlighted in the sustainable development goals (SDGs), innovation is needed in the design and delivery of degree programmes. Gender inclusion and diversity are increasingly recognised as key tenets of Education for Sustainable Development. Energy access education in Africa provides an excellent context in which to explore ways of delivering gender inclusive Masters programmes and the curriculum transformations needed to address the dual challenges of SDG7 (energy access) and SDG 5 (gender equality). This paper explores the evolving context of gender mainstreaming in energy access education at Institutions of Higher Learning (IHLs) in Africa, drawing on a desktop study and interviews with 8 African Universities in the Transforming Energy Access Learning Partnership (TEA-LP). The paper calls for the adoption of a more holistic approach to mainstreaming gender in energy access education at IHLs, encompassing curriculum content, teaching methods, learning environments and the broader institutional enabling environment.

Keywords: *University; curriculum development; gender; inequality; pedagogy; teaching environment.*

1. Introduction

In response to the 2030 Agenda for Sustainable Development, Education for Sustainable development (ESD) has gained traction in the international development arena as a way of advancing the sustainable development goals (SDGs). ESD seeks to provide 'the knowledge, skills, attitudes and values' needed to achieve the SDGs (Leicht et al., 2018: 35). Institutions of Higher Learning (IHLs) have a key role in driving EDS in teaching and learning, research and development and within university governance and operations (Nhamo & Mjimba, 2019). Gender equality and the empowerment of women and girls (SDG 5) is needed to effectively respond to the challenges underlying the SDGs. Concurrently, there is an impetus to mainstream gender in IHLs, to advance ESD through equality in the learning environment and excellence in education regardless of gender, social status or ethnicity (Kahamba et al., 2017). The confluence of these interlinked global imperatives provides an opportunity to critically re-think models of higher education to prepare graduates with the skills, competencies and values needed to drive societal change (Michelsen & Wells, 2017).

Education for SDG 7 (universal access to energy) provides an excellent context for exploring the transformations needed to address the energy access challenges on the African continent. Sub-Saharan Africa has the lowest energy access rates, and gender inequality in energy access *and* higher education is stifling progress towards achieving the SDGs. Masters programmes in renewable energy and energy access specialisations can instill in graduates critical skills and competencies required to transform energy access in their countries and beyond (Golba et al., 2015). Furthermore, access to these programmes is critical for improving women's engagement in the energy sector (IRENA, 2019). Gender inclusion and diversity thus underlies comprehensive energy access education because (i) women and men require equal access to education and training in energy; and (ii) curricula need to reflect gender needs of this dynamic sector in content and teaching methods (Pailman et al., 2020). The practice of achieving this remains largely unaddressed. Utilising a case study of the eight African universities that comprise the Transforming Energy Access Learning Partnership (TEA-LP), this study sought to answer the following research questions: *1. How is (energy) academia gendered in Africa? and 2. What transformations are needed to become more responsive to sector needs?* Identifying urgent changes required in *cultures of teaching and learning*, *curriculum content and pedagogy, and institutional enabling environments,* this paper proposes a holistic approach for achieving gender equal ESD for SDG7.

2. Methods

This paper draws on a desktop study and empirical data from 16 semi-structured interviews with course convenors and lecturers (11males, 8 females) from eight African universities in the TEA-LP, conducted during a workshop in February 2020 in Addis Ababa. The TEA-LP

provides support to universities in Kenya, Ethiopia, Nigeria, Lesotho, Malawi, Uganda and Cameroon (with a Pan-African footprint) to develop energy access courses for Master's degree programmes (See: https://tea-lp.org). The interviews, which serve as a baseline and snapshot of individual university contexts, were transcribed, coded and thematically analysed in NVivo 12. Using both inductive and deductive coding techniques, themes explored include: championing gender awareness at a departmental level, gender and course enrolment, gender in the curriculum and pedagogy, gender roles in society and perceptions about energy professions.

3. Findings

While there are many factors that shape energy access education, this paper identifies three key interlinked dimensions to consider in the design and delivery of gender inclusive and responsive Masters programmes. These are: (i) cultures of teaching and learning, (ii) societal perceptions, norms and roles and (iii) curriculum content and pedagogy. Cultures of teaching learning are influenced by broader societal norms and values, which informs curriculum content and the learning experience (Figure 1). Universities are indeed microcosms of society, reflecting societal values, whilst shaping their own institutional identities (Kahamba et al., 2017). These dimensions are discussed below.

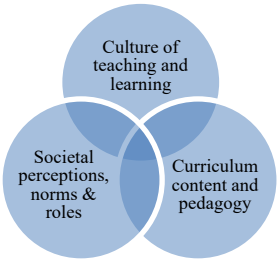

Figure 1: dimensions of energy access education

3.1. Cultures of teaching and learning – a need for multi-disciplinarity and diversity

In energy access education, 'cultures' of teaching and learning can serve as a departure point to explore the factors that shape the gendered experiences of students and staff in university departments. Energy-related Masters programmes are often housed within engineering departments, and students and staff are affected by the prevailing departmental culture.

Despite progress towards gender inclusive education, a 'technical' engineering culture remains prevalent in engineering education, which is often male dominated and lacking diversity (Carberry & Baker, 2017; Ihsen, 2005). This influences notions of 'who engineers are', 'what engineers do' and 'whose knowledge counts' (Godfrey, 2003), which impacts identity, belonging and ability to connect with the degree programmes (Ihsen 2005; Carberry

& Baker, 2017). In response, Ihsen (2005) calls for diversity (e.g. gender, cultural, and socio-economic) and the inclusion of non-technical competencies in engineering education. Crucially, more women pursue engineering specialisations that have a clear social and environmental benefit (Du & Kolmos, 2009), which provides an important entry point into energy access programmes.

While technical competencies remain essential to the design and development of energy technologies and systems, a purely 'technical culture' in departments does not produce the full range of competencies required by energy professionals to respond to SDG 7 (Golba et al., 2015). Energy Masters programmes need to incorporate, amongst other, social, environmental and economic perspectives as well as soft skills (Perdue, 2020). All interviewees emphasised the role of multi-disciplinarity and systems thinking for their degree programmes and advancing energy access. This can also attract students from disciplines outside engineering.

> One of the challenges that we repeatedly face is a lack of a systems thinking approach, people are looking at problems from one dimension, but it has multiple dimensions, and if you able to look at it from multiple dimensions you are able to generate a solution that is relevant and sustainable (SS1, female).

Furthermore, interviewees felt that technology needs to be connected to its broader purpose:

> Energy access and sustainability is basically talking to the consumer and our multi-disciplinary programmes, for example, entrepreneurship and business model(s), project management and finance, we also have community mobilisation, these courses give life to the technical competencies and the ultimate focus is commercialisation, that is what will enhance access and sustainability (BM1, male).

Thus, a joint focus on changing teaching and learning cultures within departments, as well as adopting a systems approach in education that has a clear societal and environmental benefit, can alleviate gender inequality.

3.2. Societal perceptions, norms and roles – navigating gendered expectations of female graduates and accommodating women in IHLs

In addition to the cultures of teaching and learning at departmental level that affect gender equality in energy access education, prevalent societal norms and beliefs about women and men in engineering and energy professions were strongly expressed in the interviews:

> There are lot of people who would be telling you, that's a male career (SSI, female).

> There is a perception that engineering is meant for mainly the male because they deal with machines and heavy equipment…we don't really stress activity women have done in the engineering (RU2, male).

Furthermore, perceptions about domestic roles and expectations affect women in IHLs. Female academic staff and post-graduate students play multiple roles as academics, students and caregivers. While some universities have measures in place to cater for female staff and post-graduate students with young children, university structures often do not fully cater for their practical needs. Several interviewees concurred:

> The ladies who joined the Engineering school are very brilliant in terms of skill…, (they) topped our class and later go on to very brilliant careers…It's not that in terms of ability they are unable, it's just that the societal demands that later come up either when they get married, or as they get into more responsibilities, tend to take them away from the STEM issues. Also, the big demands in terms of travel, fieldwork also take a toll (JS2,male).

> There must be something that is hindering women, maybe from the social perspective.., for instance after undergraduate (studies) women go into many other roles including starting up a family and when you start up a family there are certain things you will not do as a woman, because when the children are there you are expected to give up your career for the family, (more) than the man would be expected (CG1, female).

An urgent change in attitude is needed that recognises the place and contributions women in the energy access sector, as engineers and energy professionals, and is cognizant of women's professional and reproductive burden. Rather women should be fully supported to navigate professional and personal domains and identities during and after their studies. At a practical level, gender-appropriate support is needed to attract female students and enable them to complete their studies. This could include childcare facilities for post-graduate students with young children or suitable accommodation to students with young families, and consideration of their needs in fieldwork and travel commitments.

3.3.Gender mainstreaming in the curriculum and classroom

The curriculum itself is an essential dimension of energy access education, and requires a holistic approach that integrates gender in learning outcomes, content, teaching methods and style, learning environment and assessments (Roberts & Moxham, 1995). Curriculum development must cater for male and female students, interactions between genders, the gendered motivations and experiences of students in their understanding of technology and the ultimate societal impact the curriculum sets to achieve (Ihsen, 2005).

Furthermore curricula need to be revised for gender-biased messages. As Grunberg (2011: 7) argues, curricula are not neutral, but 'always serve as a means of social control, legitimating existing social relations, representing somebody's version of what constitutes important knowledge'. A curriculum can thus either entrench existing gender stereotypes, biases or norms or be used as a tool for transformation. This study found that this gender bias remains prevalent in engineering materials, and one interviewee noted:

> Looking at …the examples you might have, it's very masculine. You have to now develop …your examples with this at the back of your mind. Saying there is a gender aspect involved, how do I show that…it has to be very well thought out in terms of how it's delivered even if it's a male person delivering (JS2, male).

An inclusive curriculum incorporates gender diverse perspectives, which will benefit all students, and users of energy technologies (Mills & Gill, 2009). This could have a greater impact for delivering energy access in an equitable way. Interviewees identified a need for the representation of women and men in the curriculum itself to create sufficient depth of knowledge of energy access challenges:

> They have to be aware of the societies they are going to be engaged with. Engineering is not only a technical aspect, it impacts on society, so whatever society's needs are, those are things that can feed into your curriculum (JS2, male).

> The curriculum should bring out…the gender role in energy access… Those roles should come out clearly in the curriculum (CG1, female).

In addition to curriculum content, it is important to consider the approaches used in the classroom, as teaching methods and representative examples can have a significant impact on gender inclusion and equality within a degree programme. Group activities and problem-based learning (PBL) create interactive learning environments that are connected to context (Mitchell *et al*., 2019; Perdue, 2020). PBL scenarios need to be representative and incorporate technical and non-technical perspectives (e.g. end-user dimensions of energy technologies). Interviewees stressed that students engaged in PBL need tools to work effectively in diverse teams, as gender diverse teams do not automatically lead to gender inclusion.

> The girls are more silent than the boys in answering, but that comes from the cultural issues that we have been talking about, but nowadays, as I told you it's changing so everybody is just answering. Now in my class I point out… anybody that I want to answer (MM2, male).

Learning to work in groups and allowing all students to participate in lectures can result in more well-rounded energy access solutions in the classroom and within real life applications (RU2,male). Another interviewee noted:

> People need to be able to communicate and then in that way work together to develop solutions. ..I think part of that systems thinking, different people think differently, so just allowing people to speak up in class in class or creating an environment for them to speak up (SS1, female).

Thus, in addition to gender inclusive content, teaching methods must engage all students in class discussions, also recognising cultural factors that may hinder female students from actively engaging in predominantly male classrooms.

4. Championing gender inclusive energy access education - where to start?

Where does transformation of energy access education begin? Based on the findings discussed above, this paper proposes transformations: i) in the classroom, ii) at a departmental level and iii) within the energy sector and external programmes.

The classroom itself is an ideal setting for transformations to take root, and lecturers can embrace new and creative ways of engaging students of different genders, learning styles and preferences. Furthermore, interviewees emphasised the need for greater gender awareness in their departments:

> Lecturers… need to appreciate the basics of gender discourse because you cannot force them to recognise gender inequalities unless they themselves appreciate that gender inequality exists (MN1, female).

Finally, the energy sector itself, professional bodies and external programmes have a key function in driving transformation, as interviewees commented. Notably, industry bodies have been instrumental in professional development of female students and graduates (SS1, female). Individual and collaborative efforts that begin in the classroom and are supported by faculty staff, industry and broader programmes are thus invaluable for championing the transformations needed for gender inclusive ESD.

5. Conclusion

This paper challenged the technical engineering culture and societal perceptions about women and men in ‘traditional’ engineering, energy professions and higher education, and has shown how it impacts the teaching and learning environment of energy access education. To respond to SDG 7 effectively, transformations are needed towards an educational model that promotes systems thinking, multi-disciplinarity and diversity, and gender considerations

in all aspects of the curriculum. Masters programmes in energy access, therefore, need to transcend the existing 'technical culture' to provide comprehensive and holistic education, and to appeal to diverse student interests, needs and intrinsic motivations. A more holistic approach to mainstreaming gender in energy access education, within learning environments, curriculum content, and the institutional enabling environment, would contribute to address the gender gap at IHLs and transform how energy access education is designed and delivered. Furthermore, this offers a tangible entry point to deliver programmes for ESD that, in our example, addresses the dual challenge of achieving SDG7 and SDG5.

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The tools related to mathematics teachers' pedagogical reasoning: critical review

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Abstract

Shulman (1987) introduced pedagogical reasoning in his model of pedagogical reasoning and action, refers to the phases of activities involving comprehension, transformation, instruction, evaluation, and reflection. The present study aims at a critical review on the tools for investigating the phases of pedagogical reasoning and action for mathematics teachers. Based on a focused search in the database Scopus, 13 articles were reviewed. Findings showed three categories included mathematical tasks, teaching materials and videos. We further classified each category and connected it with Shulman's phases of pedagogical reasoning. Mathematical tasks are classified as pure mathematical tasks and mathematical pedagogical tasks which can be connected to comprehension and transformation phases. Teaching materials are classified into three sub-categories, including materials in planning session, in implementation session, and after implementation which can be connected to comprehension and transformation, instruction, and evaluation and reflection phases, respectively. Lastly, videos are classified into three subcategories including video of self-teaching, others teaching, and movie which connected to evaluation and reflection phases. Two findings are highlighted including (1) the correspondence between the tools for pedagogical reasoning and Shulman's phases of pedagogical reasoning and (2) the features of each sub-category of the tools related to pedagogical reasoning.

Keywords: *Mathematics teachers; pedagogical reasoning.*

1. Introduction

The term of Pedagogical Reasoning was introduced by Shulman (1987) in his model of pedagogical reasoning and action, refers as a process of transforming knowledge, such as transforming the subject content knowledge into teachable content by considering students' diversity of ability and needs. Pedagogical reasoning becomes one of notable aspects of teachers' teaching and learning process that it influences teachers in making decision either in planning, implementation or after implementation sessions. In some conditions, teachers' pedagogical reasoning might be accessible through teacher professional development, such as practice-based and collaboration (Pella, 2015). According to model of activity by Engeström (1999), professional development consists of some components including tools, subject, and object. Herein, the tools for investigating or improving teachers' pedagogical reasoning are critical in the transformation process since they are the key components of the cyclic process of pedagogical reasoning (i.e. Shulman's model). These various tools have their own characteristics in how and when they would be used in teacher education program, which is also discussed in this present study. Therefore, this review paper aims to examine what and how the tools could be employed to enhance teachers' pedagogical reasoning by answering the following questions: (1) What are the tools that investigated and used in these studies related to pedagogical reasoning? And how they connect to Shulman's model of pedagogical reasoning? And (2) What are the features of the tools used for pedagogical reasoning?

2. Pedagogical Reasoning

Pedagogical reasoning is defined as the process of developing pedagogical content knowledge, such as starting with initial understanding and shifting with a new understanding of pedagogical content knowledge which influence teachers in making decision. Several actions are involved in pedagogical reasoning, including comprehension, transformation, instruction, evaluation and reflection (Shulman, 1987).

2.1 Phases of pedagogical reasoning

Comprehension – "To teach is first to understand" (Shulman, 1987, p.14). It is crucial for a teacher to understand the teaching content themselves and to comprehend a set of ideas in their discipline and how those ideas interrelated and connected within and with other discipline (Nilsson, 2009). Transformation - Transforming the subject knowledge into a teachable content is the most influential process in pedagogical reasoning and action (Starkey, 2010). As the paramount aspect, transformation involves combination of some activities, they are: (1) preparation (2) representation of the ideas (3) instructional selections (4) adaptation of these representations to the general characteristics and (5) tailoring the adaptations to individual student needs (Shulman, 1987). Instruction - The observable

performances of teacher during teaching moment are comprised in this action (Shulman, 1987). Most of pedagogical aspects of teacher could be seen in this process in how teacher conforms the transformed content in the actual classroom condition, included managing the classroom, delivering clear content, facilitating the discussion/activities, and interacting effectively with pupils through question and answer, compliment, comment or motivation as well. Evaluation - Evaluation follows instruction and that includes checking for students' understanding and misunderstanding during the instruction and testing students in formal or informal way after instruction (Shulman, 1987). Furthermore, it is not only concerning about students, but also evaluating for teacher's instruction such as the gap between teacher and students, teacher and teaching content, and as well as gap between students and teaching material. Reflection - In this action, teacher begins a retrospect of teaching and learning process that has occurred. "The teacher reflected on the lesson in three ways, included pedagogical decision making, how the students engaged in the lesson and the effectiveness of the lesson" (Starkey, 2010, p. 239). Finally, the process of pedagogical reasoning cycles back to gain a new comprehension, which is a new understanding as a result of the learning through the pedagogical actions.

2.2. The tools used for pedagogical reasoning

Based on model of activity theory (figure 1) by Engeström (1999, p.30), the tools play a role to mediate the subjects (i.e. teachers) and objects (i.e. teachers' interpretation or knowledge) that produce the outcomes. Herein, the tools for pedagogical reasoning refer to the materials that are observed by participants and require their pedagogical reasoning. Teachers' pedagogical reasoning about the materials may base on their pedagogical content knowledge and then produce teaching and learning. Several examples of the tools for pedagogical reasoning are lesson plan (Nilsson, 2009) for before implementation session, textbook or activity sheets for implementation session (McDuffie & Mather, 2009), and students' work (Baldinger, 2020) for after implementation. The tools of pedagogical reasoning are useful for teachers if they are employed effectively in teacher education program.

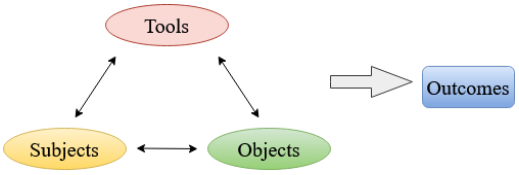

Figure 1. Model of activity, according to Engeström, Y.

3. Method

The literatures were identified by exploring Scopus database with keywords "pedagogical reasoning" or "curricular reasoning" or "instructional reasoning" or "practical reasoning" or

"reflective reasoning" or "reasoning * teaching" or "reasoning * learning" or reasoning * student" AND "mathematics" or "mathematical" AND "teacher". The total of 30 articles were located, through the selection process, the 13 articles (Andrews-Larson, Wilson, & Larbi-Cherif, 2017; Arani, 2017; Aydogan Yenmez, Erbas, Cakiroglu, Cetinkaya, & Alacaci, 2018; Baldinger, 2020; Chen, Marshall, & Horn, 2020; Choy, 2016; Dyer & Sherin, 2016; Horn, 2010; Kim, Metzger, & Heaton, 2019; Lesseig et al., 2017; McDuffie & Mather, 2009; Niess & Gillow-Wiles, 2017; Von Minden, Walls, & Nardi, 1998) were included in this review study.

4. Results

4.1. The tools for pedagogical reasoning Shulman's phases of pedagogical reasoning

Based on table 1, we can see the correspondence between the tools of pedagogical reasoning and Shulman's model of pedagogical reasoning.

Table 1. The connection between tools for and phases of pedagogical reasoning.

Tools \ Shulman's Phases		Comprehension	Transformation	Instruction	Evaluation	Reflection
Mathematical task	Pure mathematical tasks	#4, #13	-	-	-	-
	Mathematical pedagogical task	#6	#6, #13	-	-	-
Teaching Materials	In Planning sessions (i.e. lesson plan)	#12	#1, #3, #8, #9, #11, #12	-	-	-
	In implementation (i.e. textbook)	-	-	#3, #11, #12	-	
	After implementation (i.e. students' work)	-	-	-	#3, #11, #12	#3, #4, #8, #11, #12
Videos	Self-teaching	-	-	-	#7, #12	#7, #12
	Others teaching	-	-	-	#2, #10, #12	#2, #10, #12
	Movie	-	-	-	-	#5

N= ID number of the articles

For the tools of pedagogical reasoning, findings showed the categories of materials included *mathematical tasks*, *teaching materials* and *videos*. We further classified each material into sub-categories and connected it with Shulman's phases of pedagogical reasoning. Firstly, *mathematical tasks* are classified as pure mathematical tasks (for teachers) and mathematical pedagogical tasks (for students). Specifically, the pure mathematical tasks can reveal teachers' mathematical reasoning while mathematical pedagogical tasks provide teachers need to reason about the representation of content. Thus, the two sub-categories can be connected to comprehension and transformation phases. Secondly, *teaching materials* are classified into three sub-categories, including materials in planning session (i.e., lesson plan), in implementation session (i.e., textbooks), and after implementation (i.e., students' work). In planning session, we see teachers' reasoning to engage with the content while teachers'

instructional reasoning is showed in implementation session. Then, teachers' reasoning is expressed when they evaluate the results of the lesson. These three sub-categories can be connected to comprehension and transformation, instruction, and evaluation and reflection phases, respectively. Lastly, *videos* are classified into three sub-categories including video of self-teaching, video of others teaching, and film. The videos are included in evaluation and reflection phase, where we could investigate teachers' reflective reasoning about self-teaching and teachers' noticing skills when they watch the video of others teaching.

4.2. The features of the tools for pedagogical reasoning

The three tools related to pedagogical reasoning (*mathematical tasks, teaching materials,* and *videos*) have some characteristics in the how (the way they used) and when (i.e. before implementation, implementation, and after implementation) they are used in the studies. Firstly, *mathematical task* is used specifically on session before the implementation. To be confident in delivering the materials to students, teachers would practice with some mathematical tasks before they teach them to their students, especially for novice teachers. For further anticipation, before implementation, teachers are required to transform their mathematical knowledge into teachable content so students can understand the material easily. Secondly, *teaching materials* can be used before implementation, in implementation, and after implementation. Teaching materials are varied including lesson plan, textbook, teaching tools/apparatus, activity sheets, students' work, etc. the most popular teaching materials that used in the studies is lesson plan. Lesson plan is a concrete evidence to investigate what teachers know and how teachers teach, especially to observe teachers' decision-making and noticing skills. Lastly, the *videos* are used after implementation process. Usually, video is employed as an object in teachers collaboration time (Arani, 2017; Chen et al., 2020; Dyer & Sherin, 2016; Lesseig et al., 2017), which offer opportunities for teachers to discuss, reflect and evaluate the teaching and learning process on the videos.

5. Conclusion

The results showed three categories of the tools included mathematical tasks (pure mathematical tasks and mathematical pedagogical tasks), teaching materials (planning session, implementation session, and after implementation) and videos (self-teaching, others teaching, and movie). We also further classified each category and connected it with Shulman's phases (i.e. comprehension, transformation, instruction, evaluation and reflection) of pedagogical reasoning. According to the review, two findings are highlighted, including (1) the correspondence between the tools for pedagogical reasoning and Shulman's phases of pedagogical reasoning and (2) the features of each sub-category of the tools of pedagogical reasoning. The former findings could be used by teacher educators as reference to design their materials for investigating and improving teachers' pedagogical reasoning and action.

Regards the features of sub-categories, it is suggested to further investigate and compare the process of pedagogical reasoning as teachers interact with different category of materials in order to find a more efficient approach to teacher education.

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Evaluation systems in online environments

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Abstract

One of the biggest challenges of online teaching is student evaluation. With the students not being physically present, assessing their level of knowledge on a subject presents different challenges than those traditionally encountered in face-to-face teaching. In this paper we present an overview of different evaluation systems and reflect about its advantages and disadvantages when applying them in online environments.

The most common evaluation systems: multiple-choice quizzes, open question exams, essays, projects and oral exams, are ranked depending on several criteria. Criteria include items that any professor should take into consideration such as easiness of design and preparation or difficulty of student cheating. The advantages and downsides of each evaluation system are presented and several mechanisms to mitigate the disadvantages of each method are proposed.

This paper is helpful to professors and teachers, particularly in the current situation where the Covid-19 pandemic has moved most high-education teaching online.

Keywords: *Online; evaluation systems; exams; cheating; individual assessment.*

1. Introduction

The Covid-19 pandemic has forced schools, universities, business schools and all type of education institutions to either cancel courses or move to online teaching (García-Peñalvo et al., 2021). Moving online presents many challenges, from choosing the appropriate online platform to adapting materials and teaching styles (Barra et al., 2020). Within all these challenges, one of the most important ones is individual student evaluation.

Education institutions are required to guarantee that remote assessment is secure, reliable and fair, in particular, protecting against academic misconduct while also safeguarding a fair provision and treatment of students (Guangul et al., 2020). There is a wide array of evaluation systems that have traditionally been used in physical settings. Some professors chose to evaluate students through individual written exams, where students are gathered in a room and work on their own answers while an invigilator controls their behavior. Other professors propose some in-class activities while they go around the class solving doubts and gathering information on the attitude and knowledge of each of the students. None of these two examples of evaluation systems could be transferred to an online setting without losing much of its essence. The same is valid for many other evaluation methods.

Which evaluation systems are more adequate for online settings? What are their associated advantages and disadvantages? In this paper we aim to provide a clear overview of different evaluation systems that could be applied in online environments and rank them according to a set of diverse criteria. The criteria chosen capture the most relevant concerns of professors when designing an evaluation system: from easiness of grading to exam duration, including also difficulty of student cheating or objectivity in grading. Since no evaluation system is perfect, we discuss potential methods, called mitigation levers, that can help minimize the drawbacks of each evaluation system.

We believe our paper contributes to the current literature on higher education and particularly on evaluation systems by providing a general view of the evaluation methods available for online settings. Our overview is particularly relevant for professors. Although we acknowledge that each education level, subject and professor will differ on their preferences and needs, our framework is flexible enough to provide an answer to each professor who, depending on the relative weight he/she gives to each criteria, can find the most adequate evaluation tool to fulfill his/her purposes.

2. Literature review

Despite assessment practices in higher education institutions have been largely discussed in the literature, designing an appropriate assessment strategy is a continual challenge for instructors (Akimov & Malin, 2020). This situation is even more difficult in remote and

hybrid training modalities, where there is a lack of harmonized approaches of assessment (Kearns, 2012). Although online courses existed before the coronavirus spread, universities have been forced to readapt the way they are assessing students' performance and started using online assessment tools such as quizzes (either multiple-choice or in an open-question format), oral exams, evaluation through projects or written essays (Guangul et al., 2020).

This variety of approaches opens up many interrogates questioning which examination methods, particularly at the individual level, are the most appropriate ones (Barra et al., 2020) as distance modes of course delivery have brought new challenges.

In choosing the type of assessment, several considerations need to be taken into account (Hsiao & Watering, 2020). One of the critical issues is the validity and reliability of the assessment and if the method of delivery meets the intended purpose (Tuah & Naing, 2021). The assessment must be consistent, fairly applied, and must allow students to demonstrate the extent to which intended learning outcomes have been achieved (Shraim, 2019). The design of online exams must follow pedagogical principles, rather than merely embodying innovative technology, and the whole process must be carefully planned (Whitelock, 2006).

Another key concern that has risen with the transition to online examinations is whether this will make cheating easier (Chirumamilla et al., 2020). The impossibility of sharing the physical space with students during examination situations and have them face-to-face has led to a number of cheating practices (e.g., impersonation, forbidden aids, peeking, peer collaboration, non-allowed outside assistance). Depending on the type of examining technique, different countermeasures can be implemented (e.g., proctors, biometry, randomizing questions, broadcasting, use of antiplagiarism software, etc.), yet, online assessments are still vulnerable to academic dishonesty.

The type of assessment practice chosen will have a major impact on students' learning and academic achievement. Therefore, when discussing which evaluation methods work best, it is necessary to self-reflect about the rationale behind the assessment.

3. Methodology

In order to investigate which assessment methods are more suitable to different situations, the study was organized in three stages. First, we conducted a review of the literature aimed at identifying the most commonly used online assessment methods in higher education and the pros and cons of each method. The search was conducted in Web of Science and Google Scholar. We retained articles in academic journals but also reports published by independent organizations (e.g., European Commission). Also discussions on public forums as a result of the Covid-19 outbreak and its impact in evaluation processes were considered. The keywords used in the searches combined relevant terms such as "online", "assessment" and

"evaluation". In addition to the above searching terms, we filtered papers by year of publication, selecting only papers published after 2005, when we believe online education started to take off. Main journals in which the selected papers were published include *Higher Education*, *Studies in Higher Education*, *Assessment & Evaluation in Higher Education*. After analyzing the documents, a list of five online assessment methods was obtained. These methods can be defined as follows:

Multiple-choice quiz (MCQ). Online quiz that contains closed-answer type questions which allow assessing essential knowledge. Questions might include text, pictures, sound or other media and weight individual answers. In a quiz the grading is automatized and questions can be randomized. This assessment method requires a learning platform.

Open question exam. This is the conventional assessment method in which students are posed with open-answer type questions. It presents different questions (e.g. testing memory, testing knowledge about concepts, testing application of the key learnings, etc.) and usually requires an answer of a couple of paragraphs long (up to one page).

Essay. Students are challenged to come up with the key concepts and theories covered during the course and put them in their own words to interpret or discuss a given topic. This method allows evaluating students' aptitudes to recall, organize and integrate different theories and viewpoints in the form of a written work.

Project. Students are asked to think beyond the boundaries of the classroom and are challenged to apply what they have learned to an in-depth exploration of a topic. The project can be evaluated by means of an oral presentation or with the written report. If the former, the assessment is based on a presentation prepared by the student and followed by a dialogue with the instructor on this piece of work. In the case of a written report, there is no face-to-face conversation between the student and the instructor and therefore, the evaluation occurs asynchronously.

Oral exam. Oral exams (also called *vivas*) test students' ability to verbally communicate theories, ideas and key concepts covered in a course. The lecturer poses questions to the student in spoken form and the student has to respond to them. Depending on the answers, the lecturer has the opportunity to ask follow-up questions, and thus, make this evaluation tailored to the individual student.

In addition, we also distinguish between closed-/open- book assessment situations (applicable to MCQ and open question exams). In a closed-book assessment students are confronted with the exam by solely relying on their own memory. On the contrary, in open-book exams they are allowed to refer to any material they want to consult while carrying out the exam. This later form of examination tests for more than just rote-learning.

Another outcome was the identification of the main aspects lecturers look at when choosing an assessment method: the workload required (easiness of design and preparation, and easiness of grading), the type of knowledge to evaluate (covering a module/the entire course, and deepness of the learning), the extent to which the assessment method prevents students from dishonesty (cheating with peers, and access to other sources of information), the reliability of the instrument (grading objectivity) and its feasibility (duration of the exam), and whether it is possible to maintain visual contact with student.

Next, in a second stage we organized two focus groups with professors aimed at discussing the challenges and effective practices in online assessment. Professors were selected from different disciplines and met the requirement of being actively involved in teaching innovation practices. Two focus groups of 8 professors each were performed, one with professors whose main teaching experience is with undergraduate students and another one with professors whose main experience is with graduate students. The professors came from different programs, schools and universities including medical school, architecture, management, journalism and engineering. The participants were also diverse in gender, age and career level, including lecturers, assistant professors, associate and full professors. The focus groups allowed the researchers to contrast the findings from the literature review, make sure that no relevant evaluation methodology was left out and that all the critical characteristics that an evaluation method should possess were taken into account.

Finally, in the third stage, we created a survey targeted to students in order to capture their opinions and preferences about the different forms of assessment. Although students are not the most adequate to estimate the difficulty of design and preparation of a certain type of evaluation method, they are probably the most competent to appraise the easiness of cheating. With that in mind, we designed a questionnaire where the different assessment methods were listed. Opinions were asked about difficulty of cheating, either interacting with other peers or accessing not-allowed information and about deepness of the learning that the evaluation method was able to test. General questions about evaluation method preferences as well as open questions about what type of online assessment methods have they experienced were also included. We collected responses from a variety of students enrolled in different disciplines (e.g., engineering, management, law, economics, nursing, journalism). Students represented different nationalities (Spanish, Italian, English, French, Netherlands, USA) and were diverse in gender and age (from 18 to 30 years old). Survey responses were in line to what had previously been observed in the literature and confirmed in the professors' focus group, reassuring that we did not forget any relevant point.

With the information gathered (i.e., relevant literature, and professors and students' points of view) we developed the double entry matrix presented in the following section. The cells in the matrix were filled out separately by two researchers. Later, the matrices were compared. In case of disagreement a third researcher was consulted to reach an agreement.

4. Results and discussion

Our results are summarized in Table 1. Assessment methods are displayed in columns while the selection criteria appear in rows. A green cell means that a certain evaluation system perfectly fulfills a particular criterion, while yellow should be interpreted as a partial fulfillment and red as a poor performance. In some instances a criteria is not applicable. The bottom part of the table presents the mitigation levers (Stack et al., 2020) that have been identified and that, if applied properly, can help overcome some of the shortfalls of each evaluation method.

Table 1. Evaluation systems overview.

	Multiple choice quiz		**Open question exam**		**Essay**	**Project**		**Oral exam**
Criteria	Open book	Closed book	Open book	Closed book		Written	Oral	
Easiness of design and preparation								
Easiness of grading								
Prevents interaction with peers								
Prevents access to other information	N/A		N/A		N/A	N/A	N/A	
Course coverage								
Deepness of learning								
Grading objectivity								
Exam duration					N/A	N/A		
Visual contact with student								
Mitigation levers								
Synchronous	•	•	•	•				•
Rubric					•	•	•	•
Question parameters	•	•	•	•				
Code of honor	•	•	•	•	•	•	•	
Camera on	•	•	•	•				•
Strict time limitation	•	•	•	•				•
Plagiarism detection			•	•	•	•	•	
Browser lockdown	•	•	•	•				

Source: Authors. Note: N/A means Not Applicable.

Multiple choice quizzes, either open-book or closed-book (columns 2 and 3 of Table 1), are a popular online evaluation system. They offer some great advantages like the easiness and objectivity of grading, sometimes even done by a computer, limited exam duration and, if well designed, can cover much of the course content. In contrast, designing them properly is not easy as questions should be mutually exclusive and present no ambiguity. In addition, especially if the software used does not allow for permanent visual contact with the students, this type of evaluation method makes cheating, either by interacting with peers of by accessing forbidden information, relatively easy. To avoid these shortfalls, some mitigation mechanisms can be put in place. We suggest that the exam is done in a synchronous manner, so that all students are doing the quiz at the same time and with a computer software that permits seeing student faces. Additionally, putting some effort in changing question parameters such as randomizing the order of the questions and answers or not allowing the student to go back and review a question already answered, are usually good practices to avoid student dishonesty. Finally, there are software applications such as Respondus[1]© that have a browser lockdown system that only permits students to have open the exam window during all the exam duration.

Open question exams (columns 4 and 5 of table 1) are easier to prepare than multiple-choice quizzes but are usually more time consuming to grade and allow for a higher degree of subjectivity. By giving students the opportunity to express themselves with more freedom, it is easier to assess the deepness of the knowledge acquired. Cheating by interacting with peers or accessing information is less straightforward than in quizzes but can potentially still be an issue. In addition to the mitigation strategies already discussed for quizzes, the use of anti-plagiarism systems can be adequate in this setting.

Essays and projects (column 6, 7 and 8 of Table 1) are by nature asynchronous and require the student to think deeper. Plagiarism is one of the biggest risks in this context that can be mitigated by using a plagiarism detection system. Grading is lengthier and more subjective but this drawback can be softened by using a rubric that clearly establishes the grading criteria and to which students must have adhered on.

Finally, oral exams (column 9 of Table 1) allow a one to one interaction between the professor and the student. This evaluation system has many advantages. As soon as the exam is finished, the professor has a clear idea of the knowledge of the student on the subject and can grade accordingly. In addition, since it is synchronous and individualized, cheating becomes difficult. In contrast, being impossible to run several oral exams in parallel, doing an oral exam is very time consuming for the professor, something that can only be minimized by having a strict time control.

[1] https://web.respondus.com/he/

5. Conclusion

Our study is a practical compendium on the advantages and disadvantages of online individual evaluation methods. By reviewing the literature and gathering the point of view of professors and students, we have developed a framework that professors can use to assess which evaluation method is more adequate in their context, taking into account the subject, the technology and the time available.

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Using Online Forums to Promote Collaborative Learning in Introductory Programming Courses

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Abstract

The asynchronous online discussion can enrich learning experience in many ways, even in classroom or blended learning scenarios. It is quite challenging to design an effective online discussion. The presented study draws on the action research strategy. After observing and analyzing students' learning problems in introductory programming courses, we came up with intervention of the online collaborative activity to guide students during their individual studying at home in a more regulative manner. The main goal was to involve students in active learning and strengthen the feel of being a friendly community member. Students were producing sample test questions/tasks for others, and then using products of their classmates for their own learning. The intervention was evaluated deeply using both, qualitative and quantitative methods. This reflection implied that the activity's design was appropriate and the impact on students' learning process was positive. We found the constructivist features of the activity essential as for its effectiveness. The learning scenario described in this paper provides a verified framework for designing similar collaborative activities suitable mainly for problem-oriented areas of study, e. g. in science or engineering education.

Keywords: *Online forums; collaborative learning; programming; action research.*

1. Introduction

An asynchronous online discussion can enrich learning experience in many ways, even in classroom or blended learning scenarios. Besides the community building aspect, the online environment gives students more time to think about the topic; motivates students to interact with others (to learn from others); enables students to use their own, less formal language; makes it easier for introvert or slower students to present themselves as active and valuable members of the group.

It is quite challenging to design an effective online discussion. In (Schellens & Valcke, 2005), the researchers investigated question, whether working in asynchronous discussion forums fosters knowledge construction. Garrison (2007) explored the issues emerging from research on social, cognitive, and teaching presence in an online community of inquiry. Shaw (2013) examined the relationships among group size, participation, and learning performance factors when learning a programming language in a computer-supported collaborative learning context. In (Abawajy & Kim, 2001), a taxonomy of online forums was suggested. The authors distinct 3 types of online forums:

The auxiliary forums represent optional, open, self-directed, unstructured discussion in which the learner-to-learner interaction prevails. The teacher responds to students' posts from time to time, in order to keep discussion threads alive and relevant or to support students with learning difficulties. In programming courses, our students are active in online forums dedicated to homework assignments. These forums are appreciated especially by novice programmers, who seek for help from their more advanced colleagues.

The hybrid forums are used to enhance or mediate collaborative learning activities. The participation is often compulsory and assessed. Topics and deadlines are set by the lecturer. In programming courses, we use such online forums quite frequently: for short warmups (during lab sessions), team competitions, projects presentations or peer assessment of solutions. In (Lovázsová & Palmárová, 2012), an activity based on competitive online collaboration suitable for courses on computer programming was described. Students were posting their solutions of problems (programs) in an online forum. Various behavioral patterns of participants were recognized after analyzing students' visible and invisible presence within the online environment. In (Michaličková & Lovászová, 2014), students were creating a glossary of new terms and programming statements and sharing essays on programming topics with classmates. Both activities were intended to foster students' higher order thinking skills. In this paper, we present a constructivist and collaborative learning activity realized through online forum. It was designed in order to facilitate student's learning when studying for the final exam.

The *embedded forums* are typical for distance courses, including MOOCs. In general, online forums are considered a primary means of interaction among learners and instructors.

Though, Onah et al. (2017) doubted that forums are effective means of promoting engagement and learning. They compared two delivery modes of forum participation. Results indicated that forum use overall is low and that tutor-moderation may close down participants' discussion, while peer-support forums fail to offer adequate support.

2. Collaborative learning through an asynchronous online forum

2.1. Research strategy

The presented study draws on the *action research strategy*. Action research was introduced by Kurt Lewin in the 1940s and later adopted and applied by many other educational researchers, also in programming courses (Talib et al., 2017). The theory and practice of action research comprise one or more iterations (cycles) with consecutive phases of planning, acting, observing, and reflecting. As pointed out in (Cohen et al., 2007), the action research can be cast into two simple stages: a *diagnostic stage* in which problems are analyzed, and hypotheses developed; and a *therapeutic stage* in which the hypotheses are tested by a consciously directed intervention or experiment in situ. The action research works on and tries to solve real problems of everyday practice. It is often collaborative, seeks causes and tries to work on those causes. The solutions (interventions) are planned, implemented, and evaluated by the practitioners themselves.

2.2. The background context

The suggested collaborative activity was designed and examined within an introductory programming course taught to in-service teachers studying informatics in order to extend their qualification. There were 19 students enrolled in this course (13 women and 6 men), all of them were novices to programming. The course is focused on fundamental concepts and structures in Python (input and output, variables, data types, conditional statements, cycles, random numbers, tkinter for drawing purposes) and takes one semester. As in many other introductory programming courses, students find the subject difficult, mainly because of its abstract, dynamic, and creative nature. During face-to-face lectures and laboratory exercises, we prefer constructivist and inquiry-based learning activities. Students solve lots of problems on their own (or guided by a teacher) and are encouraged to perform experiments or discuss in groups. We use LMS Moodle (Moodle.org, 2021) for all e-learning activities. The final exam is realized using the Moodle's Test module.

2.3. The diagnostic stage

Our research was launched by noticing (also in other courses on programming taught at our university), that many students are afraid of their final exams and feel rather isolated and stressed while studying at home individually. Although students, who were successful in

hands-on programming assignments during the whole semester, express the lack of confidence after seeing a sample test for the first time. While analyzing data logged by the Moodle system during previous years, we found out, that most students use textual materials for reviewing the course's content and almost all of them try to solve the sample tests. Even multiple attempts are common, though the correct answers are provided immediately after the very first attempt is finished. We always evaluate the exam results with each student separately in order to identify causes of the errors made and explain the correct solutions. It turned out repeatedly, that many students tend to memorize sample questions and correct answers. While solving the exam test, such students have difficulties to recognize analogies, do not apply their knowledge effectively and are more likely to fail.

2.4. The therapeutic stage

To help students to overcome the reported learning problems, we planned and implemented two interventions, one after another. During the first cycle preceding the actual study (with other 13 students attending the same course at that time), we focused on taking a sample test together with students in order to demonstrate an expert's way of thinking as well as some problem-solving strategies potentially useful for the upcoming exam test. Though students appreciated the activity a lot, the informal post-exam interviews as well the test results' analysis showed that most students may need some additional distance guidance to achieve better results.

2.4.1. Planning an intervention

During the second cycle, we tried to supplement the previous intervention with such an online activity that would guide students during their individual studying at home in a more regulative manner. The main goal was to involve students in active learning and strengthen the feel of being a friendly community member. Students were instructed to produce sample test questions/tasks for others, and then use products of their classmates for their own learning. We believed that such a *social constructivist approach* would be effective. To provide some extrinsic motivation for students' participation, best questions published by students were promised to be included into the bank of test questions and so could be used also during the real exam.

2.4.2. Implementing the intervention

Students were familiar with online forums, as we use them quite frequently. The settings were made in the Forum module to avoid students from copying ideas of others (in Moodle, the Questions and Answers discussion forum allows one to read the discussions' content only after contributing himself/herself first). After the very last lesson, the online forum was opened for contributing over the period of 2,5 weeks (18 days). There were 5 topics chosen for students and sample contributions were provided. The topics were selected so students

could contribute in a creative way. After finishing the online activity, students took their final exam. The timeline in Figure 1 shows the collaborative activity's progress:

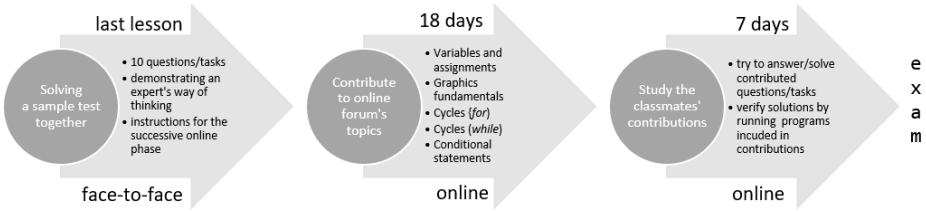

Figure 1. Three phases of the collaborative learning activity.

2.4.3. Evaluating the intervention

The 17 out of 19 students participated in the online forum actively, 2 students did not access the forum at all (due to personal reasons, the activity was not compulsory). Every participant contributed to every topic and published 5 questions/tasks. The final collection included 85 students' contributions and 15 contributions added by their teacher (as samples and to cover two other topics from the course's content).

Table 1. The quality of students' contributions.

Topic	Number of contributions	Average quality score	Average exam score
Variables and assignments	17	1.82	2.65
Graphics fundamentals	17	1.88	1.94
Cycles (for)	17	1.41	2.82
Cycles (while)	17	1.41	2.82
Conditional statements	17	1.35	3.00

In Table 1, results of the products' analysis are summarized (but not to present any correlations). The quality of contributions was judged and coded with integers (0 = sample was misunderstood, so the related contribution was inappropriate, 1 = contribution provided an analogy of the sample, 2 = contribution modified the sample in a more creative way). During exam, students were rather successful in answering all types of questions as their average scores were mostly over 2.6 (out of the maximum 3 points per question). The first topic provided students opportunity to use various operators and multiple variables of different types. In graphics-oriented questions, students tried to surprise their colleagues with funny and nice graphical outputs. The contributions concerned with remaining topics on cycles and conditions were adhering to a common template in most cases. In general, quality

of students' products was satisfactory to be included in a shared collection and used as a study material.

Within the post-exam short interviews, we asked every student to reflect her/his home study activities pursued over the previous weeks. All 17 students (active participants) considered the collaborative learning activity based on using the online forum beneficial. The logs' analysis revealed some details about students' online behavior. The Moodle system monitors all interactions of students within an online forum. For our purposes, only discussion views and post creations were needed to count. Figure 2 depicts the number of logs on individual days during the contributing period (days 1-18) as well as the following study period (days 19-25).

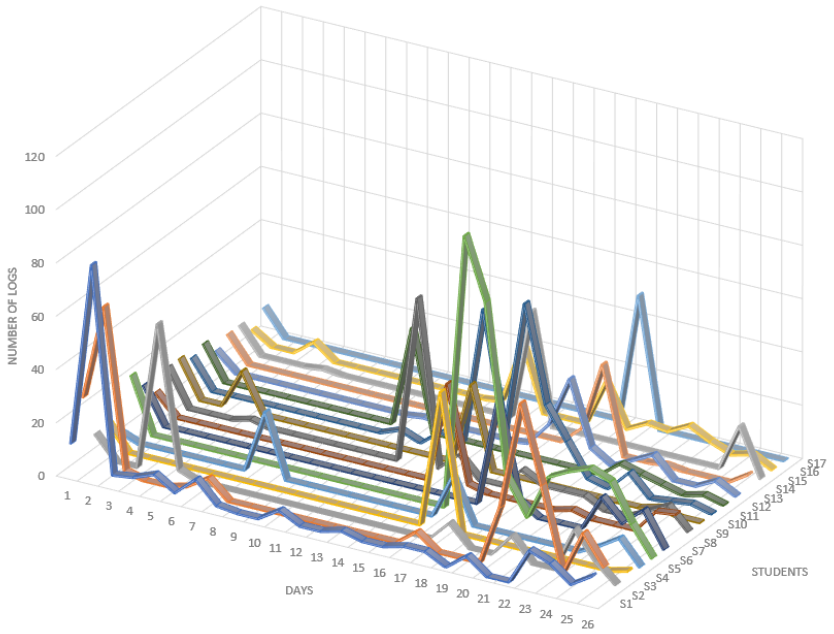

Figure 2. Students' online behavior throughout the online phases.

The activity of students accelerated in both phases during the very last days (11 participants contributed to all topics during one session on a single day, 5 participants needed 2 days, 1 participant published his contributions during a 3-day period). To confirm students' interest in contributions of others, we also checked their returns to forums' topics after completing their contributing phase. On average, 8.29 additional sessions were identified, which implies that students did use the material for study purposes. Students were also asked to describe the process of creating and using the common product verbally. Their responses confirmed our hypothesis. While preparing a contribution, one had to think of a problem, consider the proper notation and verify the intended result using the Python's interpreter (most students

were running their pieces of code repeatedly before publishing the final version). While studying contributions of others, students were verifying solutions the same way.

The overall results of the exam test were satisfactory (slightly but not significantly better than in previous years or in other courses), the average score reached 22.47 out of 30. As the main goal of the suggested intervention was to provide students with assistance and foster motivation, we found the intervention effective. To support this conclusion, we state some of the participants' reflections expressed during the post-exam interviews:

- S1: "The collection of questions we created was great, I will archive it and use later with my own students. I was checking the forum almost every day."
- S3: "I spent much time with preparing the question on graphics. But some questions were simple for me, I did not need to solve everything."
- S5: "The topics on cycles were most important for me. I have finally learned how to trace the variables' values on paper."
- S6: "Seeing others' activity was motivation for me to participate actively. My contributions were rather minimalistic, but without publishing, I would not see contents of the collection."
- S12: "Some questions were alike, so I skipped them. I solved all of the problems on variables and cycles though."
- S13: "The sample contributions were helpful. First, I thought I would just change the numbers, but it was quite challenging to prepare something original."
- S16: "This was a very good idea. I felt like I am doing something meaningful."
- S17: "Topics were ok, but some contributions were not formatted well, so I had to copy the notation to my Python editor first to understand what is going on."

3. Conclusion

After observing students' learning problems, we came up with intervention of the online collaborative activity. The intervention was evaluated deeply using both, qualitative and quantitative methods. The main criterion for concluding the intervention's effectiveness was whether there would be a positive shift in students' learning process while studying at home. Students found the activity as being beneficial for them. The analysis of logs and contributions of students documented their real involvement well. To create and solve new instances of test questions/tasks, the application of higher-order thinking skills was needed.

The learning scenario described in this paper provides a verified framework for designing similar collaborative activities. It is applicable mainly in problem-oriented areas of study (e. g. in natural sciences or engineering education). In our study, the group of collaborating students was small. Number of students is critical as the huge number of questions or tasks

could be overwhelming. Some students underestimated the formal aspect of their work and did not refine contributions' format after pasting their source code into the forum's embedded editor. We recommend teachers to train the "rules of posting" with students practically before starting the contributing phase, so they could realize the differences better. The collection of questions/tasks prepared by students was used also later, in a course on didactics, where students discussed the quality of contributions in order to cultivate their critical thinking.

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Development and Evaluation of Online Approaches for Improved Kinaesthetic Learning in Science

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Abstract

Kinaesthetic learning is expressed when physical actions are used to connect concept development to reality, for example through model building, trial and error practice, or role-play interactions. Learning through a kinaesthetic modality is highly effective and complementary to other learning modalities. Recent advances in gamification for education have increased access to science simulations and learning online. However, the transfer of offline kinaesthetic techniques to online learning remains under-researched and poorly implemented on affordable, scalable platforms. Here we describe an accessible approach for educators on how to incorporate online kinaesthetic aspects into lessons through use of a scalable and affordable framework developed called the 'Kinaesthetic Learning System' (KLS). This framework should be of particular use for learning complex molecular life science topics but can be adapted and modified independently by the educator to address different knowledge levels and for expansion to other disciplines.

Keywords: *Kinaesthetic; e-learning; education; online-learning; biochemistry; life science.*

1. Introduction

The human brain is an extraordinarily complex organ that employs multiple cortical structures to process, store and integrate information, through multiple sensory systems (Kolb & Whishaw, 1996). When multiple areas of the brain are engaged by a task, learning is significantly increased by comparison with learning through one sensory modality such as reading alone or listening alone (Mayer, 2003). Digital technology potentially offers significant advantages over traditional learning approaches as it has the capability to provide increased opportunities for better engagement of multiple cognitive centres of the brain. However, the majority of third level education (University level) content on digital platforms is based on visual and auditory delivery but typically neglects kinaesthetic aspects. The latter offers an approach to engage additional sensory neural elements and thus enhances the efficacy of learning.

Kinaesthetic learning (KL) or tactile learning occurs when a person uses physical actions to connect concept development to reality, such as through the medium of model building, trial and error practice or role-play interactions. As such, it is easier to recognise kinaesthetic learning rather than define it, but an apt definition is provided by Balasubramaniam and Indhu (2016) which states that "Kinaesthetic (K) learners prefer to learn by connecting to reality and they acquire information through experience and practice." (p.16)

KL is significantly under-developed for third level online learning in comparison to other learning modalities, namely reading/writing (RW), visual (V) and auditory (A). The major advances in software, hardware and cloud computing systems in recent years has made the prospect of developing online education material enhanced through the application of KL increasingly feasible. The learning of molecular sciences at third level is particularly challenging due to new concept density and the sub-microscopic nature of molecules which makes visualisation very difficult. Consequently, the learning of molecular sciences stand to gain significantly through kinaesthetic approaches.

2. The case for online kinaesthetic learning based on neuroscience

Studies on basic nervous systems have demonstrated how multiple parts of the neural system are capable of learning (Kolb &Whishaw, 1996; Bedecarrats, Chen, Pearce, Cai, Glanzman, 2018). This infers that the different neural areas are capable of different neural memories. The visual system, for example, can retain memory for colour, shape, and movement. Kolb and Wishaw outline how neural areas can be further subdivided for memory and interlinked with different regions of the brain to process incoming information from multiple stimuli. With the brain's capacity to collect information and store it in such a variety of memory formats, it becomes apparent why learning increases when multiple regions of the brain are engaged in a learning task.

In systemic terms, information from the body and external environment is carried to the brain along sensory axons emanating from sensory organs such as the ears, eyes, and skin. Motor nerves controlling all bodily movement run from the motor cortex to the rest of the body in the opposite direction of sensory axons (Kolb & Whishaw, 1996). From an evolutionary standpoint, this integration of physical and cognitive neural structures, as activated during KL, allows a more efficient means of processing information. For example, consider how much easier it is to demonstrate how to undo a zip compared with having to write out a step-by-step guide or give a detailed oral account of the action. A kinaesthetic approach to online learning that mimics the physical act of demonstrating how something works, has the potential to successfully integrate KL and digital technology for enhanced education.

A final factor to support KL is to understand the role of the cerebellum, one of the oldest regions of the brain in evolutionary terms. The cerebellum is responsible for procedural memory and motor control, and co-ordinates fine movements with learning (Crossman & Neary, 1995). The cerebellum links learning and movement in a way that may be accessed through KL approaches that are physical and practiced during a learning task and may contribute to making learning more intuitive.

3. Designing a kinaesthetic approach to online learning

Research on kinaesthetic approaches to online learning is sparse and has been limited by the lack of technological platforms. Digital technologies are now sufficiently advanced to support kinaesthetic approaches. However, development and optimisation of KL is necessary to validate and underpin its widespread adoption. Design of the individual elements suitable for incorporation into KL approaches should draw from the well-established work of Mayer and others who have identified and validated instructional guidelines for optimal online learning. The key aspects of these guidelines are outlined in Table 1 below.

Table 1. E-learning guidelines for the development of online lessons

Guidelines	Authors
Spatial contiguity effect: Position relevant text beside informative pictures	(Clark & Mayer, 2008)
Multimedia effect: Present lessons in a multimedia format	(Mayer,2003; Sankey, Birch, Gardiner, 2011)
Coherence effect: Keep content specific with no extraneous details	(Mayer, 2003)
Personalisation effect: Use conversational language rather than formal	(Mayer, 2003)
Perspective Principal: View online lessons from 1st person perspective	(Fiorella et al., 2017)
Segmenting Principal: Facilitate paced learning & design navigational controls	(Clark & Mayer, 2008)
Deliver audio with diagrams or animation but not with both text and diagrams	(Clark & Mayer, 2008)
Facilitate interactions with online learning content & test with difficult concepts	(Gegner, Mackay, Mayer, 2009; Saadé, Morin, Thomas, 2012)
Provide dual cues for recall e.g., visual with auditory	(Xie, Mayer, Wang, Zhou, 2018)

3.1. Defining the framework

A methodical effort was applied toward developing an accessible kinaesthetic learning system suitable for online platforms. A set of criteria was generated to guide development of such a system and is outlined in Table 2.

Table 2. Criteria for development of a Kinaesthetic Learning System (KLS) for online platforms

List of Criteria for a KLS
User friendly, affordable, adaptable, scalable, and expandable
Simple design that lends itself to reproduction in accessible formats
High engagement to maintain interest and attention
Facilitate assessment
Facilitate long-term learning
Present incremental challenges to the learner
Amenable to the application of scientific research methodology i.e., design, build, test, repeat
Be a true translation of traditional kinaesthetic learning approaches
Be amenable to measurable evaluation

There are many potential platforms that could support kinaesthetic approaches. Presentation software programmes typically have many features that could support KL including mouse or touchpad directed movement of objects, read/write, visual, audio and animation aspects. PowerPoint is a well-developed and widely used programme in this category and is highly accessible across education sectors. Thus, it can be considered a suitable platform for exploring kinaesthetic based lesson development.

3.2. Exploring Kinaesthetic Learning using a Complex Topic in Molecular Science

The Lac Operon in E. coli is a paradigm for gene regulation and is a complex and well elucidated genetic system and a typical core element of the molecular life sciences curriculum. The Lac Operon lesson is a conceptually difficult and challenging science topic and was chosen as a test case to explore development of approaches that meet the criteria outlined (Table 2).

Narrative for the Lac Operon lesson was developed for KL and various layouts of text and diagram elements were explored. The topic was initially broken down into stepwise segments covering over 40 concepts and reconstructed into a stepwise narrative to facilitate KL. Over 30 illustrations were created, with each illustration representing an individual element of the operon. Each element was imported into PowerPoint as icons that the students could move about independently onscreen and within PowerPoint slides, through use of a mouse, tracker pad or touchscreen. This facilitated the construction of different snapshots representing key gene regulatory events in the operation of the Lac Operon. The generation of multiple, independent icons also facilitated creation of a full animated version of the Lac Operon (link to animation: https://youtu.be/Mti9I7fDKwc) and enabled the building of different scenario diagrams for the operon that could be assembled and disassembled in a kinaesthetic manner.

The independent icon aspect of the design facilitates numerous kinaesthetic approaches compatible with PowerPoint. Two approaches that utilised a "guided assembly" and an "unguided assembly" were selected for development with the lesson and several iterations of these approaches were examined. The final iteration of the "guided assembly" approach chosen involved providing a boxed set of icons in random order at the top of a PowerPoint slide for a given Lac Operon scenario. A diagram outline of the scenario was provided in the lower part of the slide with placeholder prompts for specific icons. This enabled implementation of the kinaesthetic aspect by clicking and dragging the relevant icons from the box into position over the correct placeholder.

The "unguided assembly" involved provision of a boxed set of icons for a Lac Operon scenario enabling implementation of the kinaesthetic aspect by assembling a diagram of the scenario in the space below the box but without the aid of placeholder prompts, according to a set of instructions. Essentially, both conditions enable a student to work independently in PowerPoint and to interact with the Lac Operon lesson by reassembling various scenarios at their own pace. This design facilitated the building of multiple levels of difficulty by altering the level of prompts/instructions provided and/or the range of icons deposited in the box. This overall design is directly applicable to the numerous molecular and biochemical process that are central to the molecular life sciences. Moreover, although not covered here, it can also be easily adapted to offer an alternative to traditional forms of assessment.

Feasibility testing of this format with a cohort of 40 undergraduate medical students was carried out using an early iteration of the KL PowerPoint lesson containing features as outlined in Section 3.2, paragraph 2, but which did not include a video aspect. The layout of the PowerPoint included introductory instruction slides on how to navigate and interact with the lesson. Lesson notes appeared on the left of each slide with descriptive illustrations matching the text on the right. The wordcount for the main text body of the lesson, excluding introductory slides, headings and diagram labels was approximately 1,700 and was split across 7 slides. This represents a complete one hour foundational third level science lesson on the Lac Operon and as such, is more suitably realistic for developing and testing the KLS.

Each static lesson slide was followed by an interactive task slide (7 in total) containing identical text and illustrations from the previous slide. Illustrations on the task slide were moveable for guided assembly through use of a tracker pad, mouse, or touchscreen. It was observed that students who used a mouse found the interaction easier than those who used a tracker pad or touchscreen, but all students were able to complete the study and assembly tasks within the allotted time frame of 25 minutes. Some students participated on their mobile phones but most participated on laptops. Students using PCs reported less technical difficulties in navigating PowerPoint than those using Mac devices. Key feedback improvements taken on board from the student cohort led to the following improvements in the KLS:

- Provision of improved instructions for navigating the lesson
- Provision of detailed stepwise information on how to use PowerPoint (as the level of PowerPoint knowledge varied)
- Reduction in the complexity of diagrams by reducing schematic content in favour of illustrative
- Incorporation of a video made from animated lesson icons and lesson notes to provide an overview of the lesson prior to study

4. Discussion and Conclusion

The molecular sciences are dense with theories and abstract concepts that cannot be readily visualised. Consequently, learning of the molecular sciences is particularly challenging by comparison with subjects which can be readily visualised. For example, anatomy contains familiar concepts (e.g., digestion) which can be explained using relatable visuals and familiar terminology (e.g., cells). Contrast this with the molecular life sciences replete with unfamiliar concepts (e.g., ionotropic receptor activation), which are generally represented as schematic visuals with basic shapes, intertwined with arrows and taught using alien terminology (e.g., cyclic adenosine monophosphate). Molecular science learning is hampered by the common use of abstract language and visuals to explain abstract processes and accordingly, reduces the relatability of the subject matter. KLS is a framework with the potential to address the challenge of making molecular science more relatable and tangible for learning.

Students can use the visual and interactive aspect of KL assembly to engage in various lesson scenarios, study them repeatedly if they so choose and at their own pace, in a manner that supports intrinsic processing (Mayer RE, Hegarty M, Mayer S, Campbell J, 2005) while minimising cognitive overload. This addresses one of the major advantages that static, paper-based learning has retained over computer-based learning thus far. Students using the KL assembly approach in PowerPoint do not require prior knowledge of the lesson content as they can interact with onscreen content in a stepwise manner in tandem with learning as they proceed through the slides. This enables a faster process of knowledge attainment for the student and reduces the time an educator must spend introducing the background information for a topic. A key aspect of the KL assembly design is that it facilitates the rapid assessment of student engagement, as judged by the level of correctly assembled scenarios, prior to examining students via traditional assessment formats.

Several successful translations of kinaesthetic approaches to online learning do exist in the form of simulations for laboratory science (for example, the ‘Anatomage Table’ (https://www.anatomage.com/table/). However, the majority of these simulations do not meet the KLS criteria outlined, particularly with respect to adaptability, affordability, simplicity in

design and user directed expandability. The KLS outlined here offers a framework which educators can use to develop, adapt, and build bespoke KL assembly approaches for enhancing their lesson material and to customise these to match the level and ability of their learner cohorts.

In conclusion, our work demonstrates how the format developed is feasible for integrating a KL approach into complex molecular life sciences. Adopting, evolving, and evaluating these approaches will enhance their efficacy going forward.

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New tools for online teaching and their impact on student learning

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Abstract

In the context of the global Covid-19 crisis, a practical introductory Geosciences course was redesigned to aid student learning in a 100% virtual format. New materials were created to i) improve disciplinary language range and concept acquisition; ii) make classes more dynamic; iii) provide tools for self-regulated learning and assessment and iv) maintain student motivation. Usefulness of the new materials was evaluated using a voluntary online survey that was answered by 40% of the students. Additional information was obtained from the university's student evaluation survey.

All tools were well-rated, but self-assessment quizzes and class presentations had the highest overall scores. Students commented on their usefulness in terms of knowledge acquisition and self-assessment. Perhaps not surprisingly, self-assessment quizzes were the one tool students felt kept them more motivated. These were closely followed by class presentations and short in-class quizzes. Students found the online access to all lesson materials very useful for self-paced learning. According to a majority of students, the in-class quizzes and student participation using the digital the whiteboard made classes more dynamic.

Overall, the new strategies succeeded in improving students' learning and independence, but more work is needed to make classes more dynamic, and especially to improve student motivation. Intrinsic motivation is perhaps the most difficult to improve because in a 100% virtual course, it is difficult to promote student-student interactions and receive visual feedback from the class. In view of the survey results, we introduce bonus activities in order to improve extrinsic motivation.

Keywords: *Online teaching; independent learning; intrinsic and extrinsic motivation; self-assessment, self-paced learning.*

1. Introduction

Due to the Covid-19 global crisis, many undergraduate programs have had to undergo a drastic shift from in-person classroom teaching to online synchronic lectures (e.g. Baber 2020). In view of the need to redesign the course for online teaching, we created new materials to address several key issues for the learning process, namely language and concept acquisition, dynamization, self-regulated learning and motivation. Not being able to demonstrate concepts using hands-on group activities has made it very challenging to keep the student population motivated. It is difficult to make online classes dynamic because of the lack of direct participation and spontaneous interaction among students (Huguet et al. 2020) in large remote-learning groups. Moreover, the diversity of the student population makes it difficult to tap into intrinsic motivation and address the differing levels of previous knowledge in an integrated way. Other challenges, such as the fact that not all students have consistent access to a computer or stable internet connection, became apparent at the end of the first semester of 2020 during the strict Covid-19 nationwide lockdown, which in Colombia lasted over 6 months. Therefore, the course redesign needed to include asynchronic tools to promote autonomy and allow students to self-regulate their learning.

There are some arguments in favor of online learning, such as flexibility and autonomy of the learning process (e.g. Baber, 2020). However, distance learning, especially in the current lockdown context, can result in students feeling unmotivated and isolated, which lowers their academic performance (Baber, 2020): these issues were identified by UNIANDES in several surveys given to students throughout 2020. Science knowledge building must address both intrinsic and extrinsic motivation, and students are more motivated, and learn better, by interacting with classmates and teachers (e.g. Glyn et al., 2009; Bergmann & Sams, 2012).

In the online version of the course, we addressed extrinsic motivation by giving short, very frequent activities that represented a small fraction of the course grade, and by reducing the weight of single evaluations such as exams. This was done to lower anxiety (Glyn et al, 2009) and to provide more opportunities for students to receive feedback and encourage a sustained effort throughout the course. Intrinsic motivation was perhaps the most challenging part of the course redesign, since we needed to create opportunities for interaction while in isolation, and emphasize the relevance of the course for non-geoscience majors. Because the course is still 100% virtual (and will likely continue to be until at least 2022), it was crucial to evaluate the overall impact of the newly created materials. We wanted to see how the redesigned tools had influenced new language and concept acquisition. We also evaluated which materials were considered most useful for students to assess their progress during the course, make the course more dynamic and keep learners motivated. Students were asked to participate in a voluntary online survey, in addition to the institutional student surveys, to help us identify areas of improvement.

2. Methods

In the context of the covid-19 worldwide pandemic, an undergraduate geoscience course was redesigned from an in-person hands-on course to a 100% online format starting in March 2020. Several new tools were created based on the existing literature, and courses provided by pedagogy and technology experts at UNIANDES as well as online platforms. The surveys were designed to assess the students' perception of the usefulness of the tools and whether they had influenced their motivation.

2.1. New tools introduced

Class Presentations: Presentations were redesigned to include in each class a list of contents and a glossary of the relevant geoscience terminology and main concepts. A list of ten questions was given at the end, so students could assess their understanding of key concepts when reviewing the material. Videos and short articles were also provided within each presentation to complement and broaden professors' explanations.

In-class quizzes: Each class included a formative assessment, consisting of multiple choice or true/false questions that were delivered during or at the end of the class by means of online surveys that could be answered anonymously. The correct answers were discussed in class, providing immediate feedback.

Post-class self-assessment quizzes: Each lesson had at least 10 questions online that were available from the day of the class presentation onwards and could be done as many times as required by the student. Those questions were designed to be more challenging than the ones in class, calling for the application of novel concepts to specific cases, and in some cases for a revision of the materials provided in class. Students saw only one question at a time and had to complete the quiz in order to get feedback. Feedback was given in the form of correct answers and the reasons why the other answers were incorrect.

2.2. Evaluation of tools

We designed an online survey using QualtricsXM (https://www.qualtrics.com/) to assess the usefulness of each material in addressing our five aims. The survey was delivered at the end of the course, and obtained 144 responses from a pool of 357 students. Since participation in the survey was voluntary, and students are required to complete the general university survey for each course as well, we were pleased that 40% of the students participated.

3. Results and discussion

3.1. New language and concept acquisition

A remarkable decline in the vocabulary of university students has been reported, which is even more pronounced for discipline-specific language (Caratozzolo et al, 2019; Twenge et al., 2019). The acquisition of appropriate scientific-disciplinary language is key for professional development and one of the skills regularly requested by employers (Caratozzolo et al, 2019). Hence, one of our aims was to broaden students' Geoscience lexicon. While we expected the glossary at the end of each class to have a prominent role in discipline-specific language acquisition, students found the tool to be only 74% effective (Fig. 1a). Instead, the self-assessments and class presentations were rated as 80% and 85% effective respectively, in improving geoscience language acquisition (Fig. 1a). We believe this may be because students learn new language and concepts better within a context than when given an explicit vocabulary list to learn. The way in which new vocabulary is delivered is key, it has been shown that the timing (before, during or after) is not as important as the manner in which a content area is delivered (Memory, 1990).

For new concept acquisition, students highlighted the relevance of the self-assessment quizzes (84%) and class presentations (85%) (Fig. 1b). We believe that the class presentations serve two complementary functions: the professor explains new concepts, and examples are given in a context that helps student´s understanding. Both purposes fall within the first levels of Bloom's taxonomy (Bloom & Krathwohl, 1956), which are necessary but not sufficient. This was then complemented by the the self-assessment quizzes, which were designed to challenge the students to integrate and apply the newly acquired concepts. The self-assessments therefore target the higher levels of Bloom's pyramid (Bloom & Krathwohl, 1956), thus providing a full spectrum of learning opportunities for students.

3.2. Self-assessment of learning

Students' self-assessment is fundamental for meaningful deep learning, self-regulated learning and metacognitive skills development (Orsmond and Merry, 2013). Especially in the current Covid-19 context, it is important to empower students to be independent and evaluate their own knowledge acquisition (Orsmond and Merry, 2013). The opportunity to evaluate understanding outside of the formal grading context helps reduce students' anxiety when undertaking graded evaluations (e.g. Glyn et al, 2009).

Students rated the self-assessments as 87.8% effective at tracking their learning (Fig. 1c). Learners especially valued being able to access self-assessment quizzes whenever they needed, repeat them as many times as they wanted, and always obtain feedback on their responses. They said it was very useful to prepare for exams, since it gave them a "safe" exam-like environment to test their conceptual understanding. This tool was purely self-

regulated and independent, so one downside was that teachers did not have access to information on student performance, and could not take any action on that front.

In-class questions and quizzes for which instant feedback was provided were also highly valued (73%; Fig. 1c) in terms of self-assessment. Since they were completed within the class, students could see if they needed to go over some concepts again, or proceed directly to the more challenging post-class self-assessment quizzes. Some students also viewed these short quizzes as a kind of summary of the key concepts seen during class, and that helped them identify possible gaps in their knowledge acquisition. Questions and quizzes in class also gave the teacher the opportunity to track students' understanding of the concepts, correct misconceptions and emphasize key ideas covered in the lesson. In this case, the limitation was that only students who attended the classes synchronically could take full advantage of these tools. However, the questions and answers were also recorded, so some students reported them to be useful when viewing the recorded classes asynchronically.

3.3. Making online classes more dynamic

Even though some students commented that online classes were tedious and repetitive, several of the designed tools were useful to improve the flow and class dynamic (Fig. 1d).

In-class quizzes were again rated the highest for making the course more dynamic (74%) closely followed by the list of questions at the end of the class presentations and the post-class self-assessment quizzes (71%) (Fig. 1d). To our surprise, some students suggested increasing the number of non-graded quizzes. This was unexpected, since one of the requests from the university was to markedly reduce student load during the Covid-19 crisis.

Virtual classes were rated as 67% useful for making the course dynamic (Fig. 1d), which is not a bad result considering that in-person classes include hands-on activities and materials that could not be used in the virtual version of the course.

Although the virtual whiteboard was not included in the set of tools we designed, it was mentioned several times in the comments of the university survey of student perceptions. The opportunity to use the virtual whiteboard to answer questions posed by the teacher was perceived to make the online classes more dynamic. We noted that during in-person classes students were often reluctant to participate verbally or using the board, but the online version provided anonymity, which increased students' willingness to participate and take the risk of answering questions. This was an unexpected benefit of the virtual format.

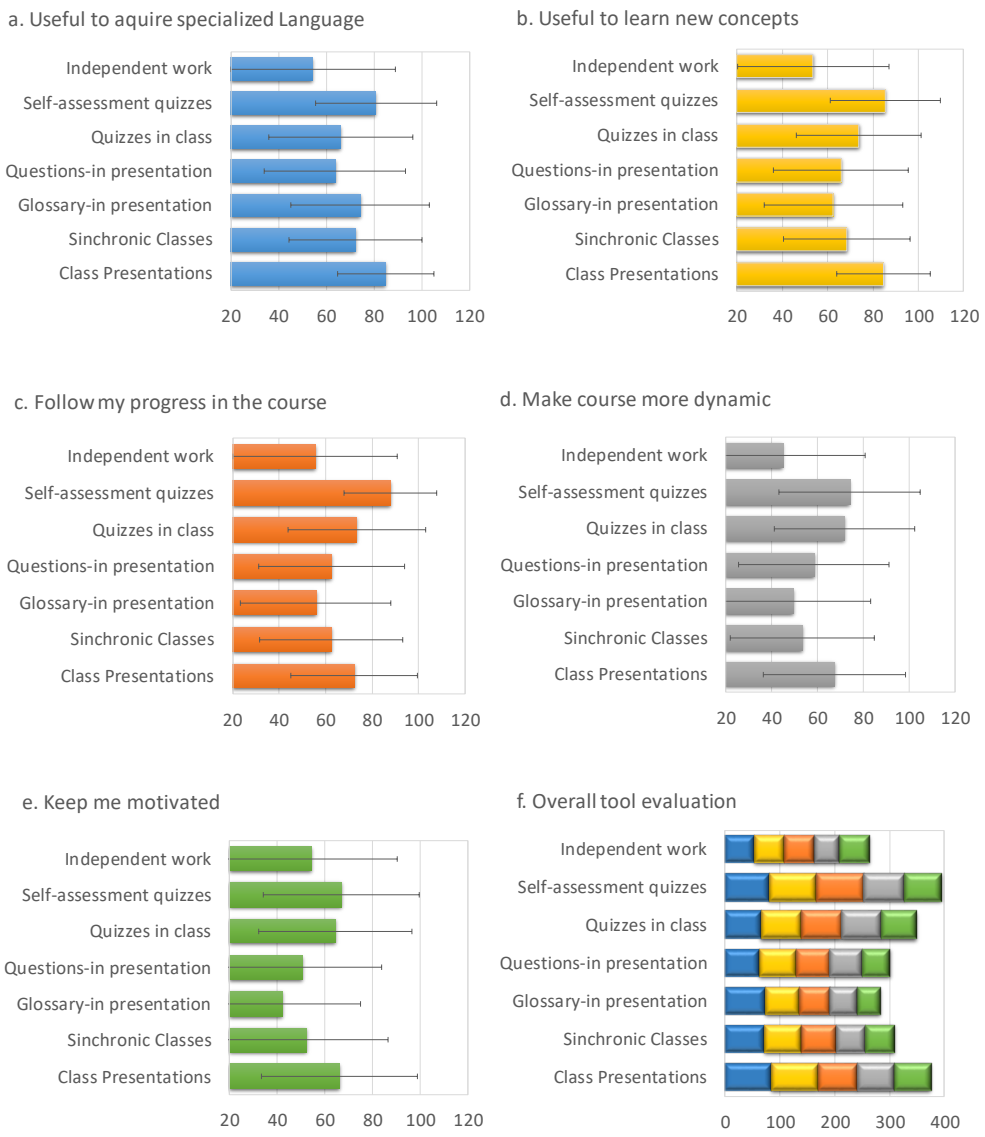

Figure 1. QualtricsXM survey results of tool usefulness on a. lexicon acquisition, b. concept acquisition;c. self-assessemnt; d. dinamization of the course; e. student motivation and f. overall tool ratting. To learn new language (blue), To follow progress (orange), to keep motivated (green), To learn new concepts (yellow) and to make course more dyaic (grey). Data are based on 144 answers and standard deviations are indicated with grey bars

3.4. Motivation

Generally, motivation can be divided into intrinsic and extrinsic (Ryan & Deci, 2000). Intrinsic motivation happens when the individual considers the information interesting, relevant and enjoyable, whilst extrinsic motivation is related to a specific outcome (such as grades) (Ryan & Deci, 2000). Science knowledge-building must address both intrinsic and extrinsic motivation to be truly successful (Ryan & Deci, 2000), and students are more motivated, and learn better, by interacting with classmates and teachers (e.g. Glyn et al. 2009; Bergmann & Sams, 2012). As educators, we aim to engage students in learning in class in order to motivate them to continue learning on their own (e.g. Van Der Hoeven Kraft et al., 2011). We feel that increasing motivation was the goal we addressed less effectively: students perceived most of the new tools as not particularly effective for increasing motivation (Fig. 1e). Self-assessment quizzes (66.8 %) and class presentations (66%) got the highest evaluation, compared to the other tools (Fig. 1e) but where still in the lowest range.

Class presentations included numerous examples, images and videos that were designed to capture the students' attention. Several students commented on the university survey that being able to access recordings of the classes and review the contents of the presentations motivated them to learn and work on their own. Some also mentioned that having additional videos with in-depth explanations motivated students to learn more on the subject and to explore other sources independently. Thus, it seems intrinsic motivation to learn was fostered by this tool. Learning science for its own sake (intrinsic motivation) is not the general driver in this course since most students will only take it because it is compulsory. Nonetheless, some students commented that they felt the course content was engaging and relevant to their everyday life, which helped keep them motivated. Many of the students are engineers, thus including examples relevant to engineering, and “surprising facts” was found increase intrinsic motivation.

4. Conclusions

Overall, the “forced” online version of the course was positively evaluated by the students, with most of the newly-introduced tools considered successful in improving learning. Further work is needed to make online classes more dynamic, interactive, and motivating.

The self-assessment quizzes received the highest overall rating, as they were useful not only for keeping track of progress independently, but also for reducing assessment anxiety, increasing motivation, making classes more dynamic and for learning new vocabulary and concepts.

Class presentations were also very well rated especially for acquiring new knowledge and keeping students engaged.

In order to address some of these issues we are increasing the number of interactive activities involving the digital whiteboard, as students seem more willing to interact with the teacher and each other in an anonymous virtual setting. We also further reduced the weight of graded individual homework assignments and exams, and included some optional activities that contribute to an overall bonus mark. It has always been impossible to achieve a perfect score (5) in this course, so we hope that a 5% bonus will contribute to extrinsic motivation.

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Suddenly moving large classes online: Illuminating the experience of the teaching staff in one university

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Abstract

In early 2020, the transition of large classes from the face-to-face to the online context occurred overnight and at scale at a time when the crisis was being faced at all levels of society, nationally and internationally.

This paper is based on research which examined the impact of this sudden transition on large classes in Dublin City University with a view to illuminating the experience to inform future practice (Authors., in press). A rapid, systemised review of literature was carried out with the aim of contextualising data gathered through surveys with staff and students in relation to our experience of moving large classes online in the early stages of the Covid-19 pandemic. While the study examined the impact from the perspectives of teaching staff and students, this paper reports on the perspectives of teaching staff only. Large class teachers found this experience challenging, reporting a sense of isolation and worry. However, it would seem that opportunity was seen in the face of adversity, whereby staff have identified potential for better ways of doing things going forward as a result of their experiences between March and May 2020

Keywords: *Large-classes; online; emergency-teaching; Covid19.*

1. Introduction

Technology-enhanced learning (TEL) and a greater flexibility in programme delivery are highlighted as indicators of success/progress in Dublin City University's (DCU) strategic plan 2017-2022 (DCU, 2017). The swift pivot of face-to-face programmes to the online environment as a result of Covid-19 created a situation whereby students and staff had to engage with a teaching and learning context reliant on technology. The transition of classes from the face-to-face to the online context occurred overnight and at scale at a time when the crisis was being faced at all levels of society, nationally and internationally. Therefore, online teaching and learning in this context could not be the same as planned online courses because the former was reactive in nature at a time of crisis while the latter is usually underpinned by evidence based best practices regarding online pedagogy (Eaton, 2020; Hodges et al., 2020) . These practices include development of social, teacher and cognitive presence through carefully designed engagement pathways and activities (Ní Shé et al., 2019); embedding universal design for learning (UDL) to enhance inclusion of all learners online (Kumar & Wideman, 2014); and the provision of appropriate professional development for teachers embarking on the online teaching journey (Farrell et al., 2020) .

Teaching staff have, by default, learned new skills and been forced to (re)consider pedagogy. At the early stages of the pandemic, teaching staff were forced to fashion solutions quickly and under pressure (Hodges et al., 2020); a unique situation which was swift, often under-resourced and characterised by lack of planning (Smith & Hornsby, 2020). The acquisition of online teaching skills was rapid and at scale as the majority of classes, programmes and modules transitioned online simultaneously. For large class cohorts, the renewed focus on pedagogical practice awakened by the pandemic is welcome, challenging assumptions and providing an opportunity to reimagine the experience of teaching and learning for large groups (Authors., in press). The problems with class size are not embedded in the scale per se but rather in the pedagogical approaches chosen (Hornsby, 2020). Basic pedagogical principles such as good planning, being systematic, developing authentic assessment practices are important as much for teaching large classes (Exeter et al., 2010) as they are for teaching online.

2. Methodology

The purpose of this research project was:

- To shed light on the sudden transition of DCU's large classes (100+ students) from the face-to-face teaching and learning setting to the online environment in March 2020 from the perspectives of staff and students.

- To contextualise the findings arising from the examination of the transition referred to above by reviewing relevant literature.
- To inform the work (a) of academics in DCU teaching large-class cohorts and (b) of DCU's academic developers and learning technologists, supporting them in this endeavour, as large programmes and modules move online in the forthcoming academic year.

The research approach was evaluative in nature, with the aim of illuminating the innovation (Parlett & Hamilton, 1972) of moving large classes online from a range of perspectives in the DCU context and in the wider, international context. Data were collected from three key sources: (1) a rapid, systematised review of relevant literature; (2) surveys of DCU students and staff who experienced the recent pivot of their large classes online; and (3) information relating to the Teaching Enhancement Unit (TEU) teaching supports provided to staff during the period March-June 2020. The scope of the project was determined by the tight timeline for the project itself and by the urgency of providing guidance by September at the latest. so that it could be used by DCU staff as they moved large-class modules online for the new semester (January 2021).

2.1. Literature Review

From the outset, reviewing the literature was conceptualised as a data gathering process, informing the research questions rather than an exercise in providing a rationale for the study per se. To that end, the approach to reviewing the literature was systematic, although due to time the constraints of (a) the project itself and (b) the phenomenon under investigation, it was not possible to conduct a systematic review in its purest sense. The principles underpinning the literature review were as follows:

- To gather together and examine what was already known, understood and experienced by others (Gough et al., 2021) in relation to each element of the focus of this study i.e. large classes, online teaching and learning and inclusion of all learners.
- To gather a range of perspectives to gain an understanding of how the two key pedagogical phenomena under investigation (large classes and the sudden pivot to online learning) were experienced by others and how they approached the challenges arising (Gough et al., 2021). This was particularly important in relation to the sudden pivot online, hence we searched for material through the more unconventional social media route, Twitter to ensure we were accessing a range of perspectives.

- To utilise a systematic approach to searching the literature which would minimise bias while simultaneously providing clarity (Cornish, 2015), taking the tight time-frame into account.
- To balance the more formulaic systematised searching approach with the interpretive voice of the authors (Booth et al., 2021).

In terms of the swift pivot from face-to-face to online teaching and learning experienced globally by the higher education community since March, it was deemed likely that there would be little value in looking for 'evidence' of best practice in that circumstance but rather, the value in reviewing the literature was to take account of the context and complexity of the situation (Cornish, 2015).

The approach finally adopted can best be described as a combination of a rapid and a systematised review; the completeness of the former determined by time constraints and the latter characterised by a systematic process, stopping short of a systematic review (Grant & Booth, 2009). This rapid, systemised review was conducted between 15 July and 30 August 2020, focusing on the following key areas:

- Large classes in higher education
- Inclusive approaches to designing learning
- Perspectives on the recent and sudden pivot from the face-to-face to online teaching and learning context
- Existing key DCU research reports relevant to the focus of this study

2.2. Staff and student survey design

Staff were surveyed using a questionnaire comprising open and closed questions. The research team decided to use questionnaires to maximise reach to the staff and student body to ensure inclusion of as many perspectives as possible. Questionnaires for both staff and students were developed between May and June. Both versions were piloted with two staff and two students respectively; time did not allow for inclusion of more pilot participants. Feedback from the pilot participants was used to amend and refine aspects of each questionnaire. Google Forms was used as the platform for the questionnaire.

2.3. Teaching supports

Both the self-paced resources from our staff support page and the synchronous sessions involve the use of electronic systems that capture data about those that engage with them. As the TEU is responsible for the provision of these resources and offerings, these data were explored to enhance the synthesis of the data arising from the surveys.

3. Findings & Discussion

Findings are reported from the perspectives of staff only for the purposes of this paper. Full report on findings may be found in the research report (Farrell et al., in press).

Table 1. Class sizes of staff respondents.

What best describe the size of your large class(es)?	Staff
100-200 students	29
201-300 students	7
301-400 students	2
More than 400	9
Total	*47*

47 out of 350 staff that teach large classes responded to the survey. Only three of the 47 staff respondents indicated that they had not used Moodle, the university VLE, before moving online in March. Fifty-five per cent (n=26) staff respondents reported having prior experience of teaching online; however, the depth and breadth of that experience was not explored in the survey.

Using a Likert scale, staff were asked to indicate their comfort levels in terms of teaching online with 73% (n=34) indicating higher levels of worry about teaching their large classes online at the beginning of the emergency transition. Perhaps unsurprisingly, 70% (n=33) indicated that they lacked confidence about teaching their large classes online, with at least half of these identifying as being at the lower end of the scale. Interestingly, despite feeling worried and unconfident, staff indicated that they did feel competent to teach their large classes online with 40 staff respondents indicating feeling competent in their ability to carry out their work in the new environment. However, they did indicate that they were more worried about moving their large class cohorts online than they were about smaller groups with 89% (n=42) indicating medium to high concerns.

When asked if using Zoom was a challenge, 74% (n=35) disagreed that it was, with 26 of these respondents strongly disagreeing. This seems to indicate that the use of Zoom as the 'classroom' was not a key factor in contributing to the challenge experienced by staff in terms of synchronous teaching. The perceived lack of challenge in using Zoom may possibly be attributed to the support staff received in using the platform; 78% (n=37) disagreed that lack of support was a challenge although 80% (n=38) indicated that finding the time to attend training sessions was challenging. 85% of staff revealed a very strong feeling of disconnect with the student cohort and it may be likely that this is a factor relating to the perception of staff that they struggled with synchronous teaching. At least two-thirds of staff strongly agreed that transferring tasks online was a key challenge.

Staff views mirrored those of students in terms of their perception that the main advantages of online learning were the provision of additional online resources (36%, n=17) and the opportunity for students to engage with materials asynchronously (21%, n=10). Some staff also reported that the chat function enabled greater participation with the large class cohort.

Staff were asked open questions regarding what elements of teaching they believed remained the same and what changed when they moved their large classes online. Table 2 provides an overview of the key themes emerging from the analysis of that qualitative data.

Table 2. Staff perceptions of changed and unchanged elements of teaching large classes online.

Unchanged elements of teaching large classes online		**Changed elements of teaching large classes online**	
Content being covered	34	Less personal interaction	24
Presentation	13	Harder to adapt delivery to students' needs	22
Very few similarities	5	Student participation	21
Getting students engaged	4	Less student participation	9

Those staff members teaching large classes did not engage as much with Zoom LSSP resources as staff teaching in other contexts. This is possibly due to the fact that there was more asynchronous engagement planned for large class cohorts than for smaller groups. Furthermore, very large classes (over 300) could not be hosted on Zoom Meetings so all engagement was likely to have been asynchronous for those cohorts. Interestingly, the highest ranked resource was that supporting Loop's Gradebook, indicating perhaps that assessment is a key area requiring staff support regardless of class size. Almost all staff reported that the summative assessment for their large class groups had changed partly (49%, n=23) or entirely (19%, n=9) as a result of the move online. With the future in mind staff and students were asked to consider recommendations and suggestions for each of teaching, learning, assessments and technical supports for the next semester. The reason was twofold: acknowledging that Covid-19 would likely still impact in some way at least in the immediate future but also to identify what are the elements of teaching online that can be continued when we return to face to face teaching. Respondents identified a very wide range of areas for improvement. The staff who responded to suggestions regarding learning going forward, tended to make recommendations for their own pedagogical approaches as they had when considering teaching rather than suggesting approaches students might make to enhance their learning in the online space.

4. Conclusions

Emergency online teaching is distinctly different to planned online teaching. Despite this research being conducted in relation to the emergency pivot online there is an opportunity

for DCU to learn from the experiences of the crisis to inform pedagogy (Persky et al., 2020) at institutional, faculty, school, programme and individual academic levels. The feedback from staff and students during this pandemic can help inform both our teaching and our academic staff development going forward.

Staff indicated a sense of disconnect i.e. cameras turned off during synchronous sessions; lack of student engagement, lack of peer interaction generally and specifically in relation to tasks; and lack of feedback on tasks. It would seem that the importance of teachers being explicit in terms of their expectations of synchronous and asynchronous engagement cannot be overemphasized.

Each of these issues can be addressed through application of the community of inquiry model - teacher presence, social presence and cognitive presence (Garrison et al., 1999). The authors would argue that teacher presence in face-to-face teaching of large classes is equally relevant and its importance is often overlooked. However, creating a sense of community and belonging in large classes can be difficult. Students can feel anonymous in large classes, isolated and uncomfortable asking questions in front of their classmates. The major lesson learnt from this research and the recommendation from this research is that the implementation of the same variety of approaches to foster teacher presence in an online environment should be used teaching large classes face to face. The VLE plays a crucial role in implementing the community of inquiry model and as such the second recommendation is that sufficient CPD and support is provided to staff teaching large classes to help optimise the use of the VLE.

In conclusion it would seem that opportunity was seen in the face of adversity, whereby both students and staff have identified potential for better ways of doing things as a result of their experiences between March and May which may be useful going forward, regardless of face-to-face or online contexts. As an institution we must equally see the opportunity and address the concerns raised as part of this research through staff development thereby helping the university meet goals of the university strategic plan.

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Emotional training of online journalists via multimedia communicative projects linked to sustainable development

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Abstract

This paper describes an innovative pedagogic initiative for training Communication and Journalism university students. This initiative has been designed within the framework of a funded project financed. This has seeked to train future communicators in Transversal Competences (TC) via co-operative multimedia online journalism projects, focussed on subjects linked to the seventeen United Nations' Sustainable Development Goals, to be accomplished by all member States by the year 2030 (Agenda 2030). As this paper concludes, online journalist work with SDG projects can be a useful teaching strategy in the classroom for promoting learning skills and results sustained by the development of students' Emotional Intelligence (EI). In addition to contributing to the training of students in emotional competences, this innovative teaching initiative has led to develop other abilities related to EI, such as the capacity to work as part of a team.

Keywords: *Online journalism; teaching; affective turn; SDG; report.*

1. Introduction

Different studies explain why online journalism has been one of the main driving forces in the renovation of study plans for Communication over the last decades (Tejedor, 2006; Larrondo & Peña, 2018; etc.). By focussing on one specific case of teaching innovation, this paper seeks to justify the suitability of subjects about online journalism for innovating the university training of communicators via the so-called "affective turn" of the social sciences (Ticineto and Halley, 2007). As far as emotional training is concerned, from a basic and general viewpoint, this is a requisite that seems to be especially important in work environments such as that of online journalists. Here, strategies of newsroom convergence within the Communication Groups and the strategy of multi-channel content marks the need to work in multidisciplinary groups, with diverse work profiles, in a constantly changing environment where emotional tools are extremely useful – motivation, active listening, team vision, etc.

This work is supported by a double premise. On the one hand, the idea that emotions are a basic resource for working in online and converging newsrooms: the online journalist is a mediator with a service function and emotional qualities that are difficult to substitute by increasingly present journalistic robots. On the other hand, the idea that (online) journalism is a tool capable of generating emotions and raising awareness about the main socio-economic problems that influence society, from the perspective of global initiatives such as Agenda 2030 and the Sustainable Development Goals (SDG).

2. Emotions and journalism: educational challenges

The interest in emotional discourses are dependent on current society in which the expression of emotions is made easier by the use of connected technological devices. These are considered "affective machines" and, in the specific case of social media, are even thought of as "affective technologies" with a capacity to reconfigure current conceptions about liberal democracies. There has also been talk of an "affective society" (Belli, Harré and Iñiguez, 2010).

Whilst it may be true that journalism should be supported by values such as objectivity and impartiality, in some cases the expression "emotional journalism" has been linked to an unethical kind of journalism, dictated by sentiment and prejudice, a kind of journalism that is partial or not very objective. Literature, cinema and television have been responsible for spreading clichés that have reinforced an image of the journalist who uses emotion negatively, and so it is not surprising that society holds contradictory opinions about these professionals. Be that as it may, in this work we refer to emotional journalism as an empathic, feeling journalism along the lines of the recent contributions from authors like Skare (2020). To mention just one example, in news concerning gender injustice an emotional journalism

capable of moving the public has proved to be extremely useful. It is worth remembering also that the relationship with sources via social media has made these relationships more and more emotional, as highlighted in the research carried out by Sánchez & Mendes (2013).

To speak of emotional educational competences in journalism therefore implies working in favour of the creation of an emotional awareness in students and future communicators. Some authors also speak of encouraging abilities linked to journalists' Emotional Intelligence (EI). As Paloma Sánchez explains (2012), EI contemplates various areas or components, among which are highlighted: a) the capacity for group organisation and effort coordination among people, personal connections, i.e. empathy for favouring contact with others; b) recognition and respect of feelings and interests, which, in short, leads to a command of the art of relationships; and c) the ability to detect and sense people's feelings, motives and interests, a knowledge that usually promotes the establishment and deepening of relationships with others (Sánchez, 2012).

EI conditions and influences the abilities, capacities and skills necessary for the correct practice of the journalist profession. Sánchez's work reflects on the significant role that emotional intelligence plays in the development of the interview genre on the part of the journalist. From a more global perspective, Óscar Herrero's book (2016) – La ventana interior. Inteligencia emocional aplicada al periodismo (*The internal mirror. Emotional intelligence applied to journalism*) – also examines the influence of emotional intelligence in the development of this professional activity.Thus emotional intelligence becomes a compliment to a purely theoretical and procedural or technical knowledge. For Herrero, journalists' emotional skills help them when it comes to elaborating and creating news. According to this same author, while integrity helps journalists to be rigorous with data, empathy helps them identify the concerns of others and deal with subjects that have real social relevance.

These emotional skills are directly related to journalistic ethics and creativity, given that emotional intelligence in journalists also implies the motivation and self-esteem to innovate (Dueñas, 2002). Such emotional skills can be perceived, therefore, in many of the Transversal Competences that many Faculties promote in their Communication study plans.

Emotional competences can have a more individual facet (personal skills) and another more social one (social skills). For online journalists, individual competences are important to function in the work environment in this professional field (confidence and an adequate assessment of oneself, understanding and recognition of one's own feelings, etc.), whilst those of a more social nature would have a bigger impact on their function and role of service to society, i.e. those which derive from an attitude of empathy towards others (a capacity to anticipate society's needs, a capacity to understand the interests and needs of the public, the need to give a voice to the voiceless etc.).

Applying the model of components that Goleman (1999) considers make up EI in the field of journalism, it could be concluded that journalists that have a greater emotional intelligence are also more capable of communicating better, of being team leaders and working cooperatively, of influencing others and solving conflicts. Goleman's model is interesting because it applies emotional development not only to the personal, but also to the organisational field. In this sense, the following statement by Goleman could also be applied to the field of communication and journalism in a context in which the media companies tend to converge into multimedia teams and in which there is more and more talk of the need to recuperate journalistic values, such as the search for truth and an in-depth, reflexive journalism which is above and beyond the consumption of fast journalism: "With their emphasis on flexibility, teams and a strong leaning towards service, emotional competences will be more and more decisive in obtaining excellence"(Goleman, 1999: 52). As Sánchez states (2012: 124), "the development of emotional intelligence competences in the journalism profession is necessary because all communicative processes are influenced by intrapersonal intelligence".

3. Analysis

3.1. Context: pedagogical innovation in (online) journalism via SDGs

Within this context of constant technological, communicative and pedagogic adaptation, the University of the Basque Country introduced during the 2011/2012 academic year, the subject "Online News Writing", an obligatory subject in the second year of Degrees in Audiovisual Communication, Journalism and Advertising and Public Relations. Since its introduction, this subject has sought to strengthen those skills necessary for creating messages adapted to the characteristics and possibilities of online news media, in real time, and for working collaboratively to develop online journalistic projects with a multi-platform and social perspective. Thus, this subject develops a didactic approach related with content and genre (news, report, infographics, feature, interview…), narrative styles (multimedia, transmedia…) and formats (text, video, audio, image, etc.). From a general theoretical point of view, the subject aims to offer the necessary resources for "learning to learn" about web culture and familiarise the student with the increasingly more complex media ecosystem of the Internet. In fact, online journalism professionals are renowned for their creative capacity and their innovation.

The subject of Online News Writing (UPV/EHU) has become a hotbed of pedagogic innovation in the last decade and has been the object of four Educational Innovation Projects (PIE), all developed by the KZ-Berri Gureiker Group (IT1112-16), of the University of the Basque Country (UPV/EHU). This paper gives an account of the latest of these projects, entitled "Teaching to communicate in and for a globalised world. Promotion of Transversal

Competences (TC) and Sustainable Development Goals (SDG) in learning based on enterprising transmedia projects".

3.2. Methodology

The aim of the project is to propose value-added methodological formulae to update the university teaching of the Specific Competences (SC) of the subject, linked to multimedia online journalistic formats and genres via the development of Transversal Competences (TC) for the development of a more responsible, sensitized and critical vision of online journalists in relation to current social problems connected to a global and digitalised public. More specifically, the project has sought to implement six of the TCs indicated by the UPV/EHU (2019): Innovation and Enterprise; Social Commitment; Ethics and Professional Responsibility; News Management and a Digital Public; Critical Thought; and Teamwork.

As a result, this subject began, in the 2020/2021 academic year, to take advantage of different teaching methodologies to transmit the theoretical-practical content linked to the practice of journalism in the new environment, and to train online journalists in values and emotions. These methodologies included Project Based Learning (PBL), useful for simulating real professional environments. It is not surprising that previous studies have made clear the need to already begin practising teamwork at university with real projects (television programmes, specific radio, reports…) that help students "to begin learning to work in this profession, so as not to find themselves, as currently happens, without experience in team management when they start their first job (Sánchez, 2012: 211).

Over the first four months of the 2020/2021 year, teaching staff who cover the subject in the different groups (Spanish, Basque and English) have used PBL for the cooperative creation of multimedia reports about subjects linked to SDGs. This kind of in-depth project entailed individual and cooperative work strategies. The development of this type of project has sought to instil in students professional values such as responsibility, teamwork, self-sufficiency and empathy with readers in the online environment, with the aim of teaching how to apply new creative approaches to the solving of current problems in the field of communication. Among these problems it is worth highlighting mainly the tendency towards rapid, instant news (fast journalism), lacking in depth and, in many cases with sensationalist and commercial traits, as is shown by the expansion of phenomena such as clickbait. This is centred on the diffusion of headlines that do not seek to inform but to capture the reader's attention like a fish to a hook, by generating an emotional reaction that leads him or her to click on that information.

> *We are currently in times of many changes that involve intense transformations. It is true that, perhaps, journalism has partly forgotten its role of power guard dog, but this has coincided with a relaxation that can be felt in the whole of society. Entertainment has eaten away at information and,*

> *when this finds a space, it is nearly always of rapid consumption. Evasion takes precedence over reflection. In this context, it is not easy to provide quality news that has been worked in depth. Even so, we must continue with a commitment to providing content that isn't consumed in 30 seconds and that is more than a mere number of "clicks" (Herrero, 2017)*

The UNESCO (2019) approach to Sustainable Development Goals and the media places emphasis on the thematic agenda and the treatment of the news, but also on other directly related issues, such as journalistic education. In this regard, the UNESCO refers to the importance of generating "inclusive approaches aimed at strengthening journalism throughout the world". The UNESCO recognises the importance of promoting didactic methodologies for university education, the aim of which is to develop future communicators with a conscience and an appreciation of the treatment of subjects related to SDGs, such as that of the aforementioned UPV/EHU project.

In order to carry out pedagogic innovation in the subject of Online News Writing, groups of four students worked individually, collaboratively and cooperatively both inside and outside the classroom to conceive, plan and produce news reports or websites whose aim was the in-depth treatment of subjects linked to SDGs. Each work sub-group undertook the following tasks, organised in phases:

1. Preparation phase/Hackathon (collective innovation). The sub-groups work to think together and identify opportunities for innovation and the launching of public interest reports with different approaches (thematic hyperspecialisation in SDG, microtargetting, etc.).

2. Analysis and exploration phase. Each sub-group must assess the interest of the report in relation to the market and the current media business, viability, etc.

3. Product development phase (report, docuweb, special web, etc.). Each in-depth news product (website or special report) will be extended towards other media or communicative fields (transmedia approach) via public presentations, classroom debates, podcasts, etc. The initiative also considered the promotion of these experiences via social media, together with management and application for the development of different tools for the creation of news timelines, infographics and interactive images, among others. Two illustrative examples of the developed products are shown below.

3.3. Results and final reflections

During the 2020/2021 academic year, over fifty cooperative multimedia reports were produced, either directly or transversally linked to SDGs. To assess the degree of interest in the proposed methodology of pedagogic innovation, in the last few weeks of the Online News

Writing subject (December 2020 – January 2021) a questionnaire consisting of fifteen open and closed questions was given to all the students participating in the multimedia reports. Opinions were also gathered from the teaching staff involved in the initiative. The 158 questionnaires completed in the project reflected the need for working on aspects linked to the coordination of work groups on all levels, such as emotional training for future (online) journalists, approaching and addressing the subject agenda or coverage from a social commitment perspective. The results of the questionnaires show there is a great interest in working with SDGs in the classroom in order to achieve greater student involvement in their own training process, and in the generation of a specific identity as online journalists committed to their service role in a complex, internationalised or global society.

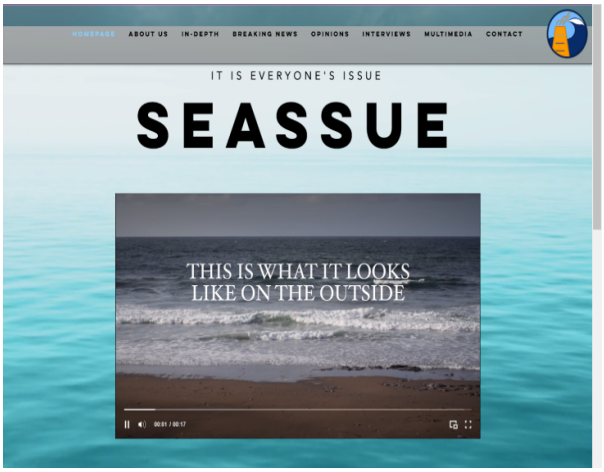

Figure 1. An example of the multimedia report created by the students. (SDG fourteen: Conserve and sustainably use the oceans, seas and marine resources for sustainable development) Source: https://seassue.wixsite.com/seassue

In view of the results obtained from the questionnaires and the majority percentages, it is possible to summarise some main ideas. On the one hand, the aims of the use of report is appropriate for working with SDGs, and the work and experience in the classroom has served to increase the students' level of empathy and awareness. This advance is especially notable in the case of problems linked to gender inequality and poverty (fifth SDG). At the same time, they have recognised that working with the SDGs has allowed them to promote the transversal competences highlighted in our teaching innovation proposal: Innovation, Social Commitment, Ethics and Professional Responsibility, News Management and a Digital Public, Critical Thought and Teamwork. Innovation was necessary to try to find different, original approaches regarding these subjects when they had already been dealt with by other news media. Likewise, news management was necessary when it came to prioritising the news provided by digital source documents and personal sources.

The students maintain that they are now more conscious of the importance of certain subjects and treatments for transmitting to a global audience powerful, quality news capable of fostering action and achieving the development aims established by the UNESCO. What's more, some of the comments make it clear that these subjects have had a great "impact" on these students. Similarly, the surveyed students recognise having increased their level of perception or awareness about the kind of treatment given by the media to these aims and their subject matter, which is still limited according to general opinion. What can be seen from the opinions given is the relevance of this methodology for making students reflect and move away from an excessive dependency on, or collusion with official sources in favour of another type of source and groups of interest (NGOs, neighbourhood associations, social movements, etc.).

Ultimately, at a time when there is a call for a more responsible journalism (committed to gender equality, sustainability, etc.) against an instantaneous, fragmented and sometimes superficial or sensationalist news, this paper shows that the consideration of SDGs within a context of journalistic education is effective. Online journalism needs trained professionals to respond to the constraints of current audiences. To this end, competences such as the ability to "move" and engage via subjects, which are of interest to the public are relevant, such as those linked to the seventeen SDGs. This initiative thus reveals the interest in and need to recuperate the social function of (online) journalism by applying the tendency of "affective turn" in Social Sciences and in higher education.

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Teaching in higher education during COVID 19 pandemic – Empirical findings and assumptions based on results of an online-survey in a European context

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Abstract

The COVID 19 pandemic is a worldwide phenomenon: On the one hand, it poses challenges to all social subsystems, on the other, it tests the extent to which they can cope with such situations. This is also the case in higher education. In this context, digitization, which has been driven forward in the field for years, provides approaches and instruments for adapting to such situations by converting the system as far as possible to operation in virtual space. This has been done in many places in universities and universities of applied sciences. It remains to be seen how this is perceived by those involved.

Therefore, the following article addresses the question: To what extent has the conversion of teaching and learning as a result of the restrictions on teaching caused by COVID 19 worked from the point of view of the teachers? To answer it, this paper presents empirical results of an online survey among teachers of the Cooperation Network for Risk, Safety & Security Studies (CONRIS). The results indicate a broad use of various digital tools for teaching and communication with students, but also deficits in the area of crisis structures as well as in social regards.

Keywords: *COVID 19 pandemic;teaching; digitization; higher education; online-survey; Cooperation Network for Risk, Safety & Security Studies (CONRIS).*

1. Introduction/Background

The COVID 19 pandemic is a critical situation that is challenging for all social subsystems worldwide since the end of 2019 or the beginning of 2020. One consequence is that all systems are put to the test in terms of their ability to adapt adequately to such a situation, it tests the extent to which the systems can cope with such situations and continue with their societal functions and tasks. This is also the case in education (Bozkurt & Sharma 2020; Daniel 2020; Mohmmed *et al*. 2020; Pascault *et al*. 2020), and here particularly higher education at universities and universities of applied sciences. Tools and approaches that the process of digitization brought years ago in the area of teaching and learning, seemed promising as relatively efficient solutions that could be implemented quickly. Converting the system as quick and as far as possible to operations in virtual space was probably an important strategy in many higher educational institutions (HEIs), not least because *"Many governments have ordered institutions to cease face-to-face instruction for most of their students, requiring them to switch, almost overnight, to online teaching and virtual education."* (Daniel 2020, 91). This has been done in many places in universities and universities of applied sciences, for example in Europe in March 2020 (c.f. Boer 2021). In this context a diversity of education formats – or even just different descriptive adjectives for these formats in some cases – like digital, distance, online or even emergency remote teaching appeared and have been discussed (Hodges *et al*. 2020; Milman 2020; Mohmmed *et al*. 2020; Pascault *et al*. 2020; Schütte *et al*. 2020). But during a crisis situation like COVID 19, however, the higher education system is not only confronted with questions about (partly new or shifting of) teaching and learning formats. The handling of such a crisis, e.g. in the context of crisis management and communication in different crisis phases, is also a challenge. Accordingly, staff members were possibly not only teachers who were in demand in terms of their flexibility, content-related and methodological adaptability, but also as a kind of crisis manager who acted and communicated at the interface between the organization and the students. It remains to be seen how this is perceived by those involved. Therefore, the following article addresses the question:

To what extent has the conversion of teaching and learning as a result of the restrictions on teaching caused by COVID 19 worked from the point of view of the teachers?

This question was raised and further developed during a workshop of the Cooperation Network for Risk, Safety & Security Studies (CONRIS). The CONRIS network started in 2007 as CONRIS in higher education, meaning universities and universities of applied sciences. The goal was, and is, to share knowledge across Europe concerning these study fields. Members of CONRIS meet regularly (twice a year) and organize a summer school every year. Currently, CONRIS is active in 12 countries from North to South and from Eastern to Western Europe, 18 partner universities and universities of applied sciences participate in the network (more info on www.conris.eu).

In order to answer the question posed further above, the decision was made to conduct an online survey among the CONRIS members. This paper presents the obtained empirical results which indicate a broad use of various digital tools for teaching and communication with students, but also deficits in the area of crisis management structures as well as in social regards. After some methodological explanations (section 2), selected survey findings are presented (section 3) and a few theses and conclusions are formulated (section 4).

2. Online-survey in the European network CONRIS

2.1. Online-survey-method – Technical and content-related aspects

The survey was firstly developed in close cooperation between the Artesis Plantijn University of Applied Sciences and Arts in Antwerp, Belgium and the Chair of Public Safety and Emergency Management of the University of Wuppertal, Germany. The target group of the survey was primarily lecturers and academic respectively teaching staff in the institutions organized in CONRIS. In a second step, the survey developed at the two institutions mentioned above was made available to the members of the network in order to collect and incorporate the relevant feedback. Subsequently, the survey was then transferred into a digital survey tool and made available to the CONRIS network members for answering for a period of four weeks. This means that the survey ran from mid-October to mid-November 2020.

The questionnaire is divided into a general section to collect the basic statistical data of the universities, such as the country and the type of institution (university, university of applied sciences). The same section specifically collects information on teaching at HEIs prior to the pandemic. The following section attempts to capture the timing of the response as well as the actual response of the HEIs to the occurrence of the pandemic. Following this, the questionnaire aims to capture specifically how lecturers conducted their teaching in the context of the pandemic. In addition to asking how they communicated with students, subjectively perceived difficulties and challenges for the teaching staff are of particular interest here. Furthermore, the tools used as well as the availability of technical equipment in the homeoffice were surveyed. The questionnaire concludes with a block of questions about possible options for a restart of the classical (presence-based) teaching concept after the pandemic.

There were different types of questions. The majority of the questions contained an option for additional comments in order to give the lecturers and teaching staff sufficient opportunity to bring their own perspective to the foreground, which was the subject of scientific interest here. After completion of the survey, the results were transferred from the online tool to SPSS, where, after cleaning the raw data, they were subjected to a quantitative evaluation, which was supplemented with a manual qualitative evaluation.

2.2. Sample and analysis method

The final sample includes ninety cases after choosing only those providing enough information for the analysis. A majority of the respondents work at a German HEIs (39%). They are followed by employees of universities in Croatia (17%), Belgium (12%), the Netherlands (12%) and Spain (9%). Only individual cases (<10) are located in Bulgaria, Finland and the UK. Most of the respondents teach full-time students (83%). The distribution of the type of university shows that a two-thirds majority works for a university of applied scienes (UAS) (67%). The composition of the sample, in terms of thematic orientation, was predictable due to the professional background of the CONRIS network. It shows that the Safety & Security Sciences are particularly well represented (57%). This group is followed by the respondents, who have a background in Social Sciences (13%) and Engineering Sciences (11%). There are other disciplines represented as well, but due to their differentiation in the sample they comprise less than 10 cases each.

Initially, the data was analyzed by descriptively presenting the composition of the sample. All ninety cases were examined for evaluation. Using the visualization of the response behavior, conspicuous features are then examined more closely. In individual cases, a comparison was made between the different types of universities to identify possible differences in the handling of these crises. Subsequently, the open questions were checked for content and then collectively grouped into categories to identify a trend. In the following, particular statements are depicted as examples for individual categories. These statements and the remarks from the open options for additional comments were marked as quotes and used to provide (qualitative) support for results of the survey.

The present results should be treated with caution due to the small sample size. As the group size was below 30 cases (for universities), individual group comparisons could not be performed. Afterwards, redundant answers were summarized. However, this does not affect the significance of the data. Double coding minimized the subjectivity of the data's modifications. Due to the non-representative composition of the sample, the results can only be conditionally applied to the entire field. Nevertheless, the results reveal first impressions of teaching during the pandemic.

3. Communicating and teaching during COVID 19 pandemic – Selected empirical results from the CONRIS survey and assumptions

3.1. General results

After restrictive measures were decided at the political level (see above), HEIs also had to react. 50% of the respondents of the CONRIS survey referred to the fact that their organiza-

tions chose for a total lockdown, 42% chose for a teaching lockdown with practice on campus, apart from some other types of 'partial' lockdown. Most of the surveyed teaching staff answered that they followed the rules of their institution, also meaning that unclear rules had been challenging in the situation (c.f. Boer 2021; Jung *et al*. 2021). The following quote indicates that: "Lots of time passed until the crisis management has been worked [sic!; author's comment: working]." But elsewhere things went well: "Followed the procedures as planned, without any big problems". In a lot of cases, the conversions of presence-based teaching and learning into virtual spaces took place at the beginning or even short before the start of the semester (c.f. Boer 2021). It meant that some form of crisis communication had to take place between HEIs and students e.g. in order to inform the latter about digital procedures, new distance-teaching and -learning formats, etc. That is why the next section presents results on communication, before results on teaching are discussed in the last section of the chapter.

3.2. Communication

Some questions of the survey referred explicitely to the use of crisis communication and teaching plans in order to handle the first phase of the COVID 19 crisis. More than 50% of the surveyed teaching staff indicated that they 'don't know' or 'there is no plan' for teaching during crisis. Regarding the presence of a plan for crisis communication 34% answered 'no' or 'don't know', while another 37% gave no answer which could be a hint that they also 'don't know' (s. figure 1).

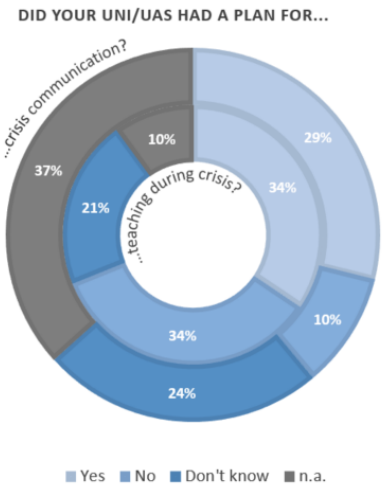

Figure 1. Crisis management plans. Source: own representation.

The results may suggest that there is either a lack of awareness or of publicity regarding plans for teaching and communication during crises, or even in some cases also an absence of such plans. Thereby, the means the surveyed teachers used for communication varied. Most of them communicated by video communication systems e.g. Zoom, MSTeams, or simply e-mail. Similar channels were used at the beginning of the crisis for crisis communication as well as 'normal' communication in the advanced crisis phase. Comparing the European regions from which the respondents come, vague tendencies can be derived that similar reactions concerning crisis communication can be identified everywhere as well as that similar communication tools were used. Due to the small number of cases, however, these are at most loose theses and not valid statements.

Although 21% of the questioned teaching staff felt their accessibility was worse than before the COVID pandemic, the majority of the respondents perceived themselves as accessible for students, probably due to the many means of communication available. The communication seemed to be "easier" and there was "better availability for students during the day", but particularly, social aspects of personal physical or presence meetings and "spontaneous contacts (…) were missing" (quotes from open options). The last point suggests a few aspects that are supported by answers to an open question on challenges in teaching: besides some hints to IT and technical issues, which seemed to be less relevant to the respondents, above all social and organizational challenges were named, which the following quotes show: "The communication plan changed so often (…). There was big uncertainty." or "keeping students 'on track' and motivated" or even "To keep the amount of information acceptable". They point to inconsistent communication and planning on the side of the HEIs as well as motivational and emotional considerations on the teachers' side towards their students.

3.3. Teaching

In terms of teaching, it becomes obvious that digital or online teaching was not new: Before COVID 19, 31% of the respondents had at least digital support for presence-based teaching, 19 % were used to blended-learning and 30% to exclusively digital teaching. Regarding teaching during the pandemic, the data shows that many types of learning methods were offered, ranging from online teaching, video-call groups up to students giving online presentations. When asked an open question about perceived lacks of/in teaching, the teachers' answers could be clustered into three categories: direct interaction/communication with students, technical equipment, feedback/exchange with colleagues. Most answers could be assigned to the category direct interaction/communication (absolute mentions = 35) (s. figure 2). Twelve of the answers addressed the lack of technical equipment such as "ergonomic tools at home" or "2 big screens". One of the respondents illustrated the lack with the suffering answer "Video calling that doesn't give you a headache".

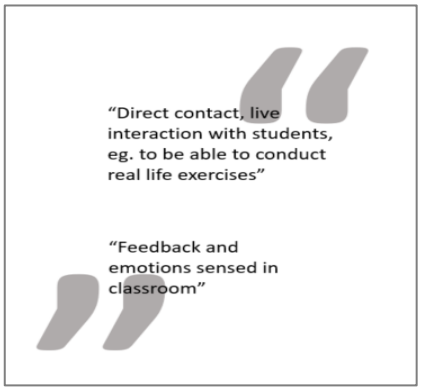

Figure 2. Perceived lacks (quotes from the category "direct interaction/communication with students"). Source: own representation.

Only six answers could be assigned to the category feedback/exchange with colleagues (c.f. Boer 2021). For example one respondent listed: "interaction, social contact, small talk, feedback, peer to peer communication".

These results also suggest that technical deficiencies are far less important to the surveyed teachers than the lack of social aspects (c.f. Jung *et al*. 2021). In contrast, the respondents perceived deficiencies on the part of their students primarily in technical issues like hardware, network-bandwidth, software or a quiet space to work. Social aspects and e.g. competences were mentioned less often. One explanation for this result could be that it is easier to perceive concrete technical issues (because they are recognizable immediately) than (abstract) social problems of other people. Since there were already further lockdown decisions shortly after the CONRIS-survey and HEIs in many European countries still remain in exclusively online teaching, it seems necessary to formulate a few conclusions and lessons learned for the follow-up period.

4. Conclusions

Lesson Learned #1: Develop a crisis management plan and talk about it (before crisis strikes): It seems that in HEIs plans for teaching and communicating in case of a crisis do not exist everywhere, sometimes are not public or even unknown to the teaching staff. So such plans are nothing which could be taken for granted in all of the HEIs (c.f. Jung *et al*. 2021). But, thinking of literature and studies on (traditional) crisis management plans e.g. of civil protection organizations such plans are widely regarded as necessary to prepare and react on crises. Therefore, it seems obvious that teaching staff of HEIs who, as a type of crisis manager, take on the role of liaison persons between organizations and students should be equipped with fixed crisis management plans. Only then they are able to react appropriately

and quickly. That is important because they represent the educating organization (e.g. university). Therefore they should be equipped with plans to provide security and reliability to students in uncertain and unpredictable situations (Bao 2020; Schütte *et al*. 2020).

Lesson Learned #2: Do not underestimate influences of social aspects: Based on the mentioned results, it could be assumed that there are minor technical, but major organizational and in particular social challenges as consequences of the situation and digitization in this field – at least on the side of teaching staff HEIs. The use of diverse digital tools, channels, platforms etc. is popular with teachers to teach and communicate. It also seems that the virtual opportunities support the organizational adaptability of the organization. But, and this becomes slowly apparent after a longer duration of the crisis: Nothing replaces direct interaction between teachers and students in presence (c.f. Eringfeld 2021).

Lesson Learned #3: Not everything that says "digital teaching" is actually digital teaching: The majority of respondents uses at least digital support tools in teaching. They seem to have been familiar with digital formats before the crisis as well. But how do these results fit to accusations about incomplete digitization of the education system (as it is the case e.g. in Germany)? How could potential discrepancies be explained? It could be seen as a hint that research is needed to take a closer look at teaching. It should be explored deeper whether it is just a temporary relabeling in terms of "online-teaching" or whether it is really a matter of concepts regarding contents, methods, didactics, etc. that are adapted to virtual possibilities (c.f. Eringfeld 2021).

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HR scenario game: Learning human resource management in a virtual environment

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Abstract

This paper introduces a computer-based online scenario game that was developed to enhance the learning of human resource management (HRM) in an undergraduate course at a business school in Finland. What makes this game unique is that students played an important and active role in developing the game in collaboration with lecturers. Our findings show that the game enhances learning, interaction, and collaboration among students. We discuss how computer-based games and their development in collaboration with students can be used as a means for learning and improving working-life skills in higher education.

Keywords: *Computer scenario game; human resource management; game development; collaboration; higher education.*

1. Introduction

This paper introduces a computer-based online scenario game that was developed to enhance the learning of human resources management (HRM) in an undergraduate course at a business school in Finland. What makes this game unique is that students played an important and active role in developing the game in collaboration with lecturers. Here, we discuss how computer-based games and their development in collaboration with students can be used as a means for learning in higher education.

The game provides a tool for learning about HRM content, processes, and decision making in HR work. Digitalization, experientialism, collaboration, and combining practical and theoretical knowledge were important ideas during the game's creation and development. Currently, the game is applied in a mass course that involves students from different faculties and disciplines. Engaging students and providing them with participation possibilities as well as written feedback are challenging in courses with dozens or even hundreds of students. However, involving students in game development and facilitation supports their motivation, collaboration skills, and working life capabilities (Cagiltay 2007, Hwang, Hung & Chen 2014). Moreover, active game development with students supports learning, belonging, and collaboration for students as well as lecturers. These competences and skills are important not only for individual students but also at the institutional level. For example, working in multidisciplinary groups, using innovative digital platforms and tools in teaching, enhancing student involvement as co-actors together with lecturers, developing students' working life capabilities in situations that simulate real-life situations, and continuous development of the game can be seen as important learning objectives, skills, and competences for university graduates. This online game can also be applied in online teaching, which has been important during COVID-19, to provide opportunities to cooperate, interact, and have small group discussions.

This HR scenario game, which aims to engage and group students, simulates practical situations in real working life and prepares students to handle work-related decisions. Playing the game engages students in considering and evaluating the consequences of certain decisions from the managerial, organizational, and employee perspectives. Students play the game and make decisions in small groups, which helps them understand different team roles and objectives.

During the game, the student teams make decisions after taking on the role of a supervisor working in a fast-growing IT company. They are presented with complicated HR situations, such as those related to recruitment and employee wellbeing and development. Instead of dichotomic (right vs. wrong) answer options, the student teams must consider the situations from different perspectives and make decisions together on how to proceed.

2. The scenario game as a pedagogical tool

This HR scenario game was developed for an undergraduate HRM course at a business school in Finland as a tool to enhance students' learning of HRM content and skills. The development and use of the game were based on the constructionist learning approach, which includes collaboration, the active role of learners, and combining theory and practice as its central ideas (Tynjälä & Gijbels, 2012; Vlachopoulos & Makri, 2017). Playing the game in collaboration with other students supports interactive learning, especially in virtual environments (García García, Biencinto López, Carpintero Molina, Expósito Casas, & Ruiz Morales, 2016), and the use of teams makes it possible to discuss and compare different aspects and perspectives, enhances multidiscplinarity if the game is played in multidisciplinary groups, and helps students apply theoretical and conceptual knowledge learned during the course into practice (Wendel, Gutjahr, Göbel, & Steinmetz, 2013).

This HR scenario game is unique due to its development in active and continuous cooperation with students and lecturers. Students played an important role in creating and developing the content of and facilitating the game. Notably, collaborative learning was not limited to game playing; rather, it also had an important role in the development of the game.

3. Introducing the HR scenario game

3.1. Game description

The HR scenario game (see Figure 1) was developed for an undergraduate HRM course at a business school. The scenarios consist of eight different HRM content areas (strategic HRM, recruitment practices, recruitment strategy, orientation, leadership, competence development, wellbeing at work, remuneration, and international HRM). The scenarios in the game were created based on an imaginary case company. Players of the game work as supervisors in a five-year-old, fast-growing IT company. At the beginning of the game, the players become familiar with the company's details and current situation. The game was developed to support students' authentic learning experiences of HRM situations by contextualizing the scenarios in the game through the imaginary case company. In addition, having students identify themselves as supervisors gives them an active HR role.

3.2. Playing and facilitating the game

Around 400 students at the university and open university attend the course every year. The students at the university represent 6 different faculties, and open university students represent age variation from 18 to 65 years and working experience from trainee to senior HRM professionals with several years of working experience. Thus, versatile backgrounds of the students allow that all of them play the game during the course as members of

multidisciplinary teams. The game's creators have been teaching the course for several years, and they developed the game to specifically support learning of the course's HR content.

Figure 1. Screenshot of the scenario game Source: www.skenaariopeli.fi (2021).

The game, which is played in small groups (three to four students per team), is a mandatory course assignment for all students. Students attend a demo session, which has game facilitators (master-level students). In autumn 2020, the demo sessions were organized online via Zoom. The students could choose between two demo sessions during which they were randomly divided into small groups of three to four students. Random group division automatically placed students into multidisciplinary groups, which represented different faculties of the multidisciplinary university (e.g., business, education, humanities, IT, science) and backgrounds at the open university (e.g. age, education, working experience).

During the game, the small groups played each scenario at least once. At its best, playing a game can provide emotion-based experiences (Anolli, Mantovani, Confalonieri, Ascolese, &

Peveri, 2010), which can enliven other course materials (lectures, literature) and support the achievement of course learning objectives. Before the students started to play, the game facilitators advised the players to have active discussions with their team members while solving the scenarios and taking notes during the game.

After the student teams finished the scenario game, they wrote a reflection report on their learning experiences. In the reflective group report, the students were asked to discuss their experiences and perceptions during the game and to analyze their decisions in the game based on the course materials (literature and lectures). For example, they were advised to reflect on what new information they learned, which scenario they found most interesting, difficult, or confusing and why, and whether they had ever encountered some of the scenarios in their personal lives, including how they reacted.

The game facilitators evaluated the group reports and wrote short feedback comments for each group reflection report. The student teams also self-evaluated their learning, teamwork and its results. The game facilitators were orientated to their role, and they received credits and a certificate as a reward.

3.3. Collaborative development

This game is unique for its collaborative development and creation processes. Course lecturers have been responsible for the game development process, but students have also had important and active roles in the game's creation and development. Master-level students have participated in the game's development by ideating new content and acting as game facilitators during the course. This has allowed the graduate students to gain experience in planning, organizing, and digitalized learning through implementing teamwork and facilitating game playing sessions. They also participated in evaluating the game reflections.

4. Students' experiences with the game

Next, we present student experiences from the game and discuss how computer-based games and their development in collaboration with students can be used as a means for learning in higher education. Student experiences were collected from reflection reports (altogether 60 reports, with 238 pages of text), and thematic analysis was applied to categorize the students' experiences.

In their reflection reports, the students reported that the game had inspired them to discuss the outcomes together and encouraged some development ideas. The students reported four main themes: increased interaction, support of multidisciplinarity, deepened understanding, and application of the course content (theoretical knowledge learned during the course). Table 1 details these four themes.

Table 1. Students' experiences with the game.

Theme	Key elements for learning	Illustrative example
Increased interaction	Deep group discussions Combining their own experiences Increased learning and remembering Collaborative and action-based opportunities for learning Online group work and interaction skills	Cooperating and discussing the questions in the scenarios with the group helped us succeed in the game. Playing the game was an informative learning experience because the game was interesting and challenged us to think. Playing the game in a group increased the meaningfulness of gaming. The group size of four people was perfect because we all had a chance to offer our opinion and contribute to the discussion (Group 17).
Support of multidiscplinarity	Multidisciplinary groups as sources of inspiration A variety of viewpoints and perspectives Sharing their own experiences Problem-solving and analytical skills	The questions in the game inspired us to consider the situations from different perspectives. We noticed that it is not always easy to find an answer to a simple question. Situations are contextual in nature. The game showed us that HRM covers a variety of areas, and handling all these areas requires continuous development and learning (Group 18).
Deepened understanding	Concrete situations from working life Understanding the role and tasks of an HR professional Highlighting special challenges in HRM The possibility of combining previous experiences from working life with theoretical knowledge Increased motivation and strengthening of previous HRM knowledge	The game gave us concrete examples of situations that an HR manager can face and must address at work. The game provided us with a wider understanding of an HR manager's role and deepened our learning (Group 8). Many members of our group already had experience with the recruitment process, either as a recruitee or a recruiter. The real-life experiences enriched our teamwork and made it easier to understand and discuss the themes and questions presented in the scenario game (Group 18).
Application of learned course content	Increased interest in course content Discovering an interest in HRM (a specific area) Combining theoretical and practical knowledge Creating new knowledge by adding to their previous knowledge base Action-based learning and real-life situations from working life	The game supported my learning and added to my previous knowledge. I read the course book a lot and learned more. I found certain themes from HRM that really interest me. The game supported learning because it made us consider and ponder HRM topics and themes in a deeper manner. The game covered the course topics well (Group 3). The game challenged us to combine and apply theoretical knowledge into practice. We really needed to consider which answer would be correct based on the theory (Group 7).

5. Concluding remarks

This study described how a computer-based online scenario game can be applied in an undergraduate HRM course and how its development and application can enhance students' learning, collaboration, and interaction. As we have illustrated, the students appreciated the interactive and collaborative aspects of the learning experience through the game. Especially working, sharing experiences and discussing in small groups were important for increased interaction and collaborative learning. Various backgrounds of students allowed students to discuss different aspects and perspectives during the game play. Thus, multidisciplinarity offered them not only increased interdisciplinary knowledge but sources of inspiration and improved analytical and problem-solving skills.

The positive experiences with developing and using the game in teaching have encouraged lecturers to the use of games in teaching at the higher education level as a means of enhancing students' learning, increasing their interest in the course content, and adding to their working-life skills as business graduates and future experts in the field. The game is unique for its collaborative development and creation processes where students have had an important role as active game developers and facilitators. These positive experiences can encourage also other higher education professionals to applying games in their teaching, and engaging and offering participation possibilities to students during courses.

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The Virtual Shoe Salon: A creative and active approach for teaching research and data analysis to fashion students

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Abstract

The push towards creative and active learning in higher education has gained momentum in recent years, creating opportunities for innovative, student focused approaches. The Covid-19 pandemic shifted the educational landscape to the online world, propelling the need to create compelling learning activities for students. While also fostering a sense of community and facilitating both peer relationships and peer learning. This paper presents the development and initial implementation of an innovative teaching tool, The Virtual Shoe Salon, which is based on creative pedagogies and experiential learning. The Virtual Shoe Salon has been implemented to embed stronger skills in research and data analysis within the curriculum of our fashion business courses. As a teaching method it can embrace both online and face to face environments. Drawing from a theoretical foundation of material culture, combined with an adaptation of the photovoice research approach, the salon takes the ordinary, but expressive objects of shoes to engage students in research and analysis through collaboration, conversation and peer to peer learning. The paper presents the rationale for the Virtual Shoe Salon, and findings from its implementation with 250 students. Subsequent evaluation and reflection with both students and staff have evidenced the positive role of the Virtual Shoe Salon in facilitating active and collaborative learning around research and data analysis. While it has actively encouraged a dynamic and collaborative learning environment, the Virtual Shoe Salon has initiated a shared space underpinned by the sense of community and belonging for students that Covid-19 had eroded.

Keywords: *Research skills; data analysis; shoes; images; material culture; collaborative learning.*

1. Introduction

The shoe, often considered to be the most ubiquitous of all clothing items, is well theorised for expressing and mediating meaning for its wearer (Brydon, 1998). Existing research from the fields of anthropology (Hockey, Dilley, Robinson & Sherlock, 2014) and sociology (Belk, 2003) acknowledges shoes as expressions of self. The nature of shoes as ordinary, mundane, yet expressive objects, presented an intriguing case for their potential as a teaching tool for undergraduate and postgraduate students, undertaking fashion business courses. So came the idea for the Virtual Shoe Salon, a method for developing skills in research and data analysis that could be used within our Fashion Management, Marketing and Communication courses, with a view to evaluate its wider potential across disciplines. This paper presents the case for the Virtual Shoe Salon and discusses its development, implementation and evaluation as a creative and relatable tool for teaching approaches within the fields of qualitative research methods and data analysis. While its initial purpose was to bring a more interactive and experiential approach to teaching these subjects, it has also created a space for students to share stories on identity, generating cultural awareness within the discipline and fostering a sense of community and belonging, which the Covid-19 pandemic had impacted.

2. Educational context

The Virtual Shoe Salon responds to an institutional call to develop more inclusive and personalised approaches within the curriculum, that could translate across the physical and digital educational landscape. Ongoing curriculum reviews have evidenced the need for our fashion business students to build stronger skills in qualitative research and the analysis of real time data. Skills that will support the development of academic rigor but that are also integral to their future employment. The World Economic Forum (2018) predicted that an increase in data driven skills will be required in the changing landscape, and as educators this presents an opportunity to reappraise how we can embed those skills within our curriculum.

The Covid-19 pandemic forced higher education institutions to suspend face to face teaching in the Spring of 2020 and to create online learning environments that could facilitate student engagement and inclusive learning (Wahab, 2020), while encouraging a sense of belonging (Read, Archer & Leathwood, 2003). While this sudden change to the academic year brought unprecedented challenges, with little time to plan for a fully online curriculum (Mishra, Gupta & Shree, 2020), it also presented opportunities for creating innovative, student led approaches to learning, and it is this which the Virtual Shoe Salon responds to.

3. The Virtual Shoe Salon

As an ethnographic researcher who uses photography, interviews and narrative storytelling around shoes and clothing in her own work, the author has noted the benefits to students of applying a research led approach to teaching qualitative research methods and approaches for data analysis. Course and module level student evaluations have highlighted the value and enjoyment that many students say they have gained from learning about process through real world research data. However, these previous approaches have focused more on the listening through lectures model, followed by seminar discussions, rather than encouraging students to create their own data through which they can interact collaboratively with the process and outcome. The pedagogical approach that underpins The Virtual Shoe Salon is the continued recognition of the value of creativity in fostering learning within higher education (Gustina & Sweet, 2014). Creative pedagogies that are experientially defined are known to stimulate student engagement, through discovery and the co-creation of knowledge (Deniston-Trochta, 2003). As successful learning is facilitated through the activation of different senses (Biggs & Tang, 2007); applying an experiential and interactive approach to the teaching of research and data analysis should facilitate and encourage student participation through problem-solving and the co-creation of knowledge.

The Virtual Shoe Salon is realised through a workshop activity focused around student led research, collaborative discussions and the co-creation of knowledge through the analysis of data. In advance of the workshop students are given a pre-session task, which asks them to engage in visual research by taking a shoe selfie. In addition, the students are required to provide a written response to the following two questions about their shoes; what do these shoes mean to you and how do you feel when you wear them

The shoe images and supporting responses to the questions are then posted in The Virtual Shoe Salon on Padlet (figure 1). Students will share these in small group discussions through a task titled ‘interview with my shoes’. This process enables the students to develop skills in visual and qualitative research and to share knowledge of lived experience and feelings around identity. As an example of active and experiential learning this method engages students in research and will generate data which can be stored anonymously (with consent) in a student specific database.

My 'Everyday Battle' boots

What do these shoes mean to me?

The pair of shoes that bonded me and my flatmate, (now close friend) Millie, on our first scary, awkward charity shopping quest in Nottingham. Having only known her a day, she found me these... in my size... for £4. It's fair to say that these unmatched shopping skills, have made us partners in crime, and not helped our shoe hoarding obsession. I've worn them through every uni adventure soo far! They've met new people with me, explored a new home, seen late nights and early mornings, danced with me, witnessed me laugh and cry and caused me to fall over a lot! So... they mean a great deal to me, and make the blisters worth it, for the memories that they hold... and Millie can borrow them any time :)

How do I feel when I wear them?

They just make me feel cool. They're battered and scraped and second hand, and yet they make me feel like a kick ass woman! They fit my androgynous style and the heavy soles mean you can hear me coming, but I love I stomping around Nottingham in them. The extra inches boost my confidence and have caused some height arguments with my male friends, which are always a laugh. I just love them. They're not branded, designer or very fashionable, but they're reliable and that's all I need. Once lockdown is over, I'll be wearing them out until they wear out!!! :D

Figure 1. Padlet Post – Battle Boots.

The workshop then comprises an interactive peer focused session which due to the continued Covid restrictions is delivered through Microsoft Teams. Using Teams' break-out rooms, students work in small groups and follow the set of tasks detailed below.

1. Interview with my shoes: having learned about visual and qualitative research through lectures the students are tasked to enter the Virtual Shoe Salon on Padlet and share their images and narrative responses with each other. This approach draws from the methodology of photo elicitation which uses photographs as a stimulus to generate discussions which interpret meaning and knowledge (Glaw, Inder, Kable & Hazelton, 2017). Photo elicitation is an invaluable process for collaborative discussions that explore the deeper multi layers of meanings that images, along with the written narratives, can stimulate (Harper, 2002). As an approach it enables the generation of different types of knowledge as it can evoke individual emotions and memories (Harper, 2002), thus encouraging a personalised learning experience.

   Following initial conversations, the students will assume the role of an interviewer and develop a line of questioning that will enable them to elicit deeper understanding about the meaningfulness of shoes for each individual within their

group. Sessions with undergraduate students have an interview template guide to follow, but postgraduates are encouraged to work independently, developing questions organically. Coming together as a larger group we reflect and share their initial thoughts about their process of research and questioning. They are asked to debate the value and challenges that this type of research process can elicit, with the objectives of understanding its application to their studies, as well as its role in understanding consumers in the fashion industry.

2. Collaborative Conversations: returning to their small groups the students work together to analyse their data and interpret meaning from the images, written narratives and interviews that they have undertaken. Through collaboration they can share meanings, stories and experiences and thus generate a dataset of images and narratives, that can become a longitudinal, educational resource of images and text, created by students. The intention with this approach is to encourage skills in creative thinking, collaboration, problem solving and co-creation of knowledge with a focus on understanding individual identity and personal values. This method privileges the sharing of students' own knowledge and experiences and supports a personalised learning strategy, supported by the Institution.

The learning objectives that define the Virtual Shoe Salon are listed below:

- An interactive process for learning about research and data analysis
- The creation of a longitudinal student specific dataset of images and text
- An active and experiential tool for learning skills in data generation, management and analysis

4. Methodological and Theoretical Foundation

Schell, Ferguson, Hamoline, Shea and Thomas-MacLean's (2009) work on photovoice as a teaching tool inspired the design of the Virtual Shoe Salon as a teaching method. In higher education photovoice has been used by students to capture their emotions and thoughts about a phenomenon through the lens of the photographs that they have taken (Wass, Anderson, Rabello, Golding, Rangi & Eteuati, 2019). Like the traditions of photovoice our students have taken photographs of their shoes through which they can share their emotions and experiences of everyday life. Through this process they are engaging in qualitative and visual research and generating data that can be interpreted collaboratively through peer discussions.

The theoretical foundation of the Virtual Shoe Salon is grounded in material culture. Drawing from the work of Belk (2003) shoes are theorised as extensions of self and repositories of memory and thus symbolic of personal identity (McCarroll, 2019). Within the parameters of material culture (Woodward, 2019) shoes are relational objects through which individual and

social experience are constructed. In this context they become valuable tools for developing a teaching resource that is relatable to students. The ordinariness of shoes means that even when an individual seemingly does not have an obvious meaning attached to them, they still, through their mundaneness, have some communicative powers, which can be drawn out through the research and analysis. Wearing clothing is one of the most ubiquitous aspects of human behaviour. Psychology recognises the diverse and powerful dynamic that clothing has in influencing the internal and external thought processes and moods of individuals (Adam & Galinsky, 2012). Given that the essence of qualitative research is about understanding the why of a phenomenon, and that meaning is derived from human interaction with the world, the ubiquitous nature of the shoe makes it an ideal medium for engaging research.

5. Evaluation

During the 2020/21 academic year the Virtual Shoe Salon has been implemented with 171 undergraduate students and 86 postgraduate students across our Fashion Management, Marketing and Communication courses. This has generated over 250 images and narratives which have been analysed to create an additional thematic dataset of meanings that have been interpreted through the students' collaborative conversations. Reflections with students about the virtual salon method have been undertaken during the sessions using a series of questions to which they have responded through a digital template. This forms part of their learning process, but also is a means of evaluating the success and wider impact of the Virtual Shoe Salon. Consensus has been that the students enjoyed participating in the Virtual Shoe Salon and in addition to feeling they had gained skills in research and analysis it enabled them to apply a personal approach to learning. Some of the comments are detailed below:

"It was fun and really interesting to learn about what things mattered to each of us". (participant A1)

"It is nice to do something practical and to apply what we are learning". (participant F2)

"It has opened eyes to what you can you learn about research process and meaning through something so ordinary as a shoe". (Participant C7)

While they fully immersed themselves in the pre-session research activity, the workshop sessions stimulated impassioned conversations and debates around meaning between each other. When often silence has pervaded the digital classroom in group discussions, the Virtual Shoe Room seemed to generate chatter, debate and reflection. While the tool's role in raising awareness of identity around self and others was not a key factor in its development, it is an aspect that has come through strongly in the sessions and became integral to fostering the development of skills in data analysis. The images and narratives that the students have produced have been integral to encourage sharing and collaborative learning and this

personalised approach has raised insights around cultural awareness. A conversation around a pair of DM boots highlighted why a student had made this purchase on arrival in the UK from her home country of Indonesia, where wearing such a rebellious style would be frowned upon. Through their shoe images the students were able to share their own experiences and views on identity within a cultural context.

In an increasingly digital world, where much of the academic year has been spent away from campus, an activity which focuses on the individuals and their interests became an important method for encouraging collaboration and developing a stronger sense of community between the year groups.

"We have learned so much about each other. It has been really interesting just to chat and share the experiences and through that learn how meaning can be drawn from an ordinary, everyday object" (participant E2).

The impact that the Virtual Shoe Salon has on tutor experience is of significance. Post session evaluations found that it engaged students positively in learning about research and data analysis through practice, rather than the usual rather passive format of taught sessions

5. Concluding Remarks

Initial trials with the Virtual Salon have demonstrated that it has value in encouraging students to learn about research and analysis through active participation. By facilitating collaborative conversations, the students can work together to make sense of data through the sharing of values, feelings and experiences. The ubiquitous nature of the shoe has opened dialogues around ideals, identity and cultural understanding, enabling them to learn about what things matter to each other and why. Through this process they have engaged with the process of data analysis with the opportunity to reflect on the deeper meanings of their shoes. In its next phase of development, the Virtual Shoe Salon will be trialed with students from English, Creative Writing, Journalism and Psychology to evaluate its potential across an interdisciplinary landscape. As an innovative approach, the Virtual Shoe Salon places students at the centre of learning and creates a visual and textual longitudinal resource which can continue to educate and inspire students beyond the discipline.

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Light Bulb Moments in the Classroom: Probing Design Opportunities for Ambient LA Displays in Higher Education

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Abstract

Teachers in higher education are tasked with the demanding job of providing support tailored to each individual student's need. To provide tailored support, teachers need to accurately monitor students' activities and decide on appropriate support interventions. Learning analytics applications have the potential to aid teachers to maintain an overview of their students' activities. However, those applications are often designed as centralized graphical displays, taking teachers' attention away from the classroom and sometimes overburdening teachers. Therefore, we investigate whether ambient Learning Analytics (LA) displays offer a solution to complement traditional LA applications, as these systems are designed as objects that integrate seamlessly into the classroom context. We conducted an exploratory study in Higher Education to investigate teachers' needs for information and their perception of ambient LA displays in relation to their teaching practice. We formulate three key findings and a set of design opportunities to inform future work of supporting the HE context with ambient LA displays.

Keywords: *Ambient display; learning analytics; higher education; classroom; teacher; human-computer interaction.*

1. Introduction

Teachers in Higher Education (HE) are tasked with increasingly demanding jobs. They are expected to provide adaptive support to meet the needs of individual students. With a growing diversity in the student population, the combination of inside and outside of class activities, and less classroom hours than in primary and secondary education, providing adaptive support has become even more challenging. Several studies have described the complexity of scaffolding during tutorials, e.g., (Comas-Quinn, 2011; Greenberg et al., 2011; Roehl et al., 2013; Vaughan, 2007). Teachers often experience time pressure and "a feeling that learning was too distributed, that there were too many places to check and contribute to" (Comas-Quinn, 2011) p. 227).

Emerging innovations in learning analytics (LA) have been proposed to aid teachers by offering aggregated insights into students' activities and potential needs for support. Although these studies generally show that the offered information is deemed relevant by teachers, the actionability of the information is sometimes low (Van Leeuwen, 2019; Wise & Jung, 2019). This is because classroom sessions are filled with intensive interpersonal interactions with learners, and it is taxing for teachers to access the LA applications on top of their already dynamic practice. A human-centered design approach is therefore needed to make LA information more seamlessly integrated into teachers' classroom workflow. In the domain of human-computer interaction, a number of explorations have been done under the notion of ambient information system, or peripheral display (An et al., 2020). The idea is to create glanceable, relatively less-detailed displays as part of the classroom environment to enhance teachers' awareness of the situation without demanding their focal engagement.

For instance, ClassBeacons (An et al., 2019) portrays classroom proxemics data (Figure 1 Left): each ambient lamp gradually turns from yellow to green as the teachers cumulatively spends time around it, facilitating teachers to dynamically plan how to distribute time and attention over students. FireFlies-VLE (d'Anjou et al., 2019) uses ambient lamps to convey students' progress in exercises on their computers, based on real-time LA data, to ease teachers' monitoring of learning processes and their awareness about students' potential needs (Figure 1 Right). These ambient information systems have been found to meaningfully support teachers and learners in classroom activities: e.g., in supporting teachers to keep track of what is going on around and make data-informed decisions without imposing excessive mental burden. However, most of such examples have been targeted at primary or secondary classrooms. Much less is known about the potential and design implications of ambient LA displays for supporting teachers in higher education.

Figure 1. Examples of ambient LA displays in the SE context: ClassBeacons (Left), FireFlies-VLE (Right).

The current paper therefore aims to shed light on the potential role of ambient LA displays in HE. We compare earlier work in secondary education (SE) to an exploratory study in HE to better understand this relatively less addressed design context. We present several design opportunities that can serve as a research agenda for future studies in this field.

2. Method

Based on earlier work in secondary education, we investigated the HE context to identify teachers' needs for information during tutorials and discuss opportunities and implications for supporting HE teachers with ambient LA displays. We compared the results of the empirical studies in secondary education (An et al., 2019; Anjou et al., 2019) to this study in HE, allowing us to formulate specific design recommendations for the HE context. This paper can thus best be characterized as a cross-case analysis (Miles & Huberman, 1994).

2.1. Context and participants

The context of the study was an undergraduate course on the topic educational design. The course consisted of weekly plenary lectures and tutorials. The course was assessed by an individual exam and a collaborative assignment (performed in groups of 4). Students were expected to prepare for the tutorials by creating multiple choice questions about the course materials, which they submitted through PeerWise. Subsequently, all students in the course can practice with the student-generated questions, and the activity thus serves the dual goal of processing the materials as well as to jointly create a database of questions to practice with. During the tutorial, time is spent on discussing the student-generated questions and any other questions students may have about the materials. Also, the tutorials are meant for receiving teacher supervision on the collaborative assignment. The total number of students in the course was 150. They were divided into groups of about 25 students for the tutorials. The teaching team consisted of 7 teachers, each supervising one or two of the tutorial groups. The project ran for several cohorts, starting with the introduction of a non-ambient learning analytics system, and continuing with investigating the potential role of ambient systems.

The results of the first step are reported in (Van Leeuwen, 2019). In the results section, we will sometimes refer to some of these findings because they were the basis for the second step of investigating the potential for ambient displays.

2.2. Procedure and instruments

We conducted a user design and evaluation study to examine teachers' need for information and their reaction to a prototype ambient display. Because of the Covid-19 pandemic, the final step of testing the ambient display during an actual tutorial could unfortunately not be performed. The data collection consisted of two parts. First, we performed a contextual inquiry, meaning that we observed a tutorial and interviewed one of the teachers afterwards (female, more than 5 years teaching experience). The observation and interview were meant to probe how the tutorial takes place specifically in terms of the potential role for an ambient display. Thus, it focused on how the teacher and students walked around, what kind of questions teachers and students asked, what kind of cues were available to the teacher to estimate students, etc. The observation and interview took about 4 hours. Second, a co-design brainstorm session was held with 3 of the teachers in the course (2 female, 2 teachers with less than 5 years of teaching experience). In this session, the teachers were familiarized with the idea of FireFlies, a set of ambient lamps for displaying glanceable LA information, see Figure 2. They were asked about their preferences for what type of information to visualize, and for their suggestions about how to visualize that data. They were also asked to explain their choices in light of their teaching practice in this specific course. This session took about 1.5 hour. From these two types of sessions, a summary was made about design considerations for ambient displays for the HE context. This summary was contrasted with the secondary education context via a cross-case analysis. The most noteworthy similarities and differences were distilled and are discussed in the section below.

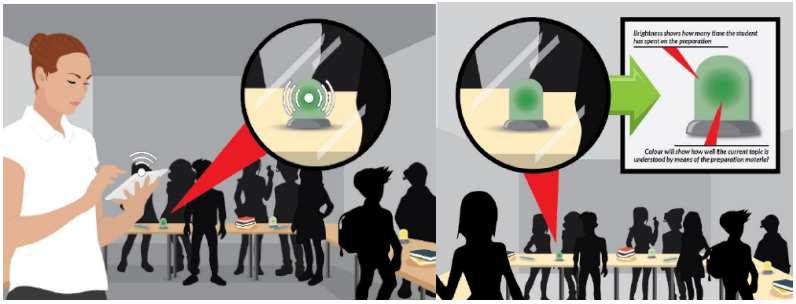

Figure 2. Images used for explaining the ambient LA concept to the teachers (by Teuwen, Thijssen & van de Ven).

3. Findings: HE teachers' needs and resulting design opportunities

3.1. Timeliness of the provided information and flexibility in the designed tool

A similarity between secondary and higher education is that teachers need information in a timely manner, so that they could still use the information on the fly to modify their practices, rather than only reflect on prior sessions. LA reports used in the first iteration of the project (Van Leeuwen, 2019) "came too late", as they were sent "a week later" from the tutorial session that the data were derived from. Another HE teacher mentioned that "just-in-time information" is needed, so that the information could more directly benefit their tutorial instead of only triggering retrospective analysis. Similarly, SE teachers in prior cases appreciated the deployed systems for offering on-the-spot LA information which is relevant to their ongoing activity (Anjou et al., 2019).

Another important similarity between the two groups of teachers is their need for flexibility and customization in the designed ambient information systems. Teachers differed in their reported practices. Some teachers for example divided their time equally among all students (e.g., using an alarm clock to keep track of the time), while others more intuitively allocated their attention to where it was needed most (see similar results in the SE case (An et al., 2019)). In line with that finding, there were also differing views on how useful a certain design solution would be, and how teachers would use it in their own classroom. As suggested in both contexts, such differing of opinions could be related to personal factors like teachers' levels of teaching experience, technology acceptance, or their different teaching styles. For example, one HE teacher said that when she was a beginning teacher, she would have liked to know what to expect in each week and which parts of the course would be challenging for students. But that information became less relevant as she had more experience.

Design opportunities: HE and SE teachers' similar need for timely information during teaching confirms the potential of developing ambient LA displays for the HE context. The personal nature of teachers' needs suggests that developers could afford flexible use or customizable features in the ambient information tool to better adapt to teachers with different experiences or teaching styles (e.g., by allowing them to configure certain display rules or features according to their preferences or professional beliefs).

3.2. Characteristics of the student population

Substantial differences of teachers' needs for ambient LA displays between the SE and HE contexts could exist due to the differences we found in teachers' descriptions of the student population. First, the learning goals and processes of HE students features much more flexibility and autonomy. One HE teacher emphasized that "students are responsible" for determining their learning process, and "with the structure of this course we offer that

freedom". As students have more control over when and at what pace to study course materials (Condie & Livingston, 2007), for teachers, extra cognitive load is demanded in monitoring the amount of time and the type of activities students engage in (Abeysekera & Dawson, 2015; Yen & Lee, 2011), and the differences between students might be larger than in other contexts. This thus requires a visualization that is able to distinguish information for different learners on a fine-grained level. We also found that students' help-seeking behaviors and attitudes in HE are different, which result in different design rationales for creating appropriate social awareness in the classroom. Prior studies showed that ambient displays contributed to student accountability and peer awareness, but careful design was needed to avoid undesirable social effects by putting students on the spot (Anjou et al., 2019). We found that students in HE, especially more experienced part-time students that may have jobs, are less subject to these social effects and are more at ease with indicating their needs for support, whereas the younger students are not.

Design opportunities: This finding implies that an ambient LA display could benefit HE teachers considerably if its information facilitates teachers to monitor and differentiate the diverse learning processes of students (e.g., by indicating what they are working on and how far they have gone). This finding also implies that when designing the social awareness of an ambient LA displays for an HE classroom, developers may need to address differing attitudes or preferences from multiple student groups (e.g., by providing teachers, as well as students, with controls over how and when to make the information visible).

3.3. Type of information and type of inferences

Another difference was found between SE and HE teachers in terms of what type of information is most relevant to have during classroom sessions. The SE teachers in prior studies appreciated the ambient displays based on in-class data (An et al., 2019; d'Anjou et al., 2019) or student inputs (Sellier & An, 2020)), whereas the HE teachers emphasized the value of combining outside-class data to support their in-class practice ("knowing how students prepared helps me prepare for a session"). As reported, these outside-class data could concern students' level of preparation, challenging parts found in the video lecture, group collaboration progress, etc. This difference is caused partly by the adoption of blended learning and the dominant format of HE lessons which has been changed from traditional lecture to face-to-face guided practice (Staker & Horn, 2012). As a result, to better support students who learn at their own pace and have differing prior knowledge, HE teachers need rich insights into learners' outside-class processes so that they could act adaptively in the classroom. It is thus implied that ambient LA design for HE could put extra focus on supporting teachers' in-class decisions by offering them insights based on outside-class LA data (e.g., visualize students' status, progress, or inputs gathered from their outside-class sessions). A related observed difference is that HE teachers might need information support that has a higher level of inferences of the LA data. As aforementioned, the flexibility and

autonomy of HE learning processes makes it difficult for teachers to identify learners' actual needs. Teachers need to interpret data from outside-class activities and use it to inform in-class decisions. The type of inferences that teachers need to make are thus quite complex. Some examples teachers gave of this complexity concern the possible problem occurring in team collaboration, or potential difficulties or misconceptions of students.

Design opportunities: These examples suggest that, in order to generate actionable insights, HE teachers need information that is aggregated from multiple LA indicators (e.g., from both their outside-class activities and in-class performances), with relatively higher level translations from the raw data. While the prior cases in SE showed that sometimes a low-level data portrayal would be useful enough for the SE teachers to skillfully interpret the classroom situations, our current study suggests that HE teachers may need ambient LA displays that are based on higher-level LA constructs or indicators based on multiple constructs, or that they need recommendations for actions.

4. Conclusion

Teachers in HE are tasked with the demanding job of providing support tailored to each individual student's need. Most learning analytics applications for teachers rely on centralized, focal displays. In this paper, we explored the potential of ambient LA displays that are designed to seamlessly integrate into the classroom context. We conducted an exploratory study in HE to investigate teachers' needs for information and their perception of ambient displays in relation to their teaching practice. Our results show that teachers' need for information differs fundamentally in comparison to the secondary education context. Most notably, the characteristics of HE students, their increased level of autonomy, and the fact that a large part of learning processes take place outside classrooms, mean that teachers need timely insights in individuals' trajectories during classroom sessions. From these results, we formulated three design opportunities to serve as a research agenda for exploring the potential of ambient LA displays in Higher Education.

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Arts-therapy as innovative educational strategy for embodied narrative, lifelong learning and inclusion

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Abstract

Art, artistic expression and arts-therapy can be an opportunity to the pedagogy need to develop effective, innovative and avant-garde visions and strategies on issues considered crucial for cohesion and inclusion, in particular regarding migration issue. Dance-movement-therapy is central to this project which is configured as art-based research in the educational / intercultural field. It is a political-pedagogical project starting within the school context to open up to the territory. The research question therefore aims to verify whether art-therapy can create inclusive and intercultural environments, integrate with autobiographical methods through embodied narratives and stimulate self-awareness and lifelong learning. Main aims are: analyzing ways of inclusion, making significant and transformative changes to growth processes, modifying prejudices and stereotypes. The research, moving within the theoretical and methodological framework of the research-intervention, followed a mixed method preserving its qualitative nature, following the phenomenological and hermeneutic approach and, at the same time, using a questionnaire (Pettigrew, Meertens, 1995), which characterized the quantitative part. Among the main results, the discovery of feeling directed towards new perspectives from which to look at the world, more aware and proactive, emerged. Results have strengthened the choice of adopting a such innovative integrated educational strategy for inclusion and lifelong learning.

Keywords: *Arts-based research; education; embodied narrative; lifelong learning; self-awareness; inclusion.*

1. Introduction

Current pedagogical strategies, aimed at lifelong, lifewide and lifedeep education, propose custom paths so that every person is, first of all, entitled to the fundamental right to his/her dignity and his/her value as a human being living in society. The promotion and development of a more inclusive society become crucial in order to understand the real problems affecting marginalization risk people. Making society and politics responsible, conscious and sharer of these problems means increasing the learning and knowledge levels in order to intervene in an effective manner through many tools and concrete actions. Sustainability of inclusion has achieved through political and economic interventions, but also through pedagogical actions aiming to reconstruct the process of personal identity. To achieve an adequate level of social inclusion, it is first of all necessary to overcome the walls raised by stereotyped concepts and prejudices about differences, to achieve an active and supportive participation of all citizens in an intercultural key. In this perspective, therefore, the importance of inclusion is closely connected with that of lifelong learning as it embraces the different all stages of life as well as all its dimensions, including issues relating to discomfort and marginalization. Lifelong education can be argued as a development and a human dignity opportunity promotion, in all its aspects, taking into account the stadial developments and the connatural dynamic social processes. The lifelong and lifewide pedagogy aims therefore to activate cultural, social, ethical as well as cognitive resources to reach a wider inclusion. Education and inclusion are fundamental objectives for each person, with specific experiences, involved in the processes of building identity and personality, which are the basis of pedagogical action. Since the report to UNESCO of the International Commission on Education for the 21st century, the concept of an education aimed at a deep and harmonious development, both personal and social for everyone, is emphasized (Delors, 2000). One of the objectives is to enhance each person's skills to relate to others and to the society. It also consists in giving back to the subject, including migrants, new stimuli, new motivations to re-build a life and re-enter the community and society in a proactive, integrated and inclusive way. The issues of social inclusion and active citizenship prove to be crucial in the processes of reflection on democracy and its implementation, understood as a fundamental part of culture and as a lifestyle, which aim to make the person more active, supportive and cooperating. Another goal is to raise awareness of the process of recognizing and promoting diversity, as a value and mutual enrichment. Programs of inclusion can be carried out through educational strategies that aim above all at the knowledge of oneself, of one's body, of one's experience, of the context through which practices of cultural participation are implemented. Through the analysis of the body, sometimes blocked by difficult and / or painful situations, we can go further, towards the development of infinite and new expressive and communicative possibilities. Through arts therapies and specifically dance movement therapy, each person can reach an in-depth understanding of himself, of his

experiences, of interpersonal relationships, of the significant educational experiences undertaken and to be undertaken, of his own growth path. Through the analysis of one's own experience, according to autobiographical methods as pedagogical and educational tools (Josso, 1991; Pineau & Le Grand, 1993; Demetrio, 1996; Alberici, 2000; Dominicè, 2000; Cambi, 2002; Formenti, 2009, 2017; Aleandri, 2012, 2015, 2017, 2019, 2020), each person can enhance significant experiences lived in the broadest areas, especially from an educational and relational point of view. That is useful to find "threads" and a more organic self-orientation, essential for planning own present and future in a positive and proactive way. Person's uniqueness and past experiences consideration are crucial from a pedagogical point of view, as a source to draw from in order to re-build and re-design the identity process, fundamental to be recognized in an increasingly fragmented society, in order to orient or re-orient, to gain a greater one's own and others' awareness. The analysis of the context, through observation and autobiographical narration, allows to understand the culture, traditions, needs, etc. In this way it is possible to plan personalized, but also collective paths, through educational actions that stimulate the process of lifelong education. "In such a perspective aimed at lifelong and lifewide learning and education, the call is aimed not only at soliciting and spreading this approach as a 'social practice' (and socializing) and widespread individual behavior, but also and above all as a lifestyle, philosophy of life, shared and internalized culture aimed at a better quality of life and the well-being of both people and society" (Aleandri, 2012, 15). Within this pedagogical action it ia possible leading people from marginalization to new perspectives of commitment and personal growth, first of all with themselves and then towards others, as a real inclusive dimension. For this reason, a pedagogical approach oriented to lifelong learning and education aims to enhance any kind of education, from the formal one to the non-formal and informal one. It will allow to turn the experiences of every individual into a growth opportunity, in the continuous development process aimed to outline one's own identity. It means also its primary relational and social connotation. In such scenario, therefore, an education, oriented not only to allow each one to develop one's own creative vocational and innovative potential but also to achieve full equality and social inclusion, takes shape.

2. The research project

The research takes shape within a secondary school in the eastern suburbs of Rome to reflect on migratory phenomena, which in these times undergo very rapid changes, and on the political and ideological influences that pollute information and consequently feed fears and discrimination. These conditions affect the education of students around the world. In a society where differences often become an element of marginalization, we wanted to deepen the relationship between education, prejudice, inclusion, and artistic expression, in particular with the body and dance. The project developed in collaboration with the Department of

Education of Roma Tre University, the school Liceo Amaldi in Rome and Intersos-Italy. The research-intervention aims at verifying the effectiveness of the use of artistic languages within an educational context, in relation to the migratory phenomenon and the consequent prejudice. The research focused attention on the context and on the participants. The concrete action was carried out with artistic proposals, concerning dance, the body and the languages of art, which favored reflection, comparison and relationships. The researchers and the participants themselves exercise observation and active listening to realities or imaginaries in the making, and the arts act as a narrative and language tool to promoting knowledge and the exchange of emotions. The research named "Pedagogy of the Border" is inspired by Henry Giroux's definition according to which what can perhaps improve and better promote intercultural competence are invitations to engage in "border crossings" (Giroux, 1992). The act of crossing borders helps students develop intercultural competences and skills that enable them to live together consciously beyond differences. Therefore, it is necessary to establish pedagogical conditions for which students become border crossers in order to understand otherness and further generate borderlands in which the different cultural resources allow growing new identities (Idem). The research aims to bring together and make known migrants and adolescents through dance movement therapy, the body, embodied narrative and the performing arts, to educate people to a cooperative spirit, to mutual respect to achieve individual well-being within a community growing in differences. Starting from the body, the substance of our being and the place of our identity, a slippery body for everyone, a body in transformation for adolescents, a tortured, mortified, abused body for migrants mean being able to use universal expressiveness where no one is advantaged. A Pedagogy of the Border is therefore configured as a non-place (Auge, 2009), free from signs of power and belonging. Migrants and adolescents have similar needs such as identity, autonomy, self-esteem, etc., and similar characteristics such as transition, sense of belonging and identity. Dance is a tool for well-being and care and it is proposed as a bridge between cultures, framing the friendship between those who are "foreign to the other".

2.1. Participants

The participants were 30/35 people in total per meeting, of which 14 students and 15 migrants, 2 tutor teachers and 3/4 among cultural mediators, psychologists and Intersos-Italia operators. Students are 17-18 years of age, migrants are aged between 17 and 25.

3. Methods, aims and tools

The research followed mixed methods, preserving its qualitative nature following a phenomenological and hermeneutic approach, and integrating it with a quantitative device deemed appropriate to the reflections and the nature of the research, a questionnaire about prejudice (Pettigrew and Meertens 1995) filled out by students, before and after the scheduled

workshop meetings. The research is an Art-Based Research (ABR) (Barone & Eisner, 2011; Knowles & Cole, 2008; Leavy, 2009) that is, a research that uses arts, in a broad meaning, to explore and eventually challenge human action and experience (Savin-Baden, 2014). Priority is given to the artistic process, the main tool through which to live and observe the experience by the participants, including the researcher (McNiff, 2012). As regards the qualitative investigation tools, the following were used: the semi-structured phenomenological interview (Larkin *et al.*, 2006; Zammuner, 2015), the focus groups (Lucisano & Salerni, 2018), the participant observation and the logbooks (Benvenuto, 2015) witten by the students and tutor teachers. The general purpose of the research-intervention, which we can define as immersive, consists in reflecting and analyzing how a very particular experience of Border Pedagogy can contribute to:

- transform a distorted information-media paradigm into an emancipative-evolutionary one based on direct knowledge of people and their lives towards lifelong, lifewide and lifedeep learning perspective;
- favor a transformation of prejudice in the context and a mature and responsible growth of adolescents;
- contribute to deconstructing stereotyped conceptions;
- form new imaginaries with which to look at reality; build a critical and rhizomatic thinking away from toxic narratives (Fiorucci, 2019).

4. Main results

The research took into consideration, in general, some concepts or categories (Gianturco, 2004). These are indicators of psychocorporeal and intercultural development identified in the process of building the project, then integrated by the analysis and coding of focus groups and semi-structured interviews. We can therefore indicate as categories:

- Evolutionary processes and the body-mind relationship in psychocorporeal development - An intercultural challenge, a body among bodies.
- Process of emotional and identity growth - Create relationship and intercultural baggage.
- Intercultural training needs - Art as a way of learning and exploiting diversity against toxic narratives. A postcolonial reinterpretation.
- Community learning - Getting to know each other through corporeality and art.
- Access and development of critical thinking - Look at the kaleidoscope, divergent mind against prejudice.

- Empathic relational area - Creating bonds.

In particular, we highlight the categorization relating to the process of emotional and identity growth which also indicates the impact on the level of self-esteem of the participants. In this area, which includes emotional growth and a greater definition of identity, the group has grown, as a whole, and has transformed. Among the variables investigated, it is interesting to highlight how solidarity is increased at the end (out) of the educational intervention compared to the beginning (in) (Fig. 1):

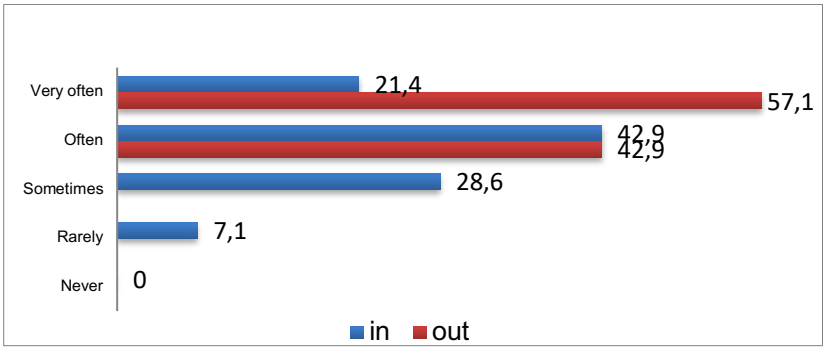

Figure 1. How often have you felt solidarity with migrants who live here?

The main increased response corncerns feeling solidarity very often, which grew from 21.4% to 57.1%, and has become the response with the highest percentage.

The greater confidence in using the workspace and in the interpersonal relationships, the possibility of using the body in gradually less stereotyped forms - verified following the indications of the observation of Laban analisys (Laban, 1999), and found by the checklists compiled tutor teachers - allowed them to acquire greater self-confidence by dealing with otherness. Changes related to life choices are also important, in particular those highlighted by some students attending the laboratory in 2017 and recently interviewed for research. It was perhaps the area richest in results, it has aroused various reflections on how much and how art can convey growth paths which then turn out to be authentic transformations of the life project. Some testimonies of participants student and migrant people are following:

– *Before living with people, for example with Italian boys, it was difficult for me. Living together, we change things in our lives, it is what I was looking for and I found here.*

– *Thanks to this activity I am coming to realize what I want to do when I grow up. I want to take Law Degree to help those people (migrants), to give them a voice in this society.*

– *When we listened the stories of each of them, that entered your soul, it make you understand how much today's society gives more space to prejudice than humanity, to how much you believe more about what it is told by the media or by people not informed about. Why are we so uninformed and presumptuous? This experience awakened in me the desire to trust people, awakened me from the coma of disinformation, made me understand the real extent of everyday problems compared to the often more difficult ones that migrants face.*

5. Discussion and perspectives

One of the issues emerged within the results concerns the discovery of feeling lead to a new perspective, a new point of view from which to look at the world. The empathic response that placed the students in front of identifying themselves in those situations of discomfort and separation is relevant. It is, indeed, in such conditions of discomfort that we can find ourselves in an exotopic condition and which in fact questions one's "human condition" as Arendt (1958) would say, a disorientation and imbalance that produces an important step towards a reflective attitude on one's own to be and on their own thoughts.A decentralization / discovery confusing and exciting that concerns the identity processes and which, avoiding essentialism, can be experienced in a social context, in interacting processes where different identities are writing (Bhabha, 1994). This enhances us to reflect on writing and "on the hands that write to us", and allows us to develop ways and thoughts independent of the dominant matrices and, consequently, to change our way of "writing" (Surian & Mahmoud, 2019) and imagine or continue to imagine their life project from this observation point. This allows you to reposition yourself within your own being with a greater awareness of a vision connected to a reality that does not come from information or rumors, but from a direct source, from a shared and authentically inclusive life experience. Finding a time to reflect on the experience has allowed us to be more aware of our own existence, and in several cases to reformulate projects, dreams or simply look to the future with different eyes from a lifelong, lifewide and lifedeep learninig perspective.

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Wikipedia at the University: engaging students and teachers in open knowledge and collaborative work

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Abstract

In the last decade, Wikipedia has gone from being one of the great enemies of education to becoming a great ally, especially thanks to the degree of rigour and organisation it has achieved. The free encyclopaedia is increasingly present in universities and offers numerous opportunities for teachers for educational innovation.

This paper describes an innovation project promoted by MediaLab USAL at the University of Salamanca and aimed at the generation and publication of open knowledge, at university level, in the open encyclopaedia Wikipedia.

This project aims to promote the creation of quality content in Spanish at the University, to include the rigorous editing of content in Wikipedia as part of the practical work of undergraduate and postgraduate subjects at the University of Salamanca and to offer a new free learning tool to teachers and students. The initiative has counted with the participation of more than 100 professors, 584 students and has achieved the creation of 1752 articles specialised in different areas of knowledge in Wikipedia.

Keywords: *Wikipedia; educational innovation; collaborative work, open knowledge.*

1. Introduction

Wikipedia is one of the most visited websites on the Internet, despite the fact that in recent years it has not stopped losing visits, due to the impact of Google's smart search, which gives priority to its own platforms such as YouTube. Nevertheless, it is still the fourth most visited website in the world (Alexa, 2020).

Wikipedia began its journey in 2001 and, since then, it has not stopped growing, becoming a place of reference for all kinds of queries. The Spanish edition of Wikipedia is one of the most successful, with more than 31 million visits per day (Wikipedia, 2021), many of them coming from the field of Higher Education (according to the statistics currently offered by Wikipedia itself). However, for a long time this global encyclopaedia has been stigmatised in the educational world, precisely because of its open and collaborative nature. "The main concerns that teachers have about Wikipedia are quality, accuracy and reliability", (Meseguer-Artola, 2015).

Wikipedia has developed a rigorous publication process and currently the publications made by contributors are checked using wiki technology (which allows collaborative work from a technical point of view) and the crowdsourcing production model, on which the work of the volunteers who review the content is based, among other actions (Alonso-Jiménez, 2015).

The educational use of wikis has become popular due to the variety of didactic uses it offers (Villarroel, 2007) and for being an excellent resource for transforming the process of transmission and reception of knowledge in a context marked by information and connectivity (Legaz and Morales, 2018).

The interest that this open encyclopaedia continues to arouse as a source of open information and its collaborative work formula make Wikipedia the ideal environment for experimentation and teaching innovation. Based on these premises and as part of a teaching innovation project, this experience was developed with students of Art History at the University of Salamanca.

2. WikiUSAL: A proposal for educational innovation with Wikipedia in the medialab of the University of Salamanca

2.1. MEDIALAB USAL. A space for educational innovation at the University

This teaching initiative has been developed by MEDIALAB USAL, a space created at the University of Salamanca in 2010 to promote educational experimentation and innovation. In addition to fostering innovative experiences, the University of Salamanca's medialab promotes experimentation with digital technologies, the promotion of creativity and

interdisciplinary work; typical elements of social laboratories for university innovation (Romero and Robinson, 2017).

Along with these characteristics, one of the main tasks of the medialab of the University of Salamanca is to promote the philosophy of collaborative work from a practical point of view and using open source digital tools; aspects acquired from the culture of the commons and which enable collective cultural creation (Escaño, 2017; Méndez, 2015; Lucero, 2003).

MEDIALAB USAL was created with the intention of favouring the connection between teachers, students, technology and digital media. Above all, it is a project that seeks to respond to the needs of the new educational model. Therefore, it seeks the active participation of students and teachers and, for this reason, all its projects and programme of activities have been conceived from a very practical and immersive point of view, since, as José M. Ruíz (2016) points out in one of his research projects, the medialab model "represents a highly interesting example to carry out the necessary study on the change in the educational and cultural model -which began with the end of mass media-, in which the consumer -or student or collaborator- is transformed from a passive being to an active being, converting the communicative act into a constant feedback of information" (Ruíz, 2016: 103).

Since its beginnings, MEDIALAB USAL has contributed, among other aspects, to the creation of new virtual physical spaces for collaboration and generation of open knowledge among the university community (Almaraz-Menéndez et al., 2016).

2.2. Wikipedia as a tool for educational innovation that promotes open knowledge and collaborative work

As part of this collaborative activity in MEDIALAB USAL, a large teaching project called WikiUSAL was conceived in 2013, which has been developed for years, with the aim of contributing to the rigorous and specialised creation of content in Wikipedia from the University; an initiative in which more than 100 teachers from all areas of knowledge at the University of Salamanca joined, along with more than 600 students.

The teaching proposal included prior training of the participants in the inner workings of the free encyclopaedia, the rules of publication, forms of participation and the development of specialised content, among other aspects.

The project has its own web platform (http://diarium.usal.es/wiki/), designed to provide information on progress and to promote the creation of a wiki community at the University.

In addition, all the information and materials related to the activities and initiatives that have been launched, such as videos and presentations of conferences and workshops, have been published on this website.

Along with the workshops, several tutorials on the publication rules and wiki code have been developed to support the participants, which at the same time have been shared freely with other interested people from the university community who were interested in learning how to edit in Wikipedia, in line with its philosophy of free and collaborative learning.

This great collaborative teaching innovation project of the University of Salamanca managed to create a community interested in Wikipedia editing and in its utilities as a teaching and learning methodology that gave rise to new proposals from students and teachers. Thus arose the initiative to make known the rich heritage of the University of Salamanca in Wikipedia through an editing workshop in the free encyclopaedia, which is detailed below.

3. Wikiparty: Loci et imagines' at the University of Salamanca. Collaborative Wikipedia editing through artistic heritage

To commemorate the 800 years of history of the University of Salamanca celebrated in 2018, the exhibition *Loci et imagines/Images and Places* of heritage at the University was organised, dedicated to showing the immense cultural and material heritage that the USAL has been treasuring over VIII centuries.

Despite the fact that many of the artistic pieces exhibited and the places highlighted in the exhibition were of great heritage and historical relevance, surprisingly there was no trace or mention of them in Wikipedia. For this reason, MEDIALAB USAL carried out an open and participatory proposal with teachers and students of the University to create content about these works in Wikipedia.

Due to its usefulness and attractiveness, the proposal was included in the official programme of activities to commemorate the 800 years of history of the University of Salamanca.

This activity was inspired by the working formula that is usually used in the hackathons that MEDIALAB USAL organise at the University to promote social innovation. These meetings are an excellent context to implement aspects such as collaborative work through project-based learning. (Almaraz-Menéndez et al., 2016).

3.1. Structure of the teaching activity 'Loci et Imagines wikipedia editing marathon'

The main objectives of the activity, called 'Loci et imagines Wikipeida editing marathon', were to bring the University of Salamanca closer to the public outside the University and to promote the editing of rigorous content in Spanish on Wikipedia related to the University's heritage. To this end, the teachers and students of the Degree in Art History at the University of Salamanca were involved.

The proposal started with an explanatory tour by one of the participating lecturers, who was also in charge of curating the exhibition. After the exhibition tour, an informative seminar

and a Wikipedia editing workshop were organised to teach students the formulas for creating and editing content in the encyclopaedia, as well as the rest of the operating rules.

Subsequently, teachers and students distributed the content to be edited and for a morning they created content linked to the most important elements and to the exhibition itself as a whole. Previously, as an additional activity, they had carried out documentary work on the different works.

Thanks to this activity, more than twenty articles were created on Wikipedia, related to the artistic and cultural heritage of the University of Salamanca. In addition, as a result of the editing marathon, 6 chapters of content related to the exhibition were created in Wikipedia: The City of Knowledge (about the beginnings of the University in the 13th century), The Royal Chapel of San Jerónimo, The Library. Culture and Science, the Portrait Gallery of Kings and Queens of Spain and the University and Secular Colleges. All of them are listed at the following address:

https://es.wikipedia.org/wiki/Loci_et_Imagines

Some of these places and pieces that did not have any article in Wikipedia are as important as the General Historical Library of the University of Salamanca, considered the first university library in Europe.

The activity was also very well received by the students and had an important repercussion among the university community and the press.

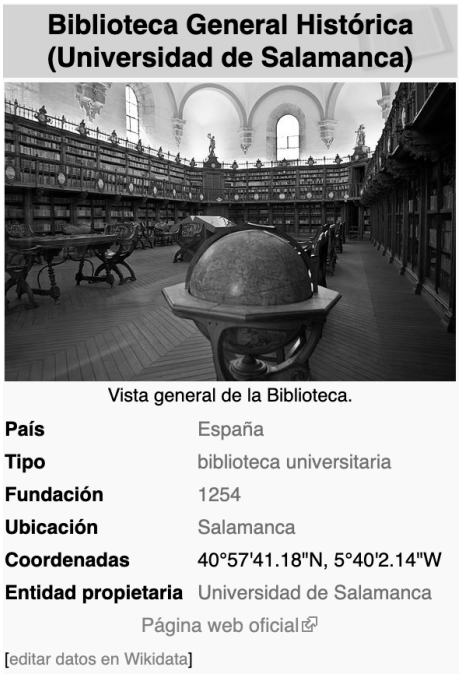

Figure 1. Wikipedia article of the General Historical Library of the USAL

Figure 2. One of the press appearances of the Wikipedia teaching activity

4. Discussion

The creation of this project has been an excellent opportunity to involve the university community in the creation of specialised and rigorous content in Spanish on Wikipedia, thus contributing to the growth of this global free encyclopaedia, whose queries and users continue to grow every day.

Undoubtedly, one of the main motivations for the involvement of the participants has been to be able to work in a real environment that is consulted by millions of people every day. This project has enabled students to present some of their academic work to a global audience, making them feel, among other things, more responsible for work of great practical utility that would otherwise not leave the classroom.

Also, by being in an open community, their work can continue to improve, transform and grow once the task is completed. These aspects help both teachers and students to integrate the principles of a free and collaborative knowledge environment.

Moreover, being part of such a project reinforces students' ability to think critically and evaluate different sources of information, which is essential in a context of information saturation and false content on the Internet.

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Teaching Communication with Disabled Patients Using Case-Based Learning – Experience from practice

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Abstract

The aim of this paper is to describe what lecturer's experiences of teaching communication are with disabled patients using CBL method at Faculty of Medicine and Dentistry, Palacký University Olomouc. The CBL didactic method includes both intentional and unintentional learning. It is a method of controlled questioning and provides more space for teaching of small groups.

During lessons students can communicate with a disabled patient, i.e. an adult with limited legal capacity due to mild mental retardation, and his public guardian. It helps medical students better understand communication processes with a disabled patient and develop interpersonal skills. Using CBL method, students think critically and ask targeted questions to the public guardian of the disabled patient. This experience strengthens the feeling of empathy with the patient, allows him to get to cooperate in treatment. Students are familiar with the communication problem before the lesson. The teacher acts as a facilitator.

The inclusion of patient with limited legal capacity and his guardian in the conduct of CBL communication seminars meet the needs of practical training in communication.

Keywords: *Disability; mental retardation; legal capacity; health communication; medical education; case-based learning.*

1. Introduction

The education of medical students in the field of communication is changing. The quality of medical education depends on various factors, such as curriculum, patient exposure, faculty expertise in the subject, knowledge, and training in teaching-learning methodology (Nanda & Manjunatha, 2013). Students in medical and health-care fields are taught using traditional methods, i.e. face-to-face lectures. It is supported by video tutorials (Wynter et al., 2019) and innovative didactic methods such as Problem-based learning (PBL) and Case-based learning (CBL). These educational methods (PBL and CBL) in the teaching of practical medicine have become increasingly popular both in the Czech Republic and abroad (Srinivasan et al., 2007; McLean, 2016; Kenchaiah & Krishna, 2016; Wynter et al., 2019; Galiana, 2019; Ali et al., 2019).

Since 2014, the Faculty of Medicine and Dentistry, Palacký University Olomouc, has been teaching communication within the 1st, 3rd and 4th year of the General Medicine study program. In the 4th year, the compulsory-elective subject "Communication with disabled patients" is taught. The course consists of 2 topics: a) communication with patients with limited legal capacity, and b) communication with geriatric patients. The main author of this article has taught medical students the topic communication with patients with limited legal capacity in 4th year of General Medicine since 2014.

The condition for effective communication with disabled patients is to understand the type of disability and the patient's specific needs. Persons with limited legal capacity are adults who have mental disorders due to which they cannot act legally, and the court appointed a guardian for them. These persons often face prejudices and are often threatened by social exclusion, discrimination by the majority society (Juríčková et al., 2014). Communication with persons with mental disorders, who have mental retardation, has its specifics (Boardman et al., 2014). The following manifestations often occur in persons with mental retardation: decreased level of mental abilities and difficulties in communication, difficulties in learning, attention deficit, poorer orientation in time and space, lower level of social skills, inadequate self-evaluation and low self-esteem. Intellectual disability is classified in ICD-10 (F70–79) as mild, moderate, severe and profound mental retardation (WHO, 2010). In practice, medical students will also need to communicate with these persons. Worldwide, a number of health issues are directly and indirectly related to communication (Wright et al., 2013). Patient-physician compliance is the result of a mutual relationship and communication. The aim of this paper is to describe what lecturer's experiences are in teaching of communication with disabled patients using CBL method at Faculty of Medicine and Dentistry, Palacký University Olomouc.

2. Case-based learning method characteristics

According to Slavin *et al.* (1995) in CBL the group focuses on creative problem solving. Srinivasan *et al.* (2007, pp. 74-75) characterize CBL method as follows:

"[…] learners are presented with a clinical problem and have time to struggle, define, and resolve the problem. However, when learners begin to explore tangents, the facilitators will use guiding questions to bring them back to the main learning objective. Additionally, students prepare in advance for the session, and they may ask questions of the local experts during the session."

CBL teaching method includes intentional and unintentional learning. This means that it includes both learning planned by lecturer and learning organized by the student himself, but also unintentional learning, i.e. learning during the analysis of individual problems, situations or dilemmas, as part of life experiences (Tučková *et al.*, 2020). CBL method is a method of controlled questioning and provides more space for teaching in small groups. This method provides more general instruction through the course of individuals (Srinivasan *et al.*, 2007; Thiel *et al.*, 2013).

The teaching of communication with disabled patients at Faculty of Medicine and Dentistry, Palacký University Olomouc is exceptional and medical students have the opportunity to communicate with disabled patient during that course (i.e. an adult with limited legal capacity due to mild mental retardation) and his public guardian (i.e. social worker). CBL didactic method has been successfully used in this teaching for two years now with positive feedback from medical students.

3. Use of CBL method in teaching of communication with disabled patients

The teaching of communication with disabled patients takes place with the participation of an adult patient with limited legal capacity and his public guardian using CBL methods as follows, see table 1.

Table 1. The use of CBL method in teaching of communication with disabled patients.

Instructional element	**Case-Based Learning (CBL)**
Presenting problem	Adam (38 years old) is patient with limited legal capacity due to mild mental retardation (dg. F70). According to the verdict, Adam is not obliged to visit doctor in company of public guardian. Adam goes to the doctor alone.
Description of situation	Adam has issues in communication with his dentist. Adam states that he does not understand the communication. Dentist often interrupts Adam´s speech, or stops him altogether. Also, according to Adam, dentist give orders and scream on him once is Adam afraid to open his mouth for examination.
Student pre-session preparation	Students get acquainted with the issue of general concept of communication with people with limited legal capacity in the seminar within the subject of "Social medicine". Then within the teaching of the subject "Communication with disabled patients", even before a patient with limited legal capacity comes to the class with his public guardian. Teaching continues with the direct participation of a patient with limited legal capacity and his public guardian using CBL method.
Initial question to begin discussion	The discussion begins with a general question: "*Why do you think there was a misunderstanding between a patient with limited legal capacity and his dentist?"* Discussion continues through additional questions: "*How would you feel, if during medical examination you were screamed on? What is it like to ask something but the doctor won't let you speak? And how, in such circumstances, does an adult patient with limited legal capacity feel in his autonomy?"* Think about what is currently going on in the patient´s mind when communicating with his dentist.
Student approach	Students are encouraged to ask during lecture, not only regarding to given communication problem/situation, but also about communication in general. Students also need to respond to questions asked by the lecturer.
Lecturer´s approach to students' incorrect knowledge or assumptions	Lecturer during CBL method can: •Redirect and explore incorrect statements: "*Why do you think so? Can you provide some examples?"* •Discuss alternate techniques: "*What bad communication habits did dentist use?" "Do you think Adam is able to decide on his treatment?" "Have you ever think how patients with mild mental retardation percieve us?"*
Faculty approach to „clinical blind-alley" digression	Probe learner for alternatives: "*Why do you think that is important in this case? What else might you consider that might be important? What do the rest of you think?"*
Student use of additional resources during the session	None required.
Case continuity	The time allowance (3 teaching hours) from the students' point of view is sufficient and therefore this seminar does not end with unanswered or unresolved questions.

Source: Modified from Srinivasan *et al.*, 2007. Note: Patient´s name was modified for legal protection reasons.

In the beginning, theoretical base in communication with disabled patients are presented. After that, lecturers introduce the case and present the problem. The communication is guided by lecturer and performed by students, using their own words to cover their individual information needs (table 1). Lecturer guides the communication and through focused questions redirects attention to specific communication aspects. CBL approach shifts from passive learning to active participation of students in the process. Discussion within the group enhances understanding of given topic. In practice, more questions arise during the communication of students with Adam and his public guardian. Medical students are the most interested in the following categories of questions: a) communication in the doctor-patient relationship, b) communication with the public guardian, c) communication with other staff, and d) the life story of Adam. These questions are, for example: *"Adam, how do you communicate with your psychiatrist?" "Why don't you want your public guardian to a company you to medical visits?" "What bothers you the most now?"* The most frequently asked questions towards public guardian are following questions: "*How do you communicate with doctors?" "How do you communicate with patients with limited legal capacity?"* During lectures, questions formulated by students are answered by Adam and his public guardian as well as lecturer, who has been dealing with patients with limited legal capacity for a long time.

Also, students learn that some questions are not well formulated and do not lead to intended response. These include: a) students ask Adam questions which are long and less understandable, b) students do not provide space for Adam's response and respond instead of him, c) in the course of session, students do not verify level of Adam's understanding, d) students communicate with Adam from position of adult towards child (act as Adam is a child) and e) students do not ask Adam, but his public guardian instead. Medical students during communication with Adam often slip into bad habits, such as mind-reading, interruption of speech, unclear or less specific statements. Assertive communication is one of tools used both in effective communication and mental hygiene.

The evaluation of students shows that communication with Adam and his public guardian is very beneficial. Especially, it is appreciated that students can ask all kinds of questions and better understand the depth of problem in broader life context. In past 2 years, 55 students participated in the communication course each year. Each group consisted of maximum 15 students (in the course of 3 teaching hours). Communication with persons with limited legal capacity seminars were introduced 5 years ago. Last two years, CBL method was used. Also, due to COVID-19 pandemic, teaching had to be in online form.

During the section, majority of students participated actively, reluctance rate was extremely low. Reluctant students sometimes explained, that they were not asking because they were afraid of Adam with assumption of possibly aggressive behavior. Adam, on the other hand, was glad that he could share his life story and perceived his participation as positive.

4. Discussion

Teaching communication with disabled patients using CBL method has its advantages. Among advantages is students' ability to learn to think critically and learn to ask targeted questions of the disabled patient and his public guardian. This experience strengthens the feeling of empathy with the patient, and allows getting patient to cooperate in treatment. Small group setting provides great advantage regarding space for participation of each student according to his individual needs. Students are familiar with the communication problem before the lesson. The teacher acts as a facilitator. The facilitator structures and leads the process according to the situation and time, involves all students equally in the discussion, promotes trust, openness and sharing of opinions, returns the ongoing discussion to the topic and goals, helps clarify incomprehensible content, prevents conflicts or resolves them. Facilitator is the person who prepares the course of the meeting and then accompanies it from beginning to end. He should play a neutral role (Wilkinson, 2011). Also, this cooperation is in some sense beneficial to the subject – patient with limited legal capacity and his public guardian. Public guardian through this intervention gains more insight into specifics of health communication and learn ways how to resolve inefficient communication.

CBL method has also limitations. We came to an opinion, similarly to Srinivasan *et al.* (2007) that controversy remains about which method of small-group learning is most effective, time efficient, and palatable to the learner and teacher. Involvement of students heavily depends on student's personal characteristics, as well as characteristics of his or her study group. It is crucial that facilitator gives space equally to each group member. Our experience with CBL teaching method in communication has shown that the role of facilitator is also very demanding and requires long-term training. "Teachers may adopt this role initially, again to model appropriate skills or to monitor and adjust progress along the way. Alternatively, students may be encouraged to develop such skills, sometimes in small groups, in an explicitly designated role." (Allchin, 2013, p. 370). Also, facilitator plays the role in cooperation with patient with limited legal capacity and his public guardian, their personal relationship and mutual trust. Based on personal relationship between lecturer and patient with limited legal capacity and his public guardian, it is important that lecturer stays independent and does not take stand of one of the sides.

Communication skills training is more effective in student-centered applications (Lau & Wang, 2013). The inclusion of CBL method in the teaching of communication with disabled patients has its justification, which is mainly seen in improvement of a relationship of a doctor and patient with disability. The research of Yoo & Park (2015) showed that students and teachers prefer the didactic method of CBL, because it contributes to the development of discussion, the topic of the seminar is predefined and it is possible to prepare well in advance. Teaching based on the use of an inappropriate communication situation leads to an active solution of the communication problem. This includes the sharing of opinions in a group, as

well as verbal and nonverbal interaction with a disabled patient present at the seminar. CBL therefore represents an effective strategy for practicing communication skills, stimulation of the interest, curiosity and inner attention of individuals, thus supporting active participation and subsequent motivation to learn. A tangible and realistic case that is used in teaching of communication is relevant to the clinical environment, thus improving students' motivation to learn. This is the reason why CBL has been becoming more effective didactic method than the traditional concept of frontal teaching to improve communication skills, develop problem-solving ability and motivation to practice effective communication in medical students. The research on communicative and social skills in medical students conducted in Spain (Ruiz de Azúa *et al.*, 2020) revealed that the medical students who participated in the study have empathy and active listening skills. However, authors suggest, that in some students, communication skills do not necessarily improve with training or experience. Health care professionals need to provide a context in which patients feel able to participate and to share decisions if they want to, thus ensuring a good experience for those patients (National Clinical Guideline Centre, UK). Effective communication with a disabled patient allows the patient get to comply with treatment recommendations.

In future, broader CBL method use would lead not only to improvement of communication skills, but make learning more efficient. CBL can be potentially performed not only in frontal way, but might include technologies (online conferencing) in combination with contact sessions. Ultimately, virtual patient strategy might be developed, with respect to complex algorithm to stimulate broader variety of both health and life situations.

5. Conclusion

Today, CBL method is still insufficiently used. Although especially in communication (not only with patient with limited legal capacity) has great potential for future medical professionals. Wider use of CBL increases the quality of education provided to medical students, especially in relation to patient care education. By connecting theory with practice, CBL method evokes deeper motivation, promotes social responsibility, raises awareness of the complexity of the physician-patient communication process and provides an educational framework to facilitate the application of basic communication skills, social and behavioral sciences in the context of personal, emotional and experiential learning. CBL can lead to improvements in clinical performance, attitudes, empathy as well as improvement in patient’s compliance.

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Training in higher education in the Covid-19 context: A case study of operation management training in a Business Innovation and Project Management Master

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Abstract

The main objective of this paper is to describe the programme implemented through the use of information and communication technologies (ICT) for the development and acquisition of quality engineering (QE)-related competences in the context of the Covid-19 pandemic. In the 100% face-to-face context, different products, such as catapults and paper helicopters, are used to apply the theoretical concepts of Six Sigma in a real environment, which would be impossible in an online or blended learning context. To overcome the difficulties due to the Covid-19 pandemic, a new programme has been defined that includes continuous ICT use, with a simulator of an injection process to generate the necessary data to develop practice. The programme and the simulator used have successfully replaced the practices and products previously used in a 100% face-to-face environment, allowing students to acquire QE-related competences in a practical way in a non-face-to-face environment.

Keywords: *Covid-19; teaching/learning strategies; higher education; simulator; online/blended learning; information and communication technologies (ICT).*

1. Introduction

In industrial organisations, a continuous improvement process (CIP) is a basic resource for generating long-term competitive advantage. To remain competitive over time, industrial organisations must develop a continuous improvement (CI) culture by implementing a CIP (Unzueta, Esnaola, & Eguren, 2020). Universities have therefore incorporated training programmes into their curricula to develop competences related to CI and quality engineering (QE).

The traditional approach to teaching these competences comprises classroom lectures, where students do not have the opportunity to develop first-hand experience in the application of manufacturing techniques New training techniques that combine the teaching of elementary concepts with their application help create a suitable environment for learning and the development of the aforementioned competences, where practical knowledge is transferred and decision-making is worked on (Juan, Loch, Daradoumis, & Ventura, 2017). In higher education (HE), different products, such as paper helicopters and catapults have been used to apply improvement techniques and methodologies in a face-to-face environment to help students acquire the necessary competences related to QE and DMAIC Six Sigma (SS) (J Antony & Banuelas, 2002; Jiju Antony & Jiju Antony, 2001; Eguren, Bertlin, Rehunen, & Unzueta, 2020; Unzueta, Orue, Esnaola, & Eguren, 2018).

However, the coronavirus pandemic (Covid-19) forced a transformation of the prevailing education models in HE. This transformation has focused on reducing classroom attendance through the support of information and communication technologies (ICT), necessitating new training models that combine the teaching of basic concepts with the practical application of these concepts through the use of ICT (Ali, 2020; Sá & Serpa, 2020).

The aim of this paper is to describe how the transformation of the training and coaching process has been organised to train the students of the Master in Business Innovation and Project Management at Mondragon Unibertsitatea (MU) to acquire the necessary knowledge and skills in QE to help them develop skills in the closest possible environment to production. This transformation changed the process from a 100% face-to-face environment with face-to-face practice (Eguren et al., 2020) to a blended environment combining theoretical lessons with simulations based on ICT to overcome the limitations generated by the Covid-19 pandemic.

2. Methodology

To analyse the implementation of a new training programme, a qualitative case study research methodology was applied (Baxter & Jack, 2008), and the following sources were used for data collection: direct observation, participant observation, interviews with students, student

satisfaction surveys and the documentation and files generated by each student's team to solve the presented problem (Yin, 2013).

The training programme was based on dynamic learning (DL) (Baird & Griffin, 2006), which is based on learning by doing and reflecting on the process. The team of professors developed and presented a problem, and the student teams developed a case in which they applied the improvement methodology based on the Six Sigma DMAIC (Pyzdek, 2003), which we call DMAIC-7P (Eguren et al., 2020) (Figure 1), to solve this problem.

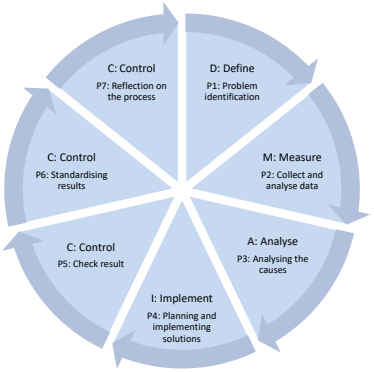

Figure 1. Six Sigma DMAIC – 7P Methodology.

The competence developed through the training programme is as follows: *Uses quality tools to ensure that the production of a product or the provision of a service meets customer specifications.*

Working in teams of four, the students applied the theoretical concepts they had been shown to a specifically designed problem or case, using as input the data provided about the problem to be solved. The developed case involves the optimisation of a plastic injection machine.

The process was carried out in a blended learning format, with the support of a Moodle platform where all the information was stored in a repository, including the theoretical files, the case description, the DMAIC-7P method templates, the injection process simulator in Excel format, the individual data of the plastic injection machine for each of the eight teams and remote access to Minitab software.

The training module lasted 20 hours and was delivered in two groups (morning and afternoon) to limit the number of participants and for teachers to have more time to attend to each team. Figure 2 shows the structure of the module and the contents to be covered in each session, including the type of session (face-to-face or online). In the face-to-face classes, priority was given to teaching the theoretical concepts and drawing conclusions from each phase of the methodology. In the online classes, tutorials were held with each team to guide their work.

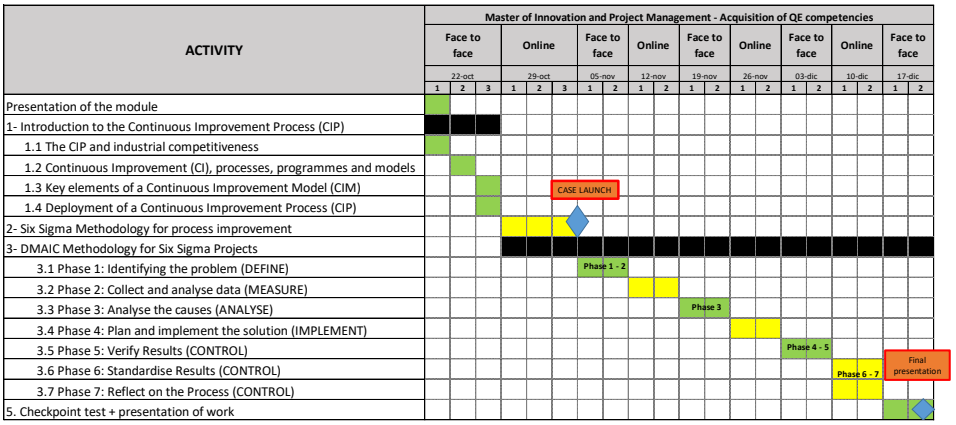

Figure 2. Module Structure and Planning.

The researchers observed the work done by each team and drew conclusions about the evolution of the training process. To evaluate the acquired skills, each team gave an oral presentation where they showed their results and reflected on the training process followed. Afterwards, the teachers and the researchers gave feedback on the observations made and the evaluation of the completed work.

The final evaluation of each student was carried out taking into account the group work performed, and an individual exam was administered through the Moodle platform, where the students demonstrated acquisition of the knowledge and competences related to QE.

3. Developed Learning Process

In the first training session, which was held face-to-face, the teaching team presented the concepts related to CI: CIP and industrial competitiveness, the differences between CI programmes, CI models and CI processes, the key elements of a CIP and how to properly deploy a CIP. During this session, the framework that the DMAIC-7P Six Sigma process improvement methodology focuses on was explained.

In the second session, held online, the DMAIC-7P methodology was explained in depth. In this session, the structure of the methodology, its phases and the main tools used in each phase were explained, as was the information deposited in the Moodle repository to be used by each team—the template for the application of the DMAIC-7P methodology, the injection process Excel simulator and the data to be used by each team. At the end of the session, the case to be developed was explained and given to each team. Each team was given different data, which forced the teams to develop their own cases.

In the subsequent sessions, each team developed the case individually using the data it received and the injection process simulator. The face-to-face sessions imparted the

theoretical concepts and the application of the main improvement tools to the whole group and discussed the tasks carried out by each team so far. In the online sessions, each team developed its case telematically and held scheduled telematic meetings with the team of teachers.

To develop the first phase (P1: Define and identify the problem), the work teams used the information provided in the case description prepared for each team. Each team defined its own project, identifying a flow chart of inputs and outputs of the process using the SIPOC tool and the output of the desired injection process.

In the second phase (P2: Measure and collect data), the teams analysed the quantitative information prepared for each team using different tools (e.g. Ishikawa, histograms, Pareto, regression or time plots) to clearly identify their specific problem. As shown in Figure 3, each team used the simulator to define the approximate levels of the process parameters (input) and to achieve the desired injection process output.

Plastic injection machine simulator

Experiment number: **7**

INPUT				
Polymer temperature	Mold temperature	Injection presion	Compaction time	Cooling down time
250	45	790	11	9

OUTPUT	
Result of experiment: Weight of the part	11,42

RESET EXPERIMENTS | RUN EXPERIMENT

Nº	Polimer temperature	Mold temperature	Injection presion	Compaction time	Cooling down time	Weight of the part
1	260	40	770	9	11	10,19
2	250	45	790	11	9	11,51
3	250	45	790	11	9	11,51
4	250	45	790	11	9	11,47
5	250	45	790	11	9	11,47
6	250	45	790	11	9	11,55
7	250	45	790	11	9	11,42

Figure 3. Injection Machine Excel simulator (Own elaboration).

In phases 3 and 4 (P3: Analyse; P4: Implement), which relied mainly on design of experiment (DoE) tools (e.g. ANOVA, factorial design-2^k, fractional factorial design-2^{k-p}, t-test and regression), each team precisely identified the appropriate levels of the input parameters of the injection process (Figure 4). In control phases 5 and 6 (P5: Verify and P6: Standardise), using the simulator to obtain the necessary data from the injection process, the work teams carried out the necessary data treatment to develop the control charts identifying the process control limits, establish the process control sheets and measure the process capacity (Figure 5).

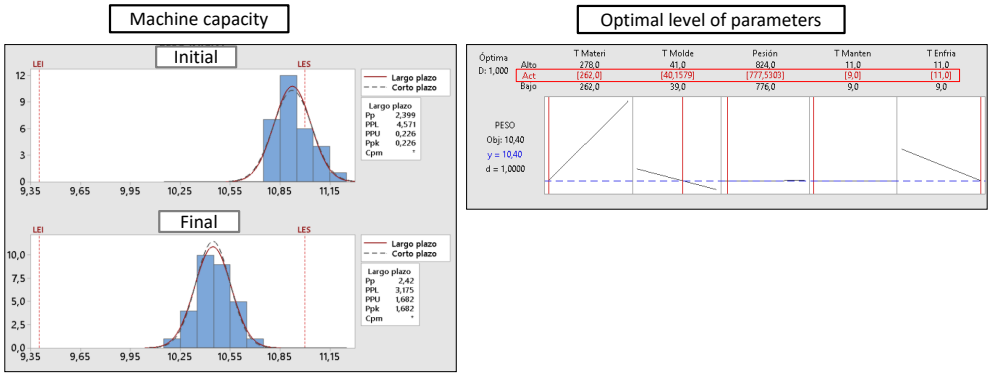

Figure 4. Results of the Analysis and Improvement of the Injection Process

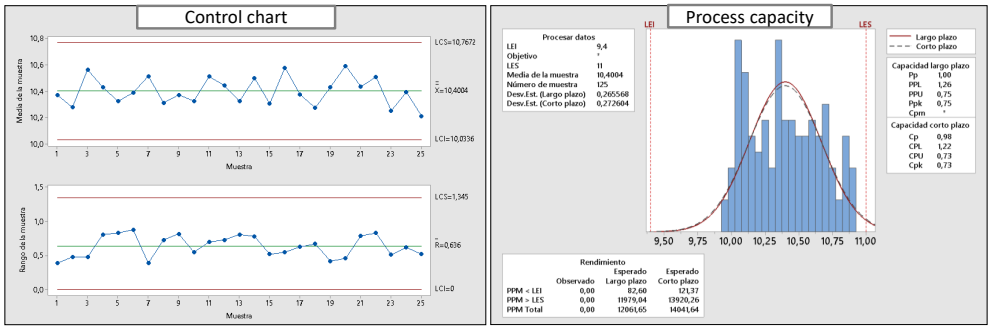

Figure 5. Example of a Control Chart and Process Capacity Analysis Completed by Students.

In the last phase (P7: Reflection), each team carried out a global reflection on the work developed and the methodology followed for its correct execution. Through group reflection, the students obtained a global vision of the improvement process, assimilating the improvement possibilities that the application of the DMAIC-7P methodology allows for achieving and understanding the relationship of the improvement tools applied individually. Table 1 shows the main improvement tools applied in each phase of the DMAIC-7P methodology.

Table 1. Quality Tools Applied in each DMAIC Phase.

	Define	**Measure**	**Analyse**	**Implement**	**Control**		
	Phase 1	**Phase 2**	**Phase 3**	**Phase 4**	**Phase 5**	**Phase 6**	**Phase 7**
	Identify the problem	Collect the data	Analyse the causes	Plan and implement solutions	Check results	Standardised results	Reflection
SIPOC							
Project charter							
Ishikawa							
Histogram							
Pareto							
R&R							
SPC							
Regression							
t-test							
Time plot							
ANOVA							
DoE 2^k - 2^{k-p}							

4. Conclusion

During the learning process implemented through the use of ICT in a blended learning environment, the students acquired technical competences (using quality tools to ensure that the production of a product or the provision of a service meets customer specifications), transversal competences (the ability to develop technical reports, develop oral presentations and conduct face-to-face and online teamwork) and competences related to the use of ICT.

In the reflection phase of the DMAIC-7P methodology, the students gained an overview of the process improvement methodology, identifying what new knowledge, skills and tools they applied during the teamwork. The results of the exam taken by each student showed whether the students acquired the pre-identified technical competence and necessary QE knowledge. In addition, the research team observed how the injection moulding process simulator satisfactorily replaced the products used in previous years for the practical

application of the theoretical knowledge acquired in the 100% face-to-face classes, allowing the application of the DL model in a non-face-to-face format. The feedback received from the students was satisfactory and similar to that from previous years.

In conclusion, although non-face-to-face classes limited the capacity for interaction between teacher and students, based on the exam results and direct observation, the research team can confirm that the knowledge acquired enabled the students to develop competencies related to the use and application of quality tools, thus overcoming Covid-19 pandemic-related constraints.

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Teaching Design Thinking in times of COVID-19: an online learning experience

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Abstract

Due to the COVID-19 pandemic, in March 2020, the Innovation Management & Design Thinking course at NOVA IMS suddenly transitioned to a 100% online setting after only two presential classes, requiring adaptations to the learning experience, course materials and class dynamics. There were concerns that the learning experience would suffer and if it would be possible to promote empathy in an online environment. This study evaluates the impact of this disruption on the learning experience, student performance and engagement by comparing the final grades, applying two surveys and conducting in-depth interviews. Our results show that instead of a contingency situation, it turned out to be a transformative experience. Learning performance and engagement were not meaningfully affected, as students were just as able to commit to their innovation projects and produce quality outcomes. We propose that blended learning experiences will leverage the best of both online and presential worlds in the future after COVID-19 and offer specific suggestions drawn from the collected data. The results are valuable for lecturers – from any course – who want to improve their learning experience in the new reality after the COVID-19 pandemic.

Keywords: *Design thinking; online learning; learning experience; pedagogical innovation; problem based learning.*

1. Design Thinking in the data-driven economy

NOVA IMS's motto, "From data to value", encompasses its mission to train leaders capable of working in a global and competitive environment, combining innovative investigation with a stimulating and creative teaching environment. While it is clear that jobs in the data-driven economy require analytical skills, uniquely human skills, such as persuasion and communication, are not usually supplied in education. However, they have gained increased importance in the industry (Börner et al., 2018). The Future of Jobs Report (World Economic Forum, 2020) identifies analytical thinking and innovation, active learning, complex problem-solving, critical thinking and creativity as the top 5 skills for 2025. Today, any data scientist, manager, marketeer or any other professional that uses data to solve business problems requires these skills to succeed. In this context, NOVA IMS created the Innovation Management and Design Thinking (IM&DT) curriculum, a 14-week course to combine qualitative and quantitative approaches to solve complex business or societal challenges.

Design Thinking is a thought process that "brings designers' principles, approaches, methods, and tools to problem-solving" (Brown, 2009). It can also be defined as "a human-centred innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping and concurrent business analysis" (Lockwood, 2009). The course was structured according to the three phases of Design Thinking defined by Brown (2009): Inspire, Ideate and Implement. Table 1 summarizes the objective of each phase and the essential tools used.

Table 1. Design Thinking stages and used tools.

Stage	Goal	Design Thinking Tools used
Inspire	Empathize with users, understand user needs, formulate design problems	Exploratory research (benchmarking, trend analysis, parallel universes, literature research), ethnographic research (interviews, user journey mapping), visualization (capture of ideas and concepts in a whiteboard, mind mapping) and synthesis (finding patterns in research, identify personas, formulate insights).
Ideate	Apply creative and divergent thinking techniques to generate and refine ideas	Brainstorming, divergent thinking techniques, visualization (capture of ideas and concepts in a whiteboard), idea prioritization (scoring and selecting ideas for implementation based on their desirability, feasibility and viability).
Implement	Prototype and test assumptions	Prototyping (storyboards, digital or physical mockups), user testing (synchronous and asynchronous).

Design Thinking's benefits as an approach to innovation and problem-solving have been described in the literature (Buchanan, 1992). The fact it can be used effectively by inexperienced teams (Seidel, 2013) and designers and non-designers alike (Brown and Katz, 2011) are two of the main reasons for its popularity as an innovative approach. Design Thinking has been shown to increase group task reflexivity, manifested through more debate in the group, which correlated with more successful outcomes (Seidel, 2013), and to reduce cognitive bias (Liedtka, 2015).

1.1. COVID-19 impact on the course

The second class of Innovation Management and Design Thinking at NOVA Information Management School (NOVA IMS), held on March 10th, 2020, was the last face-to-face class of the semester. Due to the COVID-19 pandemic lockdown, professors had one week to move their classes to a 100% online setting, which implied rethinking the experience, study materials and in-class dynamics.

Being Design Thinking a collaborative and people-centred methodology, moving to an online synchronous setting would impact all stages of its process. This way, we applied alternative tools to each stage of the Design Thinking methodology, as presented in Table 2.

Table 2. Methods used in each Design thinking stage for face to face and online classes.

Stage	Face to face class method	Online class method
Group Formation	Groups assigned by students	Groups predefined based on the students' profile
Inspire	Face to face ethnographic research (interviews and field observations)	Online ethnographic research (interviews and customer journeys)
Ideate	In-class brainstorm using whiteboards and post-it notes	Online brainstorm using virtual whiteboards like Mural or Viima
Implement	Physical prototypes and face to face user testing	Digital prototypes and virtual testing (synchronous and asynchronous)
Final Pitch	In-class presentations	Online presentations

Furthermore, we increased the available time for student coaching outside of class, recording the classes and increasing the course material available online (including short videos with a summary of the ideas discussed in each class). Throughout the semester, we openly checked in with students. We asked for feedback, as we were all going through the same disruptive experience together and would need constant feedback to adjust.

To measure the impact of the changes implemented in the Innovation Management & Design Thinking course, we monitored the learning experience on overall learning performance, student satisfaction, learning experience and student engagement.

1.2. The Design Thinking challenge and participants

The course of Innovation Management and Design Thinking is based on real-world challenges allowing students to practice the theoretical concepts covered. Every edition of the course has an industry partner proposing a challenge to students. For the 2020 edition, NOVA IMS itself challenged the students to envision a new academic building that promoted innovation, inclusivity and sustainability.

The class had 47 students from different backgrounds: 10 nationalities, 5 different backgrounds (health, management, marketing, data science and engineering) and different seniority (from recent graduates to 20+ years of work experience). The fact that the course is elective to different NOVA IMS programs increases student diversity. To leverage this diversity and produce more disruptive outcomes in the innovation project (Edmondson and Nembhard, 2009), students were assigned to groups using a specific procedure. First, we apply a questionnaire to students measuring different dimensions: academic background, personality traits, demographics and work experience; then, we clustered students based on each dimension, obtaining a final cluster solution with similar students; we then assign to each group students from each of the cluster, allowing a more diversified set. Over 14 weeks, the students worked on the project, following the stages listed in Table 1, and ending with a final pitch presentation to the NOVA IMS Dean.

2. Data Collection and Analysis

For evaluating the impact on learning performance, we compared the grades from 2018/2019 (pre-COVID-19) and 2019/2020 (during COVID-19) academic years. For student satisfaction, we compared the results of the class evaluation survey that the university uses to assess all its courses' quality. The response rates for this survey was 50% for 2018/2019, corresponding to 20 students, and 36% for 2019/2020, corresponding to 17 students. To measure the impact on the learning outcomes, we compared the grades for the project work in both years.

Finally, we handed out a survey at the end of the semester and interviewed students from both years to enrich the survey findings. In the case of student engagement, which has been defined as investment or commitment (Marks, 2000; Newmann, 1992), the survey questions focused on the three dimensions of engagement – behavioural, emotional and cognitive (Henrie, Halverson and Graham, 2015) – which students answered on a Likert scale. Concerning the impact on the learning experience, we asked students to rate different

activities as "more difficult", “the same” or “better”, comparing face-to-face to online. We received 25 responses to this survey, 16 from 2018/2019 and 9 from 2019/2020.

To explore in more detail the impact of the transition, we performed 8 in-depth interviews (4 from 2018/2019 and 4 from 2019/2020), inviting students to provide examples of situations to illustrate their feelings., and interviewed.

3. Results and discussion

Overall, the results show that the transition to 100% online classes did not significantly impact the learning performance, student satisfaction and student engagement. When comparing 2019/2020 (during COVID-19) to 2018/2019 (pre-COVID-19), grades improved by 7%, student satisfaction increased by 2% and student engagement increased by 1%. These results indicate that the adaptation of the teaching techniques to a 100% online environment effectively maintained the overall quality of the learning experience.

When looking in detail at different day-to-day activities of the learning experience, we observe that some were affected positively and others negatively in others, as depicted in Figure 1. Discussion in class, asking the professors for feedback and keeping focus during class was perceived as “more difficult” in online classes. Lecturers should have these three moments in mind when planning online or blended courses. For instance, use techniques for more effective discussion online, such as breakout rooms or using the chat for student prompts, schedule moments both in class and outside of the class for students to ask for feedback and adapting active learning techniques in the online environment to enhance student focus and engagement in an environment that is typically filled with distractions (laptops and smartphones).

Doing presentations online was equally perceived as worse, better, and the same, which indicates that it does depend on the context as much as on the students' preferences. Some interviewed students explained that they felt more comfortable presenting online due to feeling less exposed, while others missed assessing the audience’s reaction face-to-face. Working as a group and motivation to attend classes were perceived as slightly better in an online environment. Interviewed students said it was better not to have to commute home in the evening, and it was more comfortable to attend the class from the comfort of their home after a tiring workday since the class was held in a night-time schedule. Additionally, the interviews revealed that students were already doing group work online previously to the pandemic, only getting together for two specific reasons: socialization or when a physical deliverable was required (e.g., project board).

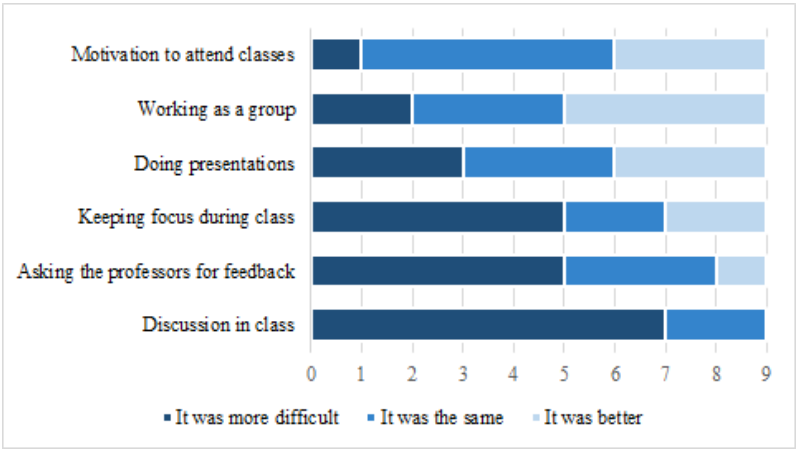

Figure 1. How students felt about online learning experience comparing to on-campus experience.

From the analysis of the students' interviews on each of the Design Thinking process phases, we concluded that the Group Formation and Inspire phases were positively impacted by online teaching. The Ideate phase was negatively impacted whereas the Implement phase and the Final Pitch were not significantly impacted by the change, as summarized in Table 3.

Table 3. Online methods impact per stage of design thinking

Stage	**Online class method**	**Change Impact**
Group Formation	Groups assigned by an algorithm, following a questionnaire	Positive
Inspire	Online ethnographic research (interviews and customer journeys)	Positive
Ideate	Online brainstorm using virtual whiteboards like Mural or Viima	Negative
Implement	Digital prototypes and virtual testing (synchronous and asynchronous)	Neutral
Final Pitch	Online presentations	Neutral

Concerning Group Formation through the sorting algorithm, students reported that they felt they had "complementing profiles in the group" and that "the assignment of the groups was fair and easier since we did now know the other classmates". During the Inspire phase, going online facilitated the interview process: "interviewing people online was really practical". We observed an increase in the number of interviews done by students compared to previous

years when face-to-face interviews were the standard. Students reported that the quality of the interviews was not affected: "The quality of the conversation is more important – it had to feel like a casual conversation and not an interview. The fact that it was online did not matter." When asked about the Ideate phase, interviewed students from 2018/2019 reported that "we created a fun environment in class for the brainstorming sessions, with snacks and beverages, which stimulated the flow of ideas. The excitement was contagious, and we even participated in the brainstorms of other groups." The experience of students was poorer – each group brainstormed online on their own – and students did not report the same level of excitement: "brainstorming was difficult, we felt lost about what to do." During the Implement phase, students did not report any difficulties in building their prototypes in an online context. The main difference from previous years was that students opted more for digital prototypes over physical ones.

4. Conclusions

When we were forced to teach IM&DT online due to the COVID-19 pandemic suddenly, we assumed that the learning experience would change: would it be possible to promote empathy and human connection in an environment where everyone would be remote and isolated? It turned out to be not a negative experience but a transformative one. We learned meaningful insights that will impact the learning experience and teaching methodology in post-COVID times.

The results from this study show us that, essentially, it is not a question of online versus face-to-face classes but a matter of how we can leverage the best of both worlds. The students' feedback we collected showed us that being online provides advantages in terms of comfort and time management for classes that function in night-time schedules – especially for working students. The evidence points to students demanding more blended learning formats in the future. As an implication, professors will need to adapt their curriculum and methods to this new reality, bearing in mind that teaching online cannot be done in the same way as on-campus. Three adaptations recommended from this experience that addressed the observed limitations of online teaching are 1) to provide additional time outside of class for student coaching and feedback, 2) to make available "offline" the lessons learned in class (e.g., by recording classes or releasing short videos with a summary) to compensate the greater difficulty of keeping focus in an online class and 3) to find ways to promote discussion in the online medium similar to face to face discussions.

While students prefer the online environment for group work and theoretical classes, the on-campus experience enhanced brainstorming activities and enabled socialization. The traditional classroom built for passive learning is obsolete (Benade, 2017). How we envision

learning spaces in the future should reflect and support these needs and new active learning methodologies.

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Forced distance learning in Covid-19: peculiarities of the position of lecturers, students of IT and humanitarian specialties

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Abstract

This research examines the attitude of faculty lectors, Information Technology students (IT) and humanitarian students (HS) towards the aspects of forced distance learning (DL) due to Covid-19. About 70% of the surveyed IT students and 50% of HS believe that DL can fully replace face-to-face classes and completely switch to DL, about 70% of lecturers have the opposite opinion. At the same time, IT had a 4.5 times higher chance of a positive attitude towards the transition to DL than HS. The majority of all respondents consider that their own notes are important and that classroom learning is better than online. At the same time, among IT that are ready to switch to DL, 69.03% believe that the perception of educational material is better in the classroom. Fewer IT students (30.1%) than HS (68.2%) and lecturers (100%) consider that printed textbooks are important. About 70-90% of students consider that the following DL disadvantages are important: communication difficulties, cocial isolation, the need of self-discipline and self-motivation and fears that the employer will not appreciate the knowledge gained from DL. For the majority of IT, lack of student events is significant, and for the majority of HS, lack of competition between students is important.

Keywords: *Attitude towards online education; distance learning; electronic questionnaire.*

1. Introduction

The World Health Organization (WHO) announced the global COVID-19 pandemic on March 11, 2020 (Cucinotta & Vanelli, 2020). Due to the need for social distancing (Nanotkar, Dhanvij, & Joshi, 2020), most educational institutions have completely or partially stopped teaching in classrooms (UNESCO, 2021), switching to distance learning (DL) (Kaur, 2020). Despite the fact that distance learning has long been used by many universities and has significant positive aspects (Oliveira, Penedo, & Pereira, 2018; Kattoua, Al-Lozi, & Alrowwad, 2016; Choudhury, & Pattnaik, 2020), many educational institutions faced various problems due to the complete rejection of classroom studies (Adnan & Anwar, 2020). Many experts say that the forced transition to DL will not end quickly (Potvin, 2021) and may be repeated in the future. In addition, new experience in the educational process, the introduction of digital technologies and the improvement of teaching methods that appear at the present time can be successfully used in the future. Consequently, the issues of adapting all aspects of the educational process to the situation of learning in isolation for full-time students are relevant and require solutions.

To search for answers to such questions, first of all, it is necessary to find out which aspects of DL arouse rejection among full-time students, and which, on the contrary, are perceived positively. It is necessary to identify the most problematic points, to understand how to provide the educational environment required by full-time students. Eight types of e-learning success factors in higher education are identified: technological, institutional, pedagogical, management, ethical, assessment, resource and social interaction (Basak, Wotto, & Bélanger, 2016). Also, when adapting the educational process to a situation of isolation, the type of specialization of students may matter. It is likely that computer science students may be better at distance learning than humanitarian speciality students (Phillips, 2020). In this study, the questions relevant to universities were considered, the answers to which will help to adapt the learning environment and students to a new era in the system of higher education.

2. Method

2.1. Participants

During the research were interviewed 199 full-time first-year students of Riga Technical University (Latvia) Faculty of Computer Science and Information Technology (33.7% females, 66.3% males), as well as full-time students of the humanities in tourism, advertising and social sciences (HS): 34 students of Baltic International Academy (Latvia) and 49 students of Financial University under the Government of the Russian Federation (Russia) (57.8% females, 42.2% males). In addition, 40 lecturers from these universities were interviewed (70.2% females, 29.8% males). The survey took place in December 2020, after

the end of classes. The average age of students was 20.18 (SD = 1.48 years), lecturers – 42.78 (SD = 8.53 years)

2.2. Instruments

An electronic questionnaire was developed with 22 questions, not including gender, age, faculty and university. To study the attitude of full-time students towards distance learning, they were asked 2 questions:

1. Please answer, would you agree to completely switch to distance learning, if at the same time there was an opportunity for both face-to-face and distance consultations? (Answers: Yes; Rather yes than no; Difficult to answer; Rather no than yes; No)
2. Do you agree that distance learning, in most cases, can fully replace learning in the audience? (answers: Strongly agree; Agree; Partly agree; Disagree; Strongly disagree)

It was also investigated the attitude of students to online and classroom studies, as well as the importance of their own notes, printed and electronic study materials. To assess the deficiencies of distance learning, a semantic differential from 0 to 3 was used, where 0 – does not matter; 3 – very important, wherein such factors were assessed: Communication difficulties with lecturers, Communication difficulties with fellow students, Lack of student events, Social isolation, Lack of competition between students, The need of self-discipline and self-motivation, Fears that the employer will not appreciate the knowledge gained from distance learning.

2.3. Statistical data analysis

Frequency data are presented as relative (%) and absolute numbers (n) of respondents. Fisher's exact test (FET) was used to evaluate 2x2 contingency tables. The critical level of significance when testing statistical hypotheses was taken equal to 0.05. Odds ratio (OR) was considered significant if there was no value equal to 1 between the confidence intervals (CI) and OR. Bonferroni correction was used in multiple comparisons.

3. Results

The current life situation for lecturers and students made it possible to assess the attitude towards the possibility of completely replacing full-time studies with a distance form for full-time students (Table 1). The research revealed dependence of the possibility of such a transition from the type of specialization of students: there were more IT students (73.8%) among those who had a positive attitude to this possibility (73.8%) than among the humanitarian students (51.4%) ($p = 0.0000$). At the same time, the chance to meet a positive attitude towards the transition to DL among IT students was 3.3 (95% CI 1.90-5.88) times

higher than for HS, and 8.2 (95% CI 3.87-17-48) times higher than for humanitarian specialty lecturers. The attitude to the full transition to distance learning among the surveyed groups was similar to the answer to the previous question: the chance to meet a positive attitude towards the transition to DL among IT students was 2.1 (95% CI 1.15-3.76) times higher than that of HS, and 9.5 (95% CI 4.08-22.0) times higher than that of lecturers of humanitarian specialties. However, the opinions of HS and L differ ($p = 0.0007$), in this case the chance of a positive attitude towards the transition to DL for IT was 4.5 (95% CI 1.81-11.42) times higher than for HS.

Similarly, the opinions of the respondents on the attitude to classroom studies differed in comparison with the online form. However, in this case, the majority of all respondents consider classroom studies to be more effective than online. Among IT students who believe that distance learning can completely replace face-to-face classes, 69.03% believe that the perception of educational material in the classroom is better. The DL experience gained by full-time students allows us to answer the question about the need for study materials in paper and electronic form. All lecturers believe that print editions are important to the learning process. This opinion differs from the students opinion. At the same time, the majority of IT students (69.9%) do not consider printed textbooks important, the chance of meeting such an opinion among them is 5.0 times higher than among HS.

For distance learning, each university already has developed technologies, which, as a rule, significantly differ from full-time studies. One of the important features of full-time learning is that studens use their own notes and lecturers, as a rule, take this into account when preparing lectures and interacting with students during classes. How important is it for full-time students to have their own notes in distance learning? Is it needed to pay attention to notes when conducting distance classes? The results force us to answer these questions positively: the majority of all groups of respondents consider their own notes to be important and their opinions on this issue do not differ.

Table 1. Attitude of full-time IT and HS students and lecturers (L) to distance learning and teaching materials. p-Values were calculated with Fisher's exact test.

	IT, n (%)	HS, n (%)	L, n (%)	p(IT/HS)	p(IT/L)	p(HS/L)
Distance learning can most often completely replace face-to-face classes						
Yes	155 (73.8)	38 (51.4)	12 (30.0)	0.0000	0.0000	0.022*
No	44 (21.0)	36 (48.6)	28 (70.0)			
Consent to full DL transition with face-to-face consultations						
Yes	127 (70.9)	34 (54.0)	8 (20.5)	0.011	0.0000	0.0007
No	52 (29.1)	29 (46.0)	31 (79.5)			
Learning material is perceived better during lectures by the audience than in online form						
Yes	143 (71.9)	65 (87.8)	38 (95.0)	0.004	0.0006	0.2*
No	56 (28.1)	9 (12.2)	2 (5.0)			
The importance of using printed study materials						
Important	47 (30.1)	45 (68.2)	38 (100.0)	0.0000	0.0000	0.0000
Not Important	109 (69.9)	21 (31.8)	0 (0.0)			
The importance of electronic study materials						
Important	194 (99.0)	73 (100.0)	39 (100.0)	0.5	0.7	-
Not Important	2 (1.0)	0 (0.0)	0 (0.0)			
The importance of your own notes						
Important	123 (77.8)	52 (76.5)	31 (93.9)	0.5	0.022*	0.025*
Not Important	35 (22.2)	16 (23.5)	2 (6.1)			

The quality of learning mostly can be determined by the difficulties which students encounter. This is especially important in situations when students initially chose full-time education, but were deprived of such an opportunity. To create a more favorable environment, it is necessary to know the problematic points and their significance for students. Research results showed that DL deficiencies such as Difficulty communicating with lecturers, Difficulty communicating with group members, Social isolation, Need for self-discipline and self-motivation, and Fear that DL quality would be poorly assessed by an

employer, were equally significant for most IT and HS (Table 2). At the same time, there were differences between IT and HS:

- there are more students among IT (56.3%) than among HS (37.3) ($p = 0.003$) for whom the lack of competition between students does not matter. It should be noted that this parameter is significant for a smaller number of students in comparison with other DL disadvantages.
- there are more students among HS (43.4%) than among IT (27.1%) for whom Lack of student activity in DL does not matter.

Table 2. The attitude of IT and HS full-time students to the negative factors of distance learning. p-Values were calculated with Fisher's exact test.

Parameter	Importance	IT, n (%)	HS, n (%)	p
Communication difficulties with lecturers	No	20 (10,1)	12 (14,5)	0.2
	Yes	179 (90.0)	71 (85,5)	
Communication difficulties with fellow students	No	34 (17,1)	22 (26,5)	0.052
	Yes	165 (82,9)	61 (73,5)	
Lack of student events	No	54 (27,1)	36 (43,4)	0.006
	Yes	145 (72,9)	47 (56,6)	
Social isolation	No	28 (14,1)	17 (20,5)	0.1
	Yes	171 (85,9)	66 (79,5)	
Lack of competition between students	No	112 (56,3)	31 (37,3)	0.003
	Yes	87 (43,7)	52 (62,7)	
The need of self-discipline and self-motivation	No	31 (15,6)	11 (13,3)	0.4
	Yes	168 (84,4)	72 (86,7)	
Fears that the employer will not appreciate the knowledge gained from DL	No	49 (24,62)	19 (22,89)	0.4
	Yes	150 (75,38)	64 (77,11)	

4. Conclusion

The results of the study showed that the majority of IT and almost half of HS believe that DL can most often completely replace face-to-face classes and are ready to completely switch to this form of education, in contrast to lecturers. At the same time, almost all students and lectors consider electronic learning resources to be important. The habits of using learning materials by full-time students, as a rule, differ from those who study remotely. For

comfortable learning of students, they must be provided with educational materials in the form they prefer. Is there a need for printed manuals and does the lecturer need to structure the lesson so that students can take their notes? The answers to these questions are important because not only the preparation of learning materials, but also the structure of the lessons depends on them. Studies have shown that most students consider their own notes to be important, while unlike IT, most HS students need printed materials, which coincides with the opinion of their lecturers. The attitude of IT students towards DL is not unusual, as many IT science students have chosen to work with podcasts rather than attend lectures (Phillips, 2020).

Learning online can make it harder for students to focus than classroom learning (Aristovnik, Keržič, Ravšelj, Tomaževič, & Umek, 2020). Also with DL, it is not possible to ask the lecturer questions when they arise, as is possible during classroom sessions (Oliveira, Penedo, & Pereira, 2018). Apparently, this is why most of the students surveyed, even those who agreed to a full transition to DL, believe that classes in the classroom are more effective than online.

DL has both advantages and disadvantages according to many researchers (Oliveira, Penedo, & Pereira, 2018). Two main problems of DL are indicated: the need for self-discipline and its lack for many students (Oliveira, Penedo, & Pereira, 2018; Bao, 2020). Almost all full-time students noted the importance of the problem of the need for self-discipline and self-motivation. It is believed that many students in the COVID-19 cohort will worry about the prospective disadvantage compared to those who studied "normally" (Daniel, 2020). Our results are consistent with this, because the majority of students expressed concern that DL quality would be poorly rated by employers.

Social factors are important for students, such as communication (Markova, Glazkova, & Zaborova, 2017), support from lecturers (Lee, Srinivasan, Trail, Lewis, & Lopez, 2011), involvement (Coates, 2005), collaborative learning. (Zhu, 2012). According to the results obtained, social isolation and communication difficulties are assessed by most students as a negative factor. Consequently, the educational institution should consider the possibilities of ensuring these functions even in isolation, guided, for example, by recommendations (Bao, 2020).

The study revealed the necessary aspects that are important in addressing the issues of adapting the educational process during isolation. In addition, it showed some distinctive features of the attitude towards DL among IT and HS students.

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Adapting your teaching during the pandemic? How social science research education adapted to the COVID-19 pandemic

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Abstract

University lecturers worldwide had to adopt to online teaching at very short notice due to restrictions related to COVID-19. This is a particular challenge for social sciences research methods education, which often requires face-to-face interactions.

Data from an online survey of lecturers (n = 105; March 2020) who teach social science methods and methodology at Austrian public universities was used to discuss their adaption behavior and the corresponding determinates. Consequently, a measure for the rate of adaption of teaching materials and methods per lecturer was constructed and a linear regression model employed to discuss the determinants of this adaption.

The results show the following: Understanding online teaching as a permanent solution for the future, the extent of an individual's teaching load and a tenured employment were identified as significant influences fostering the adaption of teaching methods and materials to the online context. The predictors discovered differ from previous studies, and it has to be assumed that the adaption behavior in the wake of the pandemic had a profound impact on the ongoing digitalization of university education.

Keywords: *Social science research methods; digitalization; acceptance of distance teaching; adaption of online teaching.*

1. Introduction – How Research and Methods Education Changed Overnight

The devasting impact of the COVID-19 pandemic became obvious in the spring of 2020 and many educators had to instantaneously adapt their teaching style towards a new reality of online-based distance teaching. How far did such changes go? What could really be changed at short notice? And who was willing to adapt their lectures more substantially than others? Those questions are at the core of the following paper which tries to explain how Austrian social science educators responded to the pandemic in the summer semester 2020, as they had to readjust for online teaching and online courses over a few weeks. Despite the fact that this abrupt change has been an unusual experience in many ways (Watermeyer *et al*., 2020), it allows for the discussion of teaching pedagogy in a field of teaching that is typically defined by the fact that there is a canon on content that has to be taught, but that the teaching styles are highly dependent on individual experiences and personal relationships (Nind & Lewthwaite, 2018).

The following section 2 illustrates the relevance of discussing research methods education, key aspects regarding the acceptance of online teaching before the pandemic struck and what may have influenced the changes in teaching in 2020. Afterwards, the data used will be described (3), before section 4 provides both insights into the changes in research methods teaching and potential explanations. A conclusion (5) closes the paper.

2. Factors Influencing Changes and Innovations in Social Science Research Education

Research methods education is a basic foundation of social science curricula as it provides students with the means to conduct primary research and distinguish between trustworthy empirical claims from invalid assertions (Wagner *et al*., 2011). Accordingly, it is not only one of the most employment-relevant aspects of the associated programs but also among the most challenging in university teaching for both students and lecturers (Earley, 2014; Wagner *et al*., 2011). It typically relies on in-person courses, often tied to in-person tutorials, group work and other interaction-intensive tasks, such as data collection (e.g. via interviews, face-to-face surveys), which are also typically part of social science research training (Michaelsen & Sweet, 2008; Prandner & Tabakovic, 2019). All these aspects were in conflict with Covid-19 regulations issued during the early stages of the pandemic in most countries. Accordingly, this necessitated new pedagogical strategies in terms of teaching research methods. This is of relevance, as it made adapting – at least in some form – to distance learning via online tools necessary. However, this form of teaching is still highly contested in academia, with educators *rejecting* it, having a *skeptical* perspective on it or using it simply because of *pragmatic* reasons and only a few *advocating* for it altogether (Bolliger & Martin, 2018; Zhang *et al*., 2020).

Reasons for this are often tied to quality concerns, as online teaching is seen as time-consuming and demanding in preparation, making adaptions hard especially when it comes to smaller, interactive classrooms where ongoing student evaluation and interaction are key (Zhang *et al*., 2020). Furthermore, previous publications illustrate that attitudes towards online teaching are highly dependent on institutional factors, as tenured faculty members, for example, are less likely to experiment with pedagogical strategies because they are already embedded in established institutional processes. Increased teaching load may also limit the potential for change or innovation in the teaching program (Bolliger & Martin, 2018; Hogan & McKnight, 2007). However, demographic analysis show that younger female educators are more open to teaching innovations than others (Horvitz *et al*., 2015). It can generally be argued that most of these effects may be tied to professional socialization and brings forward the question whether these factors also come into play when educators are forced to adapt their teaching content to an online teaching environment?

3. The Dataset and the Methods Used

The survey is part of the Digitize! initiative funded by the Austrian Federal Ministry for Education, Science and Research. It is meant to constantly monitor the digitalization of social science research methods education in Austria beginning in 2020. While the project was projected to start in mid-2020, the COVID-19 pandemic and its influence on universities forced the researchers to start in March 2020 and not to observe a field that may slowly adapt new teaching methods but one that radically transformed within a few months.

The population for the study was defined as university level educators, who teach either research-centric courses or method classes in one or more of the four core disciplines of the social sciences at public universities in Austria: *Sociology, political science, communication studies* and *educational sciences*. The corresponding individuals were identified via the online lecture lists that Austrian public universities maintain, resulting in a total population of 182 individuals who teach social science research courses or methods, of which 105 responded (response rate: 58 %). The questionnaire focused on structured questions designed to identify respondents' pedagogical strategies, feelings and experiences with online teaching and assessments. Additionally, it gathered context information and demographics (e.g. discipline, gender, years of experience, position). Two rounds of pretests precluded the start of the survey.

The items and scales used for this paper and their distribution can be found in Table 1, which also includes information on the distribution, dispersion and coding of the variables – this information is included to help understand the regression that follows in section 5. The independent variables used are tied directly to the influences identified in section 2.

Table 1. Independent Variables Used.

	Dimension	Variable	Scale	Mean (St. Dev.) or Percent
Type of acceptance distance teaching	Advocates	Typology from the two variables: Distance teaching is only a temporary solution & I will continue to implement aspects of online teaching after the pandemic (n = 85)	Two questions were used to create four binary variables. The variable for each type was coded as follows: 1 = Type assigned 0 = Other type	15.3
	Pragmatists			18.5
	Skeptics			3.5
	Distanced			62.7
Teaching load	Lesson hours per week	How many teaching units (45 min) did you teach per week this semester? (n = 98)	numeric (number of units)	4.45 (3.27)
Type of teaching	Examination-immanent course	Exclusively courses with exercises, applications, seminar or project character (n = 105)	Multiple choice recoded into binary variables 1 = examination immanent courses and other courses 0 = only examination immanent courses	76.2
	Different course types	Lectures and courses immanent to examinations (n = 105)		11.4
Assessment of the situation	Perception of additional preparation	I currently take longer than normal to prepare and follow up my lessons. (n = 91)	ordinal scales; recoded into 1 = 'strongly agree; agree' and 0 = 'neither agree nor disagree, disagree, disagree strongly' to fit linear regression	84.6
	Interaction with students	I find interaction with students via distance learning is harder to organize (n = 91)		56.0
Sociodemographic and occupational characteristics	Female	What gender are you? (n = 89)	1 = female 0 = male & divers	66.3
	Age	How old are you? (n = 91)	numeric (number of years)	42.86 (10.39)
	Position	How would you describe your current professional position? (n = 93)	External lecturer	25.8
			Junior scientists	19.4
			Mid-level	19.4
			Full professor	35.4
	Tenure	My current employment contract is … (n = 94)	1 = tenured 0 = for a fixed term	28.7

Source: Digitize! study on Methods Education Wave 1 (2020).

One of the central question batteries in this survey was used to identify how the classes were taught and how far individual educators adapted their teaching program (also see Figure 1 in section 4). This was used to calculate an adaption index, that will be used as the central dependent variable explaining how much an individual has actually adapted her/his teaching. The willingness to adopt to changes was used to create four groups of educators: Advocates, pragmatists, skeptics and distanced. Lecturers who thought that distance learning was a

temporary solution and who will not continue form the type *distanced*. Those who do not consider distance learning to be an "emergency" solution but still do not want to use it in the future are called *skeptics*. *Pragmatists* are those who would like to continue using distance learning, despite seeing it as a temporary solution. The *advocates* include those who perceive distance learning as a permanent solution and are going to continue to use it. Additionally, the educators reported an average weekly teaching load of about four and a half teaching units each of 45 minutes. While the overwhelming majority of respondents state that preparing for online lectures takes more effort, only slightly more than half finds the interactions with students more cumbersome. Two-thirds of the sample are female and 20 % are junior scientists. A majority has only a temporary contract.

4. Six Days to Adjust Workshops, Research Projects and Tutorials to Online Teaching?

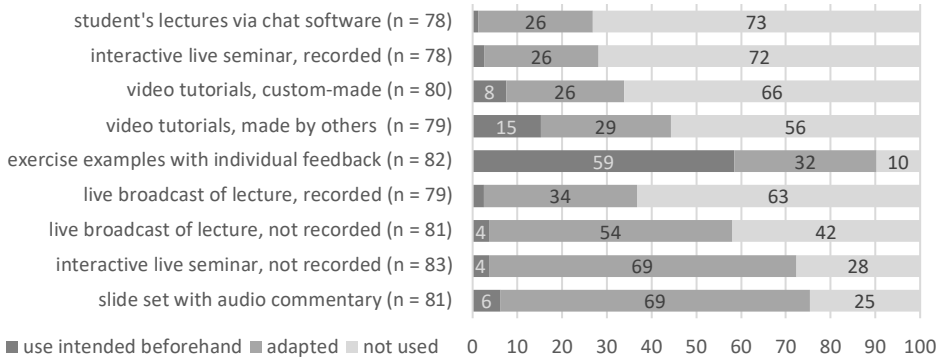

Figure 1. Adoption of teaching methods and materials in percentages
Source: Digitize! study on Methods Education Wave 1 (2020).

Only a few days into the summer semester of 2020 – on March 10 – most Austrian universities announced that they would shut down on-site lectures and courses for the foreseeable future, following a government-wide plan to stop the spread of COVID-19. However, teaching had to resume online on March 16 according to a federal issue. As neither students nor lecturers were prepared for this syllabi and course structures had to be rewritten on the fly, with no information on how long this shutdown may last. However, most lecturers could adapt quickly to a very specific situation and, as the survey results shows, many courses were adapted in extensive and significant ways (see Figure 1).

Accordingly, the most common strategies to deal with new demands without the chance to rely on preplanned solutions were adding audio commentary to slide sets, holding interactive online seminars and live broadcasting of lectures, however, without providing recordings. Tutorials or video presentations and lecture content prepared by students were employed rather seldom. Additionally, lecturers halved the number of exercises with individual

feedback which is a traditional, proven strategy for research methods education (Prandner & Tabakovic, 2019).

Furthermore, we also computed an indicator that could capture the extent of necessary didactic adaptions on an individual level: It relates the number of adapted teaching methods to the total number of methods that a lecturer used (see equation 1). This should give an insight into how much an individual tweaked their teaching style. The contractual obligations are introduced as weights to account for a potential bias coming from high or low teaching loads. They correspond with different academic jobs (e.g. research assistants, postdocs, assistant professors, full professors, senior lecturers). Those who teach fewer than 4 units per week (e.g. research associates, PhD students) receive a weight of 0.5, while a load of 8 or more units have a weight of 1.5 (e.g. full professors, senior lecturers). Accordingly, the adaptation of teaching methods and materials ranges from 0 (no adaptation) to 1.5 (complete adaptation). The respondents (n = 95) achieved an average value of 0.53 (standard deviation 0.36).

$$\text{Extent of adaption } = \frac{Number\ of\ teaching\ methods\ adapted}{Number\ of\ teaching\ methods\ used} * Weighting\ factor$$

5. Explaining the Adaption of Teaching Methods and Materials

We calculated a linear regression model to identify which factors help to explain the adaptation of teaching methods after the COVID-19 pandemic struck. It estimates the extent of adaption via the measures identified previously (see sections 2 and 3; for results, see Table 1). Due to the small number of cases, results with an alpha error below 0.1 are considered as (potentially) significant influences. Results need be read in accordance with those limitations.

As can be seen in Table 2, the attitude toward distance teaching influences to what extent teaching materials have been adapted. Instructors who plan to use online methods in the future (*advocates*) have a higher rate of adaption than those classified as *distanced*. Teaching load has the highest effect on adaption among the predicators considered. Due to the extent of the effect, it is reasonable to assume that it is not just related to the weighting of the adaption measures and that educators with a higher teaching load are significantly more likely to adapted their teaching to a higher extent than those with a lower. However, measures such as the acceptance type of distance teaching, the nature of the classes held or sociodemographic factors, such as age or gender, do not seem to influence the extent of adaption. Finally, the employment type is shown to be another central predictor for adaption, independently of the academic position (i.e. junior scientist, professor). Those who have a permanent contract – tenure – have adapted their teaching more than those without. This is an understandable result – a temporary employment is often associated with uncertainties and

ambiguities as to what extent the teaching materials developed can be used again. It could also be argued that lecturers without the security of a permanent contract see themselves pressured into spending more time and resources on their research and, therefore, have fewer opportunities to adapt their teaching methods and material than staff who already have tenure.

Table 2. Linear Regression for the Extent of Adaptation. (Dep Var.: Adaption coefficient: 0 – 1.5; higher value equals a stronger adaption of teaching).

Independent Variables		Std. Beta
Type of acceptance of distance teaching (ref: Distanced)	Advocates	0.177~
Teaching load	Lesson hours per week	0.470**
Sociodemographic and occupational characteristics	Tenure	0.281*
n =		77
R^2		0.442

~ p < 0.10; *p < 0.05; **p < 0.01; Only significant effects reported. There was no significent influence by type of acceptance of distance teaching: pragmatists, sceptics; type of teaching: examination immanent course, different course types; assessment of the situation: perception of additional preparation, interaction with students, sociodemographic and occupational characteristics: female, age, job (ref: Professor): external lecturer, junior scientist, mid-level position. Source: Digitize! study on Methods Education Wave 1 (2020).

6. Discussion

The COVID-19 pandemic resulted in university professors worldwide having to adapt to online teaching practically overnight. In this paper, we could show that a large majority of lecturers – in our typology called distanced (69.7 %) – saw the changes as a temporary solution. Lecturers with a favorable disposition toward online teaching, however, were found to adapt more of their teaching methods and materials in the wake of the pandemic. Interestingly, all other factors being equal, lecturers who teach more hours per week also adapt more of their courses. This might be due to effects of scale, which make adapting a course easier for those who have already done it for another one. Additionally, lecturers who teach many courses might have felt more obliged to adjust to the situation than those who only teach a few. However, this finding disagrees with the position found in the literature that senior staff who have a higher teaching load are likely to be less prone to change or innovate their teaching programs (Bolliger & Martin, 2018; Hogan & McKnight, 2007). This discordance might indicate a difference in the adaption behavior before and in the wake of the pandemic. Another finding of our study was that lecturers adapted their teaching material and methods less if they only had a temporary employment contract. Thus, it might be the case that the uncertainties of a temporary academic job make instant adaptions of teaching methods to new circumstances more burdensome. Further studies could perhaps illuminate

this. While previous studies have shown that younger and female academics are generally more open to the innovations of online teaching (Horvitz *et al*., 2015), no such influence could be detected in our data. This further indicates that with the sudden and mandatory pandemic-related changes in teaching modes, other factors are in play in determining adaption rates than previously.

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Online teaching in COVID-19 times. Student satisfaction and analysis of their academic performance

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Abstract

Online teaching has grown exponentially as a result of COVID-19. Universities and teaching institutions the world over have had to adapt their curricula to this new teaching and learning model. The main goal of this study is to analyse various teaching methodologies used on a sample of university students to analyse their effectiveness in terms of satisfaction, competencies and academic performance. The results suggest that methodologies that include greater student-teacher interaction or the use of videoconferencing for classes and problem-solving help to raise student satisfaction. Students also positively assess online teaching as it allows them to acquire new competencies and even to identify business opportunities. The online evaluation method used also seems to have been appropriate, as it led students to obtain better grades than in face-to-face teaching contexts. The study offers several implications for university teachers of Social Sciences who wish to adopt this type of teaching method.

Keywords: *Online teaching; online evaluation; assessment/satisfaction; academic performance.*

1. Introduction

The process of digital transformation and the consolidation of online teaching that has been under way over recent years took off as a result of the COVID-19 pandemic. Some authors (such as Cifuentes-Faura, 2020) claim that the education sector needs to re-invent itself in this uncertain context and stress that one of the greatest challenges is to hold the attention of students and improve their competencies. However, other authors such as Sangrà (2020) claim that the challenge is to adapt and to include in online teaching certain aspects of face-to-face teaching such as personalised attention, greater connection with students and effective verbal communication.

Even though there is extensive debate on what is meant by online teaching or *e*-learning, it can be defined as the use of new multimedia technologies and the Internet to improve the quality of learning by facilitating access to resources and services as well as remote exchanges and collaboration (European Commission, 2001). The *e*-learning sector is expected to surpass 243 billion US dollars by 2022 worldwide (Duffin, 2020). Over recent years, universities and educational institutions all over the world have fostered online teaching with the aim of adapting to the new reality that recommends avoiding physical contact and reconsidering the way in which the learning and teaching process takes place (Govindarajan and Srivastava, 2020). A teaching model has thus been introduced involving various methods that range from more or less hybrid teaching to purely virtual teaching. All this has required greater resources for improving and introducing new educational technologies and for training teachers and students on how to gain greatest benefit from them (Li and Lalani, 2020).

Traditionally, the literature suggested that it was necessary to include certain innovative aspects, often related to the use of technology, to make face-to-face teaching more attractive, to improve students' satisfaction and performance or to facilitate learning (Bennett et al., 2018). At the same time, online teaching was beginning to become consolidated, especially in higher education. The key aspects on which work needed to be done were: to develop and introduce new tools allowing for greater interaction with students, to offer evaluation methods suited to this context and to guarantee follow-up of the learning process (Dumford and Miller, 2018). But 2020 amounted to a turning-point, requiring teaching at all levels and practically throughout the world to be given online. The context changed completely and the main priority was to meet the needs arising for institutions and for teachers and students. All this aimed, first, to guarantee that students could still acquire and improve their competencies in the subjects studied and, second, to ensure that their motivation and/or satisfaction were as great as possible (Sangrà, 2020).

In general, online teaching allows students to access information asynchronously, at any time and in any place, using electronic tools, methodologies and devices. This type of learning

affords great flexibility for organising and planning study times and independent work (Smedley, 2010). But this process of teaching and learning can also take place synchronously. Online teaching has become a tool that facilitates and enables interaction in real time for students and teachers (Beldarrain, 2006). In addition, in this context, new technologies have played and continue to play a key role (McGreal and Elliot, 2011), to the extent that a large number of tools have appeared over recent years to facilitate such remote teaching (Huda et al., 2018). There are now platforms and applications (Moodle, Zoom, Google Meet, etc.) that allow groups of students and teachers to connect and interact in real time, making the teaching and learning process increasingly similar to how it works in face-to-face situations.

This study has a dual goal: on the one hand, to find out how a sample of university students on business-related courses assess various online methodologies and evaluation systems (in terms of satisfaction and development of competencies); and, on the other, to compare academic performance resulting from online teaching with that from face-to-face teaching. It is structured as follows. We first describe the sample used, and the design of the research. We then present and discuss the main results obtained and, finally, draw some conclusions.

2. Teaching experience

2.1. Sample and research design

This teaching experience took place during the second semester of the 2019/2020 academic year. It considered the students of a Spanish university on various degree courses within the Faculty of Economic and Business Science (169 students) and a Master's degree course (13 students) in order to know their assessment and how they adapted to the online context. A total of 182 students participated. The sample eventually used comprised 124 students, that is, 68.1% of the total. The responses obtained in each study course can be broken down as follows: Degree in Business Administration and Management (BAM) (51.61% of students enrolled on the course), Degree in International Commerce (IC) (54.05% of students enrolled on the course), Degree in Marketing and Market Research (MMR) (77.5% of students enrolled on the course), Degree in Tourism (TOURISM) (93.33% of students enrolled on the course), and the Inter-University Master's Course on Research in Business Administration and Economics (MASTER) (100% of students enrolled on the course).

The information was collected by using an anonymous, online questionnaire during the last few weeks of the semester, specifically between 25 May and 15 June 2020. 70.16% of the responses received were from women. Also, 46% of the students who filled in the questionnaire stated that they had professional experience, and the average age was 23. Each teacher explained to their students the purpose of the questionnaire and briefly explained it. The questionnaire comprised an initial section on methodology (6 questions) and teaching evaluation (3 questions) and a second section for a general assessment (6 questions). Before

the final questionnaire was sent out to the students, it was pre-tested with other university students to identify any shortcomings (items not clearly expressed, aspects difficult to understand, inappropriate order of questions, etc.). In addition, academic performance in the subjects considered was analysed.

2.1. Results

2.2.1. General assessment: teaching methodology and online evaluation

Before the students' assessment can be presented, it should be mentioned that in the subjects covered on the degree courses in BM, IC and MMR the teachers chose to provided complete, adapted materials to the students, with complementary reading and explanatory videos for the theoretical classes and detailed feedback/solutions in writing for practical work. In the case of the Master's course and the degree course in Tourism, classes were given by videoconference for both theory and practice. In all cases, the timetable was adhered to for all activities and explanations. Any questions asked by students were answered via email and videoconference in general and, in the case of BAM and MMR, a Moodle forum was also created.

One of the questions asked in the questionnaire regarding the *teaching methodology* was whether the students considered the teacher's adaptation to the new online context appropriate for facilitating learning. 78.23% of students answered affirmatively, while 16.17% stated it could have been better, suggesting above all that classes via videoconference could be increased or content could be better adapted to the new online context. Most of the students also considered that interaction was similar to the period prior to lockdown with both their teachers (72.58%) and their classmates (58.06%). In spite of this largely positive assessment of the teacher's adaptation and of interaction, most of the students found that online learning was less interesting than face-to-face learning (66.94% against 22.06%).

The questionnaire also included questions to *compare online and face-to-face teaching*. A majority of the students (53.23%) considered that the online teaching was not more difficult to follow than face-to-face teaching, while 16.94% stated they had found difficulties, and 29.34% had only occasionally had problems. The main problems identified were difficulties for understanding topics (41.6%) or an excessive workload (14.58%). Regarding the students' academic performance, 50% considered that their results would have been similar if they had received face-to-face teaching, 40.32% considered they would have been better, and 9.68% considered they would have been worse. The students also considered that the knowledge obtained is similar in online and face-to-face teaching (51.61%), and 14.52% even considered it had been better online.

Regarding the *evaluation method* used by teachers in the new context, in all subjects partial examinations were given online and in multiple-choice format. For the MMR and Master's

courses, the weight of all the components in the evaluation was kept the same and for the other subjects some slight adjustments were made. A large percentage of students (84.68%) considered that the new method of evaluation had been appropriate, as opposed to only 2.42% who considered it was not and 12.90% who believed it could have been better. The main suggestions were to increase the weight of continuous assessment and replace exams with practical work.

Finally, with regard to the general assessment section, most of the students were very (16.94%) or fairly (72.26%) satisfied with the online learning received. Moreover, 50.81% stated that the online teaching had enabled them to acquire new competencies or skills such as using ICT and improving their capacity for self-management. This type of teaching also allowed the students to discover new business opportunities, as stated by 18.55% of the students surveyed, and to identify potential uses of ICT in a range of settings (91.67% of the students who replied affirmatively to this question); regarding this last question, most of the students (83.33%) proposed that existing business lines could be offered in a virtual context.

2.2.2. Association between teaching methodology, evaluation and satisfaction with the online learning

Considering that in general students' assessment/satisfaction was positive, an analysis was performed to see if there was an association between students' satisfaction (high/low) with the online learning (alternatively, we also considered if the students had developed new skills or not) and the way in which the online teaching was given, questions were answered and the evaluation system was used. We also explored the possibility of a link between the degree of student satisfaction and their gender, age, course or prior professional experience. For this purpose, since the samples were not related and since all variables considered are qualitative, a Chi-squared independence test was used, except for the case of age, which is a continuous variable so the Mann Whitney U test was used.

Our results suggest that there is a significant association between the teachers' adaptation to the new online context and student satisfaction. So, students are more satisfied the more the teacher's adaptation has been appropriate. In addition, we found a significant association between interaction with the teacher and student satisfaction, so greater or similar teacher-student interaction leads to a greater degree of satisfaction. The students also related the evaluation method used in the context of online teaching with their satisfaction. The more the students considered the method and evaluation platforms to have been appropriate, the greater their satisfaction.

Conversely, the results show that there are no significant associations between the way in which the teacher taught the content or answered questions and student satisfaction. Similarly, student satisfaction does not seem to be related to interaction with classmates during lockdown. Regarding the relation between students' degree of satisfaction and their

gender, age, course or prior professional experience, we only found significant differences in the latter, showing that students who had performed a professional activity were less satisfied.

On the other hand, the results do show that the acquisition of new skills is significantly associated with the way in which the teacher passed on the content. The students who stated they had acquired new skills had received knowledge from teaching videos, by solving case studies in writing and in detail and from classes via videoconference. However, the recommended reading and materials contributed to a lesser degree to the acquisition of competencies. The results also show a significant association between the way in which the teacher answered questions and the new competencies and skills acquired. The students whose questions were answered via videoconference or email stated they had acquired more competencies than those whose questions were answered via fora. In the same way, there is a significant association between interaction with the teachers and the skills acquired by students. The students who stated they had interacted more with the teacher declared that they had acquired more skills or competencies. Regarding the evaluation method, we also found an association with the skills or competencies acquired. Although both groups mostly stated that the teacher's evaluation method was appropriate, those who had acquired most competencies (in comparison with the rest) suggested more that it would be necessary to modify the evaluation method.

Finally, a significant association was also found between the competencies acquired and age, course and professional experience. The youngest students and those on courses in Tourism and MMR stated they had acquired more skills than those on the degree courses in BAM and CI or on the Master's course. It was also found that the students with professional experience acquired fewer new skills.

2.2.3. Comparison of academic performance: online versus face-to-face teaching

In order to compare the results obtained by students during the online teaching period with those during face-to-face teaching, we used the t test for difference in means to compare average grades obtained in the subjects covered in this study during the 2019-2020 academic year with the mean of final grades for each subject during the three previous academic years. Considering that the final grade is the result of the student's learning and that it might be affected by the evaluation method used, the reference group in which there might have been least bias (same or similar content, same teacher, etc.), even if the teaching methodology and evaluation method had changed slightly, would be the students of each subject during previous years. Another aspect to be borne in mind which might affect the grade for the year being studied (apart from online teaching and evaluation) is whether such students are better or worse than those the previous year. To partly minimise this bias, it was decided to take the average grade from the previous three academic years for each subject.

Although we have to be aware that other aspects may have an influence (e.g., the way of assessment or possible copying), the results show significant differences in all the final average grades for all subjects. In all cases, the differences were significant at 1% except for the 'Entrepreneurship' subject on the Master's course, in which the differences were at 10%. It can therefore be concluded that, on average, the students enrolled on the subjects covered by this study obtained better grades during the online teaching period in comparison with the grades obtained during the three previous years of face-to-face teaching.

3. Conclusions

It can be concluded from the study that, in spite of the emergency situation resulting from COVID-19, in general, the teaching methodology used by teachers had been adapted well. Students gave a positive assessment to their online learning even though they find it less attractive than face-to-face learning. They consider that this type of learning has allowed them to acquire new ICT-related skills, such as the capacity for self-management or the identification of new business opportunities linked to a move to an online format for some existing businesses. Also, the online evaluation method used in some of the subjects included in the analysis seems to have been appropriate

However, in spite of this positive assessment, the students suggest some areas for improvement such as an increase in the number of classes given via videoconference and a better adaptation of materials to the online context to facilitate understanding of the subjects. Other important aspects mentioned are greater weight for continuous evaluation, and a more balanced workload for students. All these matters have important implications that should be taken into account by teachers so that they can enhance the learning and teaching process in online teaching contexts.

The main factors affecting student satisfaction are: adaptation of content to the online context, the method of student-teacher interaction and the evaluation method used. However, it seems that such satisfaction is not affected by either student-student interaction or the method adopted by the teacher to teach content or answer questions. This last factor does, however, affect students' acquisition of competencies, as do some personal factors (age, course and professional experience). Finally, we should stress that students' grades were not negatively affected by the change to online teaching because in all cases they rose significantly. This leads us to wonder if the evaluation method chosen, even if followed with the greatest possible rigour, perhaps does not accurately capture the knowledge acquired by students.

This study has certain limitations: the descriptive nature of the study, its specific context in that it considers a single Spanish university and subjects linked specifically to business as well as that most of the sample population were women. It therefore seems necessary to carry

out further studies to help improve the online or hybrid teaching and learning process that is currently being used in a large part of the Spanish university system.

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Experiences from Transforming a Lecture "Communication Systems" from Presence to Virtual Format during the COVID-19 Pandemic

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Abstract

This article describes the transition of an existing lecture "Communication Systems" from a conventional presence format to a virtual format due to the COVID-19 pandemic. The process of transformation and the evolution of the lecture during the virtual semester are characterized. The changed exam format from presence to virtual format with the experiences are described. Results of a student evaluation at the end of the semester are shown. The lessons learned are summarized also for the time after the COVID-19 pandemic.

Keywords: *Communication engineering; electrical engineering education; STEM; computer aided instruction; electronic learning.*

1. Introduction

The year 2020 was a big challenge for universites around the world to rapidly switch teaching from presence to online formats (Jesionkowska, Fominykh, Wild, & Molka-Danielsen, 2020; Mishra, Gupta, & Shree, 2020; Mohmmed, Khidhir, Nazeer, & Vijayan, 2020). OTH Regensburg reacted to the COIVD-19 pandemic with the following measures:

- Postponed semester start from 15 March to 20 April 2020.
- Complete closure of university buildings for students.
- Virtualization of lectures, seminars and lab courses as far as possible.

The transformation of the course "Communication Systems" in the summer semester 2020 during the pandemic is described. In the next Section, the course structure is explained. Section 3 describes the improvised lectures changes due to the lockdown. The seen changes in didactics are explained in Section 4 and the changes of the integrated practical part are described in Section 5. Also the exam was virtualized, see Section 6. Feedback from students is shown in Section 7 and Section 8 lists the lessons learned from this semester.

2. Course Structure

This course is a technical elective course in the sixth semester within the "Bachelor of Electrical Engineering" program. It is given during summer semesters with four lecture hours per week for 15 weeks with a nominal workload of 5 ECTS Credits. A moodle platform is used for providing course material, information and other course related support to the students. The course script is a PDF file with extensively written course material including texts, tables, graphs and pictures. The course is structured with the main topics:

- Principles of communication systems, communication media and multiplexing.
- ISO-OSI layer model, TCP/IP stack, network topologies and access methods.
- Coding, error detection, error correction and cryptography.
- Analogue and digital modulation formats.
- Introduction to optical communication systems and Digital Subscriber Line (DSL).

About one quarter of the course time is reserved for practical lessons in the lab. The goal of these practical lessons is that students get hands-on experience when dealing with a small engineering project task. Group work in presence in the lab is seen to be important for gaining technical and social skills.

3. Course Start

The semester start was postponed to 20 April 2020. Courses could start on 16 March 2020 on a voluntary basis for students. Those who were not able to follow the courses during the

hard lockdown in Germany should have a repetition phase at the beginning of the regular lecture time in April. The optional lecture start was organized as a self-study phase. The script was provided via the moodle platform. To compensate for the missing personal interaction, the following additional materials were provided:

- A weekly learning plan with the script chapters that should be read.
- Learning goals for all chapters were formulated.
- Links to additional online resources.
- Questions to test students' knowledge.

A regular chat session once per week and a discussion forum on moodle were introduced.

About 15 students started the course and also finished it. Most students used the provided resources for self-learning. Several questions were asked and intense discussions happened during this phase. Regular lectures started after the four first weeks (plus one week Easter holidays) with a repetition phase of the first script chapters. All regular lectures were done with live streams using a video communication platform. Videos were recorded and stored for students who were not able to participate during lecture hours.

4. Evolution of Didactics During Virtual Lectures

The general didactic concept of this course given in presence is strongly dialogue oriented. The script is not the main part of this course, the script contains mainly additional material for the students to read at home and deepen their knowledge. Presence time is used to explain the topics, to discuss with the lecturer and in student groups, and to solve questions and problems. This presence lecture concept with a lot of personal interaction was very difficult to transfer to the virtual lecture format. Some adjustments to the lecture format were made due to the lack of personal interaction. Before this Summer Semester 2020, there was only a very limited virtual lecture experience by the students and by the lecturer. All participants had to learn from scratch how to do virtual lectures.

Table 1 shows statistical data about the lecture structure during the semester. The left column shows the lecture week and the second column the number of recorded videos. In the third column, the average length of each video and the fourth column the longest video is shown. The number of video views can be seen in the second right column and the number of group work phases in the right column. It is known that the student concentration drops steadily during lectures (Stuart & Rutherford, 1978). Regular breaks should be therefore made for a short regeneration phase. The lengths of speaking blocks were therefore limited to about 20...30 minutes. Between these speaking blocks, questions or small challenges were given to be discussed within random groups of 2...3 students. During these group works, the lecturer

visited the groups, asked if everything is understood and discussed questions with the students.

Table 1. Analysis of Virtual Lectures.

Week	Videos	Av. Video Length	Max Video Length	Video Views	Group Works
1...4	0		Optional Self-Learning Phase		
5	4	12:48	23:07	80	2
6	6	12:14	21:37	71	2
7	3	33:22	39:38	32	2
8	6	16:30	34:32	73	4
9	4	17:11	30:22	45	3
10	5	11:05	22:16	39	4
11	5	18:31	32:19	19	4
12	4	20:21	31:55	15	3
13	3	22:13	32:53	9	2
14	2	19:12	20:42	3	2
15	1	39:25	39:25	2	1
16	3	14:56	31:05	16	2
17	0		Questions & Answers		

5. Practical Experiments

In the years before, a practical part was carried out in the lab with the following tasks:

- A telephone communication cable with unknown parameters was analyzed.
- A simple optical communication system was built by the students.

These practical tasks were not possible due to the COVID-19 pandemic. It was therefore decided to do a practical part using a simulation software. After evaluation features and complexity of different scientific software packages for simulating communication systems, GNU Radio was chosen (https://www.gnuradio.org/). This is an open source software to simulate communication systems. A large community exists for providing model solutions and discussing about questions. Simulations were mainly done in weeks 13...16 (see Table 1). Some easy examples for communication system simulations were given by the lecturer. The students should change simulation parameters, see what happens and explain the reasons.

They should also modify the simulated communication systems according to the topics in the lecture. This practical part worked for some students very well, other students had diverse problems with the software.

6. Exam Concept

Before COVID-19, the exam was a presence exam with about 15 questions and a time limit of 90 minutes. A non-programmable calculator and four hand written pages were allowed. This type of exam was not possible due to the pandemic. The lecturer decided to change this exam to a case study that can be worked out at home. Students had to declare the will to participate in the exam. They got the exam task simultaneously by email and had to send the solution by a certain date and time back. During the exam time, a forum was open at the moodle course where students could ask and answers were posted for all students. In this case study, a scenario was given to design a fast internet connection solution for a rural village with detailed parameters. Students had two weeks time to write about ten pages with their chosen solution. The grading was done by giving points for formal correctness, the completeness and plausibility of the solution.

7. Feedback from Students

The course was evaluated using a web-based survey tool. Students' overall satisfaction with the course was high. The most important results are shown below.

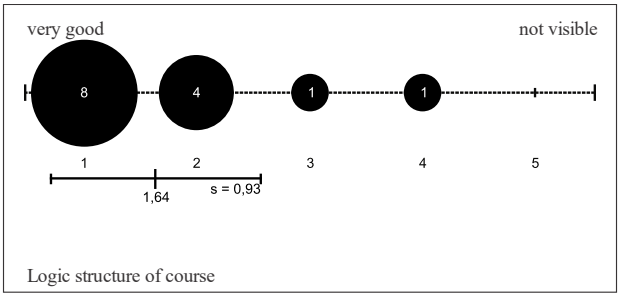

Figure 1. Logic structure of course.

The logic structure of the course is seen as good to very good (Figure 1). Compared to surveys from the presence courses, no loss in the course structure is seen. This very valuable feedback leads to the conclusion that the overall course transition was successful. Students saw a high knowledge gain during the course (Figure 2). This leads to the conclusion that no severe deficits are in the virtual course. All essential topics could be explained with a similar success using video lectures compared to presence lectures.

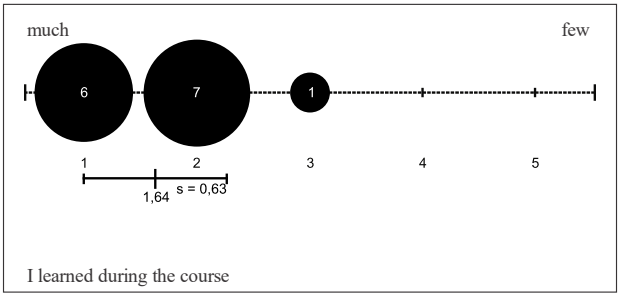

Figure 2. Knowledge gain during the course.

The question of knowledge gain is closely connected to the satisfaction with the virtual teaching methods that are shown in Figure 3. Students evaluated that appropriate virtual methods were used and evaluated these as good to very good.

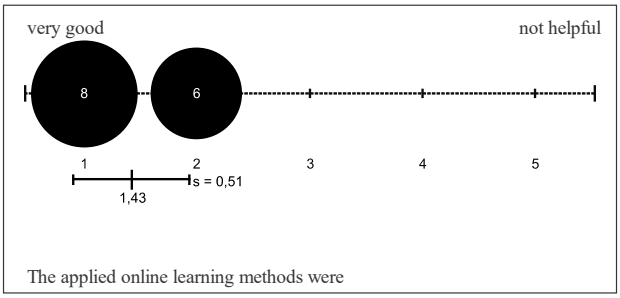

Figure 3. Usage of online learning methods.

Figure 4 shows the satisfaction with the communication media that were used by the lecturer during the online semester. It shows that the video lectures, the script on the moodle platform and email for discussion were appropriate. A personal feedback said that especially the short video talks together with many group works were seen as very positive.

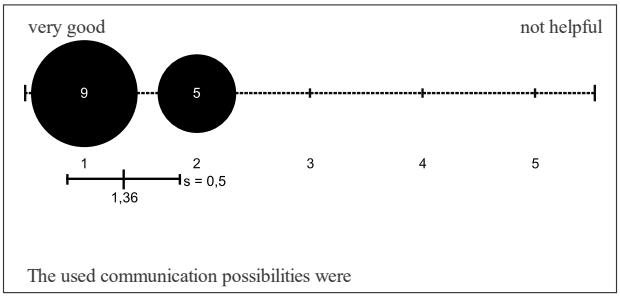

Figure 4. Communication media during online lectures.

It is very important that the recordings were very useful, as shown in Figure 5. Early recordings were viewed much more often than late recordings for an unknown reason.

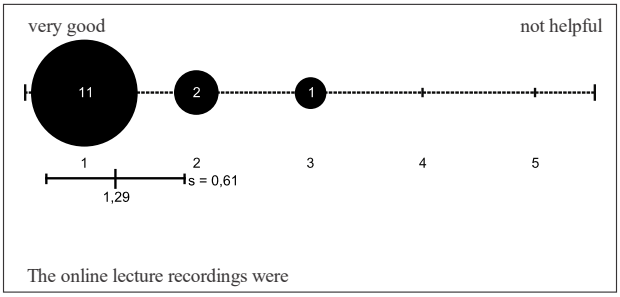

Figure 5. Value of lecture recordings.

Students state that the contact possibilities with the lecturer were absolutely sufficient, as Figure 6 shows. It can be concluded that email contact, a moodle forum and chats during video lectures are sufficient, additional chat possibilities are not necessary.

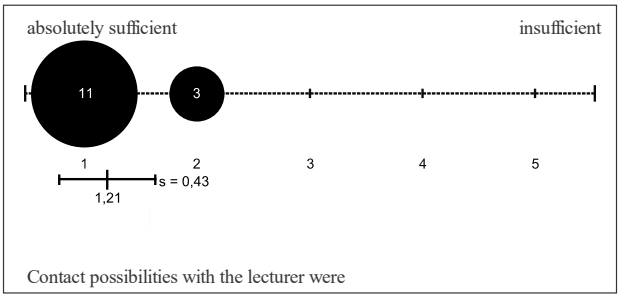

Figure 6. Contact possibilities with lecturer.

Positive comments were mainly about the group sessions where students had the possibility to discuss about topics and questions. The students wanted to have a more detailed concept to use this GNU Radio. This deficit was also seen by the lecturer. Student showed overall understanding for the difficult situation and for the efforts to do a virtual course. Summarized, students were overall satisfied with the virtual course. From this basis, it is planned to develop the course further during the next years.

8. Lessons Learned

Lessons learned from virtual lectures:

- It was some work but no challenge to modify the course for the virtual lecture.
- The main challenge during the lectures was that all student switched off their cameras. It was unclear if students were engaged and understood the topics due to missing visual feedback.

- Discussions were much more difficult due to the missing personal interaction. Most students did not dare to ask questions or discuss in the big group. Most intense discussions happened when splitting the course to smaller groups for special topics.
- Group works were not easy but possible by using screen sharing. Students needed some weeks to get accustomed to virtual group works. After this first phase, virtual collaboration was nearly as effective as collaboration in presence.
- It was very difficult for the lecturer to recognise if students are still participating in the lecture or if they are already lost.

Lessons learned from the practical part of the course:

- Students had no chance to work in groups in the lab to develop own systems. This hands-on experience could not fully be replaced by simulations. Essential competencies like project work in teams could not be taught.
- Students needed more guidance than expected for simulations. A tutorial with structured tasks is very helpful to have a starting point for developing own simulations. It is preferrable to give simulation tasks parallel to the corresponding lecture chapters.

Lessons learned for the time after COVID-19:

- Personal contact is essential to get feedback about the learning success. If no face-to-face contact is possible, appropriate alternatives have to be established.
- Lab projects in groups to get hands-on experience is essential for students to learn engineering working principles. Simulations can give additional competencies but can't fully replace hands-on experience in the lab.
- The lecturer had to leave the standard didactic program. New didactic interactions were tested in virtual sessions. The lecturer broadened the didactic portfolio also with more opportunities for future semesters.

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Feeling in Covid time

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Abstract

In this work, a Service-Learning project that consists of working on somatosensory and special senses stimulation in people with intellectual and/or developmental disabilities, is shown. This experience has been made through small and simple exercises, games or activities that allow these people to experience new sensations. The participants of this activity were students of one hand, Pharmacy and Education degrees working together and on the other hand, children of a special education school. The main aim is to develop the sensory and physical faculties and promote the functionality of the children with intellectual or developmental disabilities. The role of University students was to encourage the special school students to use their senses, applying the learnings of several subjects and collaborating with students from different degrees: Pharmacy and Education. Pharmacy students provided physiology concepts while Education students gave assistance and pieces of advice to Pharmacy students for carrying out the activities with the special school students. The sanitary situation obligates to develop this activity through video call. For both groups of students (university and school), this experience has been a different approach of learning and practicing using a new way of communication. All Pharmacy degree students thought that this experience has been good for their future professional activity. The teachers from the special education school indicated that these initiatives are very important for their collective.

Keywords: *Physiological process; senses; intellectual disabilities; service-learning; communication skills.*

1. Introduction

The pyramid of learning, developed by Williams and Shellenberger, shows the connection between the sensory system, the sensory motor development, the perceptual motor and the cognitive development (Fig. 1) (1,2). All the captured and interpreted stimulus by our body structures are important for the development of the nervous system. Somatic sensitivity includes all processes that our body captures through the skin and skeletal muscles. Special senses like taste, smell, view and hearing allow to establish other important skills as social abilities especially in people with intellectual and/or developmental disabilities. Both are important in the first phases of human development. Children with developmental disabilities are more frequently observed to experience notable difficulties in sensory processing and motor skills development (1).

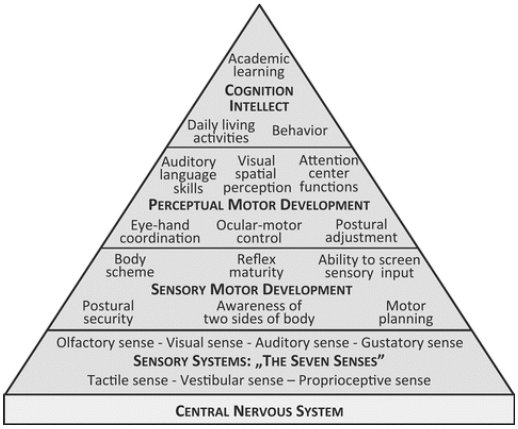

Figure 1. The pyramid of the human development Williams and Shellemberger. (1,2)

Taking into account this information, sensorial and motor systems should be stimulated. These physiological processes are included in the subject "General Physiology I" Pharmacy degree in San Jorge University.

In this project, higher education students (from Pharmacy and Education degrees) have prepared materials to stimulate somatosensory and special senses in people with intellectual and/or developmental disabilities from a special education school. Taking into account that the patient–health professional communication is a fundamental skill for health professionals (3), the university students had to learn how to use the prepared materials using adapted language for teaching students from the special education school. It is known that pharmacists, as health professionals, must be able to communicate with any type of person. However, communications between pharmacists and people with disabilities are scarce and normally, pharmacists lack of experience in this field. For that reasons, during this project,

Pharmacy students received advice to adapt the materials from students of Education degree of San Jorge university.

The use of service-learning is considered as an important tool for the learning process in Spain (Opazo, 2016). This methodology allows to create a link between theory, practice and society (Rubio, 2011). Furthermore, a personal growth of Degree students is obtained through this activity. From this experience they can acquired different transversal and specific competences for their future professional activity. In service-learning the higher education is especially relevant for transforming our society into a more inclusive one (Martínez, 2008). The student participation, in a service-learning project, takes a special importance in their motivation. Some research suggested that service-learning methodology can be more motivating to students than traditional instructional methods (Ciesielkiewicz, 2018). These activities also stimulate students' curiosity for learning, which is indispensable in order to develop self-learning skills, as well as it contributes to the development of new knowledge (Ciesielkiewicz, 2018).

This Service-learning project has three principal objectives:

3. Improve the sensory capacities of people with intellectual disabilities.
4. to improve communication skills of future health professionals.
5. the use of new technologies for communication.

Due to the sanitary situation, it has not been possible to carry out the activity in person. To maintain safety regulations, this activity has been carried out through video calls.

2. Methodology

2.1. Participants

In this activity three groups of students have participated (figure 2):

- Group 1: 28 students of second year of Pharmacy degree studying "General Physiology I" subject. The role of these participants has been to prepare original materials to develop different senses using their physiology knowledge. Then they have made face-to-face video calls to show the usefulness of these materials to the group 3. The students were assigned into different subgroups.
- Group 2: 10 students of the last year of Education degree who were studying "Detection and intervention of difficulties in specific centers" subject. These students reviewed the materials prepared by Pharmacy students and made some comments about how to adapt the activities to the characteristics of people from special education school.

- Group 3: 16 students of the special education school in Zaragoza (Spain). Their teachers provided information to the University students about characteristics of each child with intellectual disability to be taken into account for the design of the activities proposed by group 1. There were children with different level of autism spectrum and intellectual disabilities.

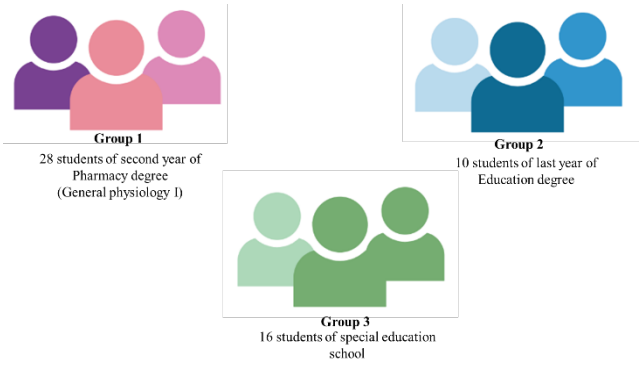

Figure 2. Participants in this project.

2.2. Topics

The work topics about somatic and special sense were:

- Visual sense.
- Tactile sense.
- Auditory sense.
- Gustatory sense.
- Tactile and proprioceptive sense and pain.
- Movement and vestibular sense.

Each subgroup from Group 1, has developed an online session with two students from the special education school, who had the same academic level. The students who worked with movement and vestibular sense used TiKToK mobile application to prepare their activity. The use of this tool allowed to carry out a more dynamic activity. Two groups worked visual and tactile senses, respectively, with children who had greater developmental difficulties. In relation to the tactile sense activity, the students have used materials with different textures and the children with their eyes closed had to identify them.

For preparing this activity, the Pharmacy students read several research papers related to sensory system and one of the disabilities (provided by the professor). These papers have been used for preparing the different activities. Each group have filled in a form explaining

the activity (development, used materials and planification of video call). Then, this document has been sent to education degree students for providing their recommendations, proposals of improvements and new ideas for pharmacy students. Pharmacy students have prepared some activities and materials. One week before of the online session with special education students, all materials have been brought to special education school for isolating and disinfecting conditions. These sessions have been planned for one hour using TEAMS application (subgroup + special education student).

2.3. Chronogram

The activity was developed following the steps shown in figure 3.

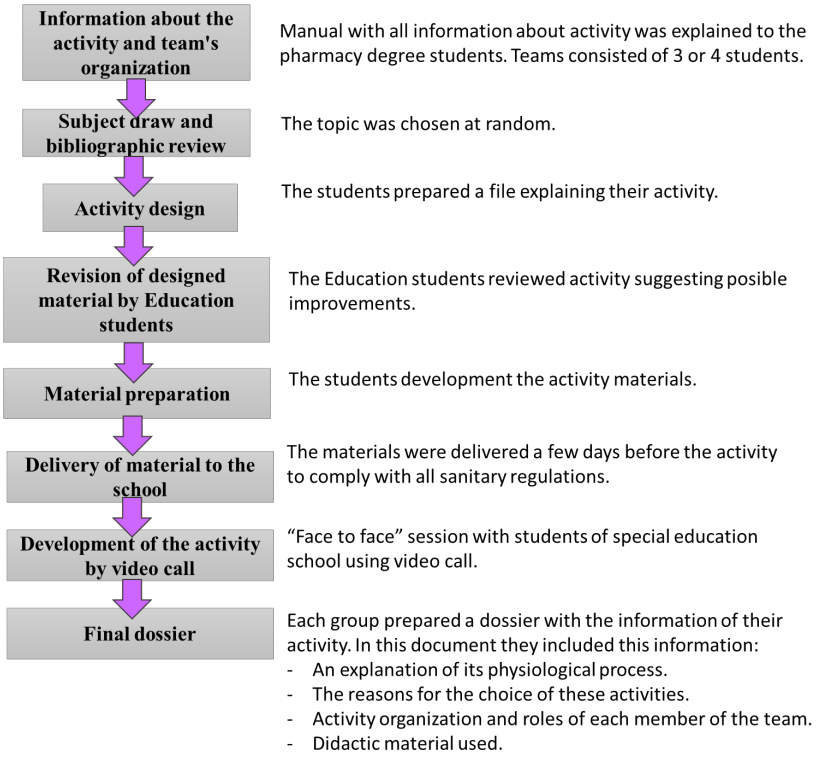

Figure 3. Steps of experience.

The evaluation of this experience has been made using rubrics. One rubric has been used for the activity evaluation (by the professor) and the other one to evaluate their groupmates work (students).

Teachers from the special education school and Pharmacy degree students have been surveyed after this experience (Tables 1 and 2), using scores between 1 and 10 to evaluate these items.

Table 1. Questionnaire for teachers from the special education school.

1) Development of these activities has been interesting in the Education Centre.
2) Development of these activities has been suitable, and they have been well adapted to each student.
3) Activities have been well organized.
4) I would recommend repeating these activities in the future.
5) The overall rating for this activity would be…
6) Do you think that this kind of activities are positive for the inclusion of people with intellectual disabilities?
7) Do you think that these activities have changed University students' perception of people with intellectual disabilities?
8) Healthcare professionals know how to communicate with people with intellectual disabilities. Do you agree with this statement?
9) Do you think that this methodology is effective for improving the communication skills of healthcare professionals with people with intellectual disabilities?
10) Materials provided by the University students have been well adapted and suitable.
11) Despite the current situation these activities have been well adapted compared to activities carried out in previous experiences.
12) It is better to develop this activity in person compared to video call.

Table 2. Questionnaire for Pharmacy degree students.

1) The information received to carry out the activity seemed correct to me.
2) The organization of the activity has been adequate.
3) I would recommend doing this activity in later courses.
4) I liked doing the activity.
5) The activity seemed appropriate and useful for my training.
6) I would have preferred to carry out the activity in person if the health situation had allowed it.
7) I believe that teaching innovation activities like this improve my teaching-learning process.

3. Results

28 students from group 1 have participated in this activity divided into 8 subgroups of 3 or 4 people each. All of them have prepared original and adapted materials to practice with somatic and special senses. Some of these materials are shown in figure 3.

Figure 4. Materials developed by Pharmacy degree students.

Each subgroup made a video call of between 30 and 40 minutes with the two students from the school they were assigned (Figure 4). During the sessions, the Pharmacy degree students could interact with them. The 8 subgroups developed all the activities they prepared. In the case of Tik-Tok activity our students show how to coordinate the body movements using a popular song "Jerusalema". They guided them step by step during the video call with some dance steps. After this session they had to practice and record the video and then teach and rehearse the dance with the rest of the classmates.

Figure 5. Video call during face-to-face sessions.

After the activity, a questionnaire has been completed by 19 Pharmacy degree students. 53% of these students had not taken contact with people with intellectual and/or developmental disabilities before this experience. Different aspects of this activity have been evaluated (from 0 to 10) by students. All of them have stated that would have preferred to carry out the

activity in person in case it was possible. Most students would recommend these kinds of activities in later courses (arithmetic mean = 9.47) and recognized that they liked doing the activity (arithmetic mean = 9.4).

In the evaluation of the activities by teachers from the special education school (n=5), the arithmetic mean obtained from the survey ranged from 7.8 to 9.4. The lowest mark corresponded to the item about communication barriers of healthcare professionals in their relationship with people with intellectual disabilities. Mainly, they highlighted the adaptation of the activity to the current situation compared to previous experiences and the interest of this initiatives for the educational center. The psychological characteristics of the recipients of this project do not allow an objective assessment of their participation. Their expressions and behavior during different activities have been their subjective results. Only students with a lower degree of disability could be asked qualitatively for their opinion about this experience. All of them liked to participate in this project and they indicated that they had learned things that they did not know previously.

3. Conclusions

A positive impact of the activity has been recognized by all participants. Such experiences help University students to change and improve their communication skills with different possible future patients, in special with people with intellectual disabilities. Students from the school who were receptors of the activities could also understand and develop their own senses with new teaching materials. Besides, it is a different activity out of their routines.

The present situation caused by COVID pandemic has been a great challenge for the initiative developed in person during previous courses. Most students have expressed the difficulty of this experience by video call. Nevertheless, the main aims of the project have been achieved and there is a general perception of satisfaction by all participants.

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Evaluation of a Higher Education Institute's Quality Framework performance during COVID-19

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Abstract

COVID-19 provided a challenge to the continuing high quality operation of higher education. Quality frameworks, which were created long before national lockdowns or social distancing, were tested in a manner that had not been foreseen on their creation.

This work examines the performance of the framework in our institute to see if it was sufficiently robust to offer our students a quality education experience, to propose some modifications and to reassure the public in terms of the standard of our graduates.

Engagement with the student body is described in detail from decision-making to evaluation at the end of the academic year of their experience on their programme of study.

Keywords: *Quality framework; emergency teaching; student engagement.*

1. Introduction

On 12th March 2020, the Irish government announced the closure of schools, pre-schools and further and higher education settings, initially until March 29th, to limit the spread of COVID-19. To minimise the impact on teaching and learning, educators were asked to provide online resources for students or online lessons, while taking into account students that may not have access to online facilities. On 27th March, the Irish government introduced a national lockdown, banning all non-essential travel and contact with people outside one's home (including family and partners).

This paper examines the impact in one Irish Higher Education institute of this dramatic change on the education offered and the manner in which the educational quality framework was tested and fared in completing Academic Year 2019-20 and then in delivering Academic Year 2020-21.

While the physical structures of the institute were closed, students, staff and the public had an expectation that the institute would continue to deliver education and to maintain the same high standards.

2. Quality Framework

The institute's quality framework was crucial to the successful negotiation of the national lockdown and the completion of the 2019-20 academic year. The quality framework pre-COVID operated in an ever-increasing, complex environment that nonetheless provided for effective policies and procedures. Of course the framework was drawn up without ever anticipating the nature and extent of the complexity that subsequently ensued.

The institute's quality framework was tested in many areas, most notably:

- Academic and Student-centred Values
- Staff and Student Quality Culture
- Informed Practice and External Engagement
- Proportional Implementation of Quality Processes
- Comprehensive, Transparent and Publicly Accountable QA
- Consistency with Policy and International Effective Practice
- Measurement

2.1. Academic and Student-centred Values

One aspect of the first national lockdown is that the students were suddenly off-campus. The institute decided nonetheless to prioritise the students' perspective from the beginning, with the students union representing the student voice. The students union and institute co-developed a COVID-19 Student Charter, which described the responsibilities and

commitments of the student body, the institute and students union and explained what education would look like in the COVID-19 era. The charter particularly highlighted the need for strong communication links to all parties, which was tested two months later, in a survey of the entire student population. From the closure day on March 12th, the institute consistently engaged with the students union and listened to ideas, challenges and concerns. Adapting learning to a COVID-19 era was difficult, but it helped considerably to do so in a manner that was collaborative and engaging. However, survey results presented later in this research indicate that the communications to the wider student body need improvement.

The dynamic and complex nature of the COVID-19 challenge meant that some early decisions were later modified as more information came to light. For example, the Academic Council decided in May 2020 to hold semester 1 repeat examinations on campus as usual in August, to mirror the format of the original exams pre-pandemic. However, as the exam dates in August approached, some students expressed misgivings about coming on campus or their inability to travel due to a regional lockdown. Academic Council decided to continue with the examinations, but also that no student would be disadvantaged, as a result of their concerns about or restrictions on attending on-campus exams. Academic Council therefore established a mitigation process, which included the possibility of September alternative assessments and modified progression rules.

Finally in terms of academic-centric values, the institute has a core objective of recruiting and developing high-quality academic staff and researchers. Therefore training and guidelines were prepared to address the pressing needs of academic staff who had a dramatic change in their academic delivery and assessment. The dedicated Technology-Enhanced Learning unit significantly increased the number and nature of training workshops to support the academic staff development and the effective utilization of the eLearning infrastructure.

2.2. Staff and Student Quality Culture

The institute's Quality Culture under COVID-19 was successful due to three interrelated activities engaging staff, students and external stakeholders:

1. the sustained operation of cycles of development, implementation and review of policies and procedures that inform activity and initiate new policy, procedures and practices;
2. a defined structure that clearly articulates responsibility of key institute community members with respect to the quality assurance activities; and
3. continued publishing policies and procedures across the range of institute activities that were open for change by all stakeholders and eventually approved by the appropriate instructional body.

Initially the organisation and communication of these activities was a challenge, especially as the institute community dealt with the infrastructure and broadband requirements of moving online. This quality culture was examined in a scheduled institutional review by an external panel of experts, with all participants communicating virtually. The original review was of course intended to be with the panel physically present on-campus, so there were concerns in relation to the operation of and capacity of a virtual review. However, notwithstanding the challenges and delays posed by COVID, the review meetings and communications before and after the external panel's virtual visit were well managed. The external panel examined the pre-COVID operation, the performance during the pandemic and the plans for the future. The panel's findings were broadly positive, but with recommendations to sustain ongoing improvements.

The scale and nature of the academic delivery and assessment changes were at levels heretofore never experienced. However, an example of the flexibility and resilience of the quality framework can be seen in the response to the challenge posed by students across the entire programme portfolio struggling to achieve all credits required for stage advancement, sometimes for reasons related to the pandemic, remote learning or regional lockdowns. Academic Council decided to delegate this key decision to each programme board. Therefore programme boards made decisions with students, in relation to students progressing, while carrying a larger than usually permitted number of credits. Programme Boards were empowered to permit students to progress carrying more than the previous maximum of 10 credits, subject to the Board being confident in the wisdom of each decision and to the Board informing the student of the challenge posed by carrying those modules.

2.3. Informed Practice and External Engagement

Engagement with all internal and external stakeholders is core to informing academic practice in learning, teaching, assessment and research; in collaboration; in economic and regional development; in establishing and realising civic and community objectives and in introducing and sustaining internationalisation.

When the first national lockdown occurred, the institute was already on a merger path with another regional institute, with a plan to then apply for a technological university status. This initiative is driven in part by many stakeholders in the region and continued notwithstanding the difficulties posed by the pandemic. The submission has been made to the government and an external review panel will begin its evaluation in mid-June.

2.4. Proportional Implementation of Quality Processes

The quality framework also includes the academic activities of the institute, including course design and approval, the setting and monitoring of standards, the making of awards and the academic integrity of the learner and learning process. Increasingly, these regulations must

also account for different types of learners, including new modes of delivery (such as technology enhanced learning, including on-line delivery), as well as the diversity of types and backgrounds of learners.

It was vital therefore that the quality framework be dynamic, flexible and responsive in the pandemic period. For example, the validation of new awards was carried out online in a manner that met the needs of quality assurance and the expectations of the award proposers.

2.5. Comprehensive, Transparent and Publicly Accountable QA

The validation and awarding procedures were still consistently comprehensive, transparent and publicly accountable, which for example meant that procedures and evaluations of new award proposals continued to be published online. Indeed online publication was arguably more important in this period of limited campus access, so the institute also published its own self-reflective report for the institutional review, as well as the expert panel report from that review. Previously the self-evaluation report had not been published.

2.6. Consistency with Policy and International Effective Practice

The institute is a full and committed members of the European Higher Education Area and, as such, benchmark their approach to quality assurance against the ESG and other comparable systems of international effective practice. The Quality Framework guiding principles, which form the core of this paper also define the basis for an annual quality review to the national statutory quality body. The annual report for the 2019-20 year detailed the effective performance of the framework, especially in the latter part of the year when the COVID response took hold.

2.7. Monitoring and Measurement

Measurement, reporting and publication are key aspects of good academic governance. The institute continued throughout the pandemic to measure and monitor performance, for example in new student applications, exam attendance, monitoring the transition online through indicators such as virtual learning environment page-hits and internal reviews of new and modified programmes.

Accountability, control and scrutiny were ensured through reporting, student surveys, programme and School Board reports, new programme and programme change panel review reports, postgraduate vivas, meeting the national statutory quality body in a Dialogue Meeting, and maintaining transparency of all framework actions through publication on the institute website.

Emergency Remote Teaching required an immediate and sustained response in the institute's Virtual Learning Environment, Moodle. Since March, Moodle has been available throughout, with 100% Moodle Uptime. Unsurprisingly, Moodle Traffic increased, up to 157% in the

March-May period compared with similar months in 2019. The daily average of just under 60,000 Moodle pageviews in the March-May period has since was immediately exceeded on return to education in September 2020, where the resumption of classes saw the number of pageviews soar to new records of over 200,000.

Student feedback and participation is an important aspect of the capacity of the institute to assess its performance. The entire student body was surveyed in May 2020, at the end of the 2019-2020 Academic Year. They gave a broadly positive response given on their experience on their programme in the previous year, notwithstanding the sudden move to emergency remote teaching and the dramatic changes in their assessment modes. Approximately 20% of the full-time major award students (about 1,300 students) took the survey. Notwithstanding all of the challenges that they faced since March, Figure 1 shows that the students' impression of their programme was better than the previous year's survey scores across every single category (scoring is on a Likert scale 1-4, with 4 being the highest rating).

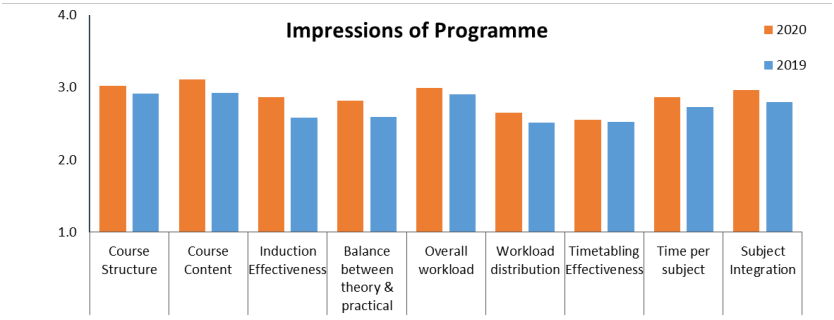

Figure 1. Students' impressions of their programme: 2020 versus 2019.

While this result is somewhat surprising a word analysis of the Course Strengths question in Figure 2 goes some way to explaining the students' rationale, where institute lecturers are clearly regarded highly by the students.

Figure 2. 2020 responses on course good features (f=7).

However, in spite of improved efforts to communicate with students, the 2020 students ranked the effectiveness of communication as the lowest scoring theme in Figure 3 and, with the exception of Project Support and Continuous Assessment Feedback, ranked the questions in this category lower than the 2019 responding students. Furthermore, this section had been the strongest category of responses in the 2019 survey, so there is a clear message to the institute that communications must be improved. The institute has changed its communication approach for the academic year 2020-21.

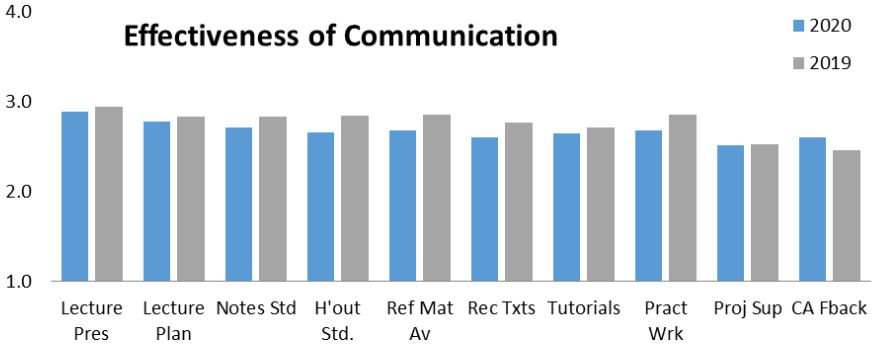

Figure 3. Effectiveness of communication: 2020 versus 2019.

Many responding students have clear ideas on where their courses can be improved (setting aside the blank and no weaknesses responses), when responding to the Course Weaknesses question, and these are synthesised in Figure 4.

Figure 4. 2020 responses on course weaknesses (f=6).

3. Conclusion

COVID-19 tested the quality framework of our higher education institute. However, the governance structure already in place was sufficiently robust to deal with all academic, regulatory and financial demands placed on it.

The institute student was involved in the solution from the outset, primarily through their representatives, in collaborative, engaged decision-making and student involvement in academic governance, but also through a heavily promoted survey for the entire student body to have their say. Overall, the students were happy with the institute's response, but expect communications to further improve.

The Quality Assurance Framework was not designed for a pandemic scenario but operated effectively during COVID-19. While the move to social distancing was initially a challenge, quite soon operations were continued as before, including new policy development; academic measurement, reporting and publication and oversight of emergency remote learning and teaching .

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¿Y si usamos los dos? Attitudes towards Translanguaging in an L2 Spanish Writing Course

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Abstract

Translanguaging is a new approach to language use, bilingual acquisition, and bilingual education that sees all acquired languages (or those being acquired) as components of one bi/multilingual repertoire (García & Wei, 2014). However, discussions of specific pedagogical applications of translingualism have remained limited and speculative (Gervers, 2018; Matsuda, 2014). Hence, it is still unclear how such pedagogies would address the needs of bi/multilingual student writers. Based on the need to further understand the use of translanguaging in the classroom, the present article explores the translingual practices and attitudes of students in a Spanish undergraduate writing class. Participants were 9 undergraduate students from a university in the United States. Data collection involved an online questionnaire, individual interviews —which focused on attitudes towards translanguaging— and the student's submission of their final project, which allowed the researchers to observe whether students reflected the translanguaging practices in the project. Results from online questionnaire and interviews suggest that students can better focus on the message they want to convey without linguistic pressure that forces them to use one language only. Additionally, pairing students for collaborative writing enhanced their overall drafting development. Results from the final projects reflect that students tend to not reflect translanguaging in their final version.

Keywords: *Translanguaging; second language acquisition; attitudes.*

1. Introduction

This study investigated student attitudes toward translanguaging throughout a multimodal writing assignment in an upper-level, second language (L2) Spanish course. More specifically, the researchers aimed to comprehend students' attitudes toward this flexible bilingual pedagogy and the possibility of translanguaging when brainstorming and drafting the written portion of their class' digital assignment.

2. Review of the Literature

Translanguaging has been defined as an approach to language use, bilingual acquisition, and bilingual education that sees all acquired languages—or language(s) in the process of being acquired—as components of one bi/multilingual repertoire (García & Wei, 2014). Speakers draw linguistic resources from various languages to communicate effectively, based on their contextual needs (Velasco & García, 2014). Traditional L2 education programs have based their curricula on subtractive bilingualism. Recently, more scholars have begun to challenge this separation and introduced translanguaging as a practice of additive bilingualism, through which educators take advantage of students' home languages to enhance their weaker language development (García & Wei, 2014; Velasco & García, 2014). These scholars defend that translanguaging promotes a deeper understanding of the subject matter, helps the acquisition of the weaker language, and helps to integrate early learners with fluent speakers (Baker, 2001). In addition, it is a natural linguistic practice among heritage or minority language students through which they question hierarchies between languages, and reject the biases of language purity and national monolingualism (Allard, 2017). Creese and Blackledge (2010) address the importance of "easing the burden of guilt associated with translanguaging in educational contexts," and restate the necessity for further research in "classroom language ecologies to show how and why pedagogic bilingual practices come to be legitimated and accepted by participants" (p. 113). Furthermore, few studies have focused on translanguaging in academic writing contexts as most investigations conducted have been "product-oriented (i.e., textual interpretation) and fore[went] the exploration process needed to identify types of writing or discourse" (Canagarajah, 2011, p. 401).

Language attitudes are "any affective, cognitive or conative index of evaluative reactions toward different languages or their speakers" (Kircher, 2016, p. 241). This implies that bi/multilingual speakers, depending on their attitudes towards different languages, dialects, or practices, decide which ones to employ in specific communicative contexts. Language attitudes contribute to language maintenance, language shift, or bi/multilingual practices (Kircher, 2016). Research shows that even though students translanguage in the classroom, some are not conscious of their practices and they verbally express that languages are better kept separate. Palfreyman and Al-Bataineh (2018) observed that two university students from

the United Arab Emirates resorted to their full linguistic repertoire. Despite their translingual practices, their attitudes turned out to be ambivalent, as they expressed that they preferred to keep both languages separated. Several authors have concluded that translanguaging is a tool that can facilitate, enhance and improve the target language learning experience in the classroom. Adamson and Coulson (2015) investigated undergraduate students' perceptions towards English-Japanese translanguaging at a Japanese university. Results from surveys showed that students perceived translanguaging as an effective classroom management tool as well as a useful tool for clarification that also facilitated the completion of writing assignments, especially to students who possess lower English proficiencies. Similarly, Carstens (2016) explored the use of translanguaging in an engineering undergraduate class in South Africa. Results showed that most of the students believed that translanguaging helped them understand complex topics as well as improve their knowledge of the English language. Furthermore, Moody, Chowdhury, and Eslami (2019) investigated graduate students' attitudes towards translanguaging in several languages in a university in the southwestern United States and concluded that students perceived translanguaging as a tool for learning an additional language. They inferred that the fact that students perceived translanguaging positively should make instructors consider allowing and encouraging its use, in a way that would stop subscribing to ideologies of linguistic separation.

3. Methodology

Data were collected from the upper-level *Spanish Writing Literacies in Context* course at a large university in the southwest of the United States. This course was facilitated in a context of translingual practices where the instructor made use of English and Spanish. By drafting texts that then were included in a multimodal assignment, students used translanguaging in new digital scenarios. They wrote a 500-word collaborative draft describing the multilingual signs they found around town and the opinions regarding those signs of people that they interviewed at those locations. This served as the written portion later included in their digital project. The sample of participants consisted of five males and four females between the ages of 21 and early 40s, making up a total of N=9 participants, participants were assigned a three letter identification code, to ensure their anonnymity. Six of them considered themselves Caucasian, three Hispanic or Latino, and one, African American. Only two students reported themselves to be native speakers of Spanish. One of them learned Spanish at home and learned English in school, he is therefore considered a Spanish heritage speaker (Valdés, 2001). The other one was a native speaker of Spanish, grew up in Venezuela, and moved to the United State at the age of nine. Data were collected through an online survey in *Google Forms* and individual semi-structured interviews administered after the multimodal project was completed and graded by the instructor. The survey included a mixture of background

and attitude questions. Over the span of two weeks, one of the researchers interviewed individually with each participant. The interview dug deeper into the survey's inquiries.

4. Results

This section presents (1) the results of one question from the online survey and personal interviews that investigated students' attitudes towards translanguaging in the classroom and (2) the results of two questions regarding translanguaging at two specific points of the writing process for a multimodal project, i.e., brainstorming and drafting. Quantitative and qualitative data are presented together to provide a thorough overview.

4.1. Do you feel comfortable translanguaging in the classroom?

Half of the students (55.5%) declared they felt comfortable. One felt always comfortable "because it is something normal" and the rest felt comfortable most of the time. One participant's response in the interview was insightful: "I like having the option, it makes me feel comfortable. It helped me not freak out with all the sentence structures". One participant felt neither uncomfortable nor comfortable ("I'm practicing [it] to get more comfortable"), and as for the remaining three participants (33.3%), they felt uncomfortable most of the time. One participant elaborated: "I speak Spanish at home, everywhere else is English, so when I try to mix them up, it bothers me, it is weird". However, in his interview, he mentioned that it sounded natural to him in the classroom, that it is an advantage that he could use both: "In my personal life, no. But in the classroom, yes. It helps me express myself better, express exactly what I want to say". Some attitudes seemed to be conflicting. One of the follow-up questions asked during the interview was whether the participants thought translanguaging might prevent people from learning. The participant QLT, Spanish as L2 speaker asserted that having the opportunity to use translanguaging might be beneficial in the classroom, but that, in the end, it depends on the individual to use it as a tool to learn and not to only use English: "Having the opportunity to switch back and forth can be beneficial but it depends on the individual if they're gonna use it in the right way cause I know a lot of times sometimes I use a lot of English as a crutch and now I am regretting it because I don't know Spanish as well as I should". In addition, the heritage speaker (QGR) expressed that: "I think English use should be limited; they don't learn the Spanish that they need to. Like if they did 50/50% English and Spanish, I think that would be helpful").

4.2. Translanguaging has been useful as I brainstorm during my drafting process Translanguaging has been useful while drafting the written portion of the story maps

For sake of brevity, as some of the students expressed that they sometimes do both simultaneously and as very similar results were obtained, we consider these two questions together and present the results for two of the four pairs. Only one student strongly disagreed

in both and wrote: "I try to think in Spanish when I do my Spanish homework" and regarding drafting: "the same as above". This participant's partner in the written project was not part of the study.

4.3. Pair 1 (QGR, Spanish native speaker & LAF, Spanish L2 learner)

Their draft and final version of the project contained both Spanish and English. QGR stated in the survey that translanguaging "helps to use two languages to see which one will portray the message better" and had a more positive attitude toward Spanish when he stated that there are words in Spanish that can't be translated to English. His perspective was confirmed in the interview when he mentioned that translanguaging helps to improve the message because: "Spanish gives you more ways to express many things". QGR also mentioned that translanguaging "helped drive the narrative", when one reads the draft "it makes sense" and that transitions were logical: "It's logical, it's not that we use one paragraph in English and another in Spanish, it depends on [languages] we speak [in the interviews]". LAF supported this idea of trying to be faithful to the original language in which each of the interviews for the project took place: "We tried to be purposeful. Depending on the languages we used in the interviews if we're interviewing someone in English, we will write it in English" and while drafting "I don't really draft, like a lot of people draft in English and then translate it and I don't. So, I just switched depending on who we were talking to or what location we were at". Regarding their collaborative work, she said: "[Translanguaging] made me feel comfortable. Sometimes when I am writing, it is hard to go back and forth, but my partner was really fluent, so it made me learn more".

4.4. Pair 2 (CTT, Spanish heritage speaker & EXZ, Spanish L2 learner)

These participants wrote their draft and final version of their project in Spanish. EXZ stated preference for using both English and Spanish, CTT shared a preference for sole Spanish use. When asked in the interviews about the usefulness of translanguaging during the drafting and brainstorming process, CTT shared that it helped him when drafting. Conversely, EXZ stated that she always brainstorms in English, her native language. Both participants shared that translanguaging was useful to first brainstorm in English but acknowledged having tranlanguaged differently. CTT translanguaged by using words in English and words in Spanish, while EXZ wrote everything in English and then translated it into Spanish. An important idea that emerged in the interview was that EXZ believed that working with someone with a higher proficiency complimented her shortcomings.

5. Discussion

5.1. RQ1: What are the students' attitudes towards the implementation of a flexible bilingual pedagogy in an L2 Spanish writing course?

Positive: Overall, students were positive in their answers to the questions in the survey and the interviews. They felt comfortable translanguaging in the classroom. Over half of the students had favorable attitudes towards a flexible linguistic pedagogy, materialized in the use of both Spanish and English for communicative purposes in the classroom. One of the main reasons for this to be so was a better understanding of complex topics, a finding highlighted in Carstens (2016) and Baker (2001). Our findings also corroborate Moddy et al. (2019), who concluded that translanguaging was perceived positively. Similarly, the role of the instructor was also seen as positive in instances when the students said something in English and the instructor repeated it in Spanish. This procedure helped the students get their point across and, at the same time, they perceived that they learned more vocabulary. When using both languages, one participant declared that she learned more of the "why" of language use. This suggests that a deeper understanding of how the L2 functions is, in fact, explicitly noted by students in the classroom. It is important to note as well that this was seen as something specific to the classroom since the same participant stated that in a context of study abroad, to better improve the L2, full immersion is needed, but that in the classroom: "I need translanguaging for sure". In general, self-proclaimed students with lower proficiency levels of Spanish elected to use much more translanguaging than those who are heritage, native, or very advanced speakers, as this linguistic practice made them feel more comfortable and eased anxiety when speaking and presenting in front of the instructor and their peers. Additionally, they saw translanguaging as support to rely on when feeling unsure of how to express themselves only in their L2. At the same time, the heritage speaker in the study confirmed that translanguaging helped him equally when he was unsure of specific words in any of the two languages. The native speaker stated that it is an advantage to be able to use both languages in the classroom—as opposed to the out of classroom contexts—since both repertoires allow to express ideas more accurately when one language is considered to be more helpful than the other in specific instances.

Negative: Ideas expressed during interviews confirmed how positive and negative attitudes can be intertwined. As in Palfreyman and Al-Bataineh (2018) students' attitudes turned out to be rather ambivalent, as some of them would prefer to keep both languages separated. The most conflicting attitudes were seen in the native speaker and two high proficiency Spanish learners as they expressed feeling "almost never comfortable" translanguaging in the classroom, according to the survey. The three of them confirmed their views during the interviews stating that this is due to the difficulty of switching back and forth from one language to the other. This might be related to the recurring idea that to improve the use of

language, the classroom needs to be conducted in Spanish as much as possible to "get as much practice out of it", because if not, as two of these participants concluded in the interviews, not doing so might prevent people from learning. These are somehow mixed results and opinions since, even if these three students did not feel comfortable translanguaging in the classroom, they understood how it could be useful in certain situations or even specific assignments.

5.2. RQ2: What are the student's attitudes towards the possibility of translanguaging when composing the writing portion of a multimodal assignment?

Positive: Like RQ1, students generally showed positive attitudes towards the possibility of translanguaging during the writing process. The consensus was that the use of translanguaging in the brainstorming and drafting was helpful to seven out of the nine participants as it helped them to express their ideas more clearly. Translanguaging in this sense was used by the participants to assist them with translation as they wrote and drafted. As one of the pairs shared, they wrote their draft in English and translated it into Spanish. The member with lower proficiency declared to always brainstorm in English in Spanish classes as writing only in the target language is "hard". On the other hand, she admitted that her partner supported her in the writing process by providing a more informal linguistic repertoire to the text, whereas she provided the formal aspect to it. We see this as part of the scaffolding provided by the collaborative assignment. This justification for translanguaging as a facilitator to the completion of writing assignments—especially to students who possess lower proficiencies—is supported by Adamson and Coulson (2015). From these positive attitudes, we can infer that the participants of this study also perceived translanguaging as an effective tool for drafting and brainstorming and collaboration.

Negative: Overall, the participants expressed the sole use of Spanish to be best when writing for an assignment in a Spanish class. Additional results that stood out related to two of the nine participants' survey opinions where they selected the *strange* and *very strange* options to describe translanguaging usage throughout the assignment. This, however, conflicts with their actuated elective usage of translanguaging in their pairs. This allowed us to infer that, although a small portion of the reported negative attitudes, translanguaging was ultimately used in every pair's assignments throughout their drafting, and brainstorming processes. These negative attitudes relate to Gervers' (2018) insight that translanguaging may not always be an effective pedagogical approach for some students.

6. Conclusions

Findings suggest a positive opinion of translanguaging when used by the instructor and in the brainstorming and drafting processes. Allowing students to be in control of the language in the L2 classroom promotes a sense of agency and decision-making that is usually covered

by negative attitudes. By helping learners to use translanguaging more freely, they can better focus on the message they want to convey without linguistic pressure. According to our findings, this is especially helpful for those students still developing their language skills. Furthermore, this study brings a new perspective by analyzing attitudes toward translanguaging when working in a written aspect of a multimodal assignment in pairs. When students with different proficiency levels are paired up, the more proficient individuals can help scaffold their partner's progress by monitoring their work in the brainstorming and writing process. Participants who worked with a native and a heritage speaker underlined the usefulness of this process and how they complemented each other. This study calls for new pedagogical approaches, the development of new multimodal writing tasks that allow for accepted translanguaging texts, and ways to change the factors that limit its use in academic settings.

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Socioeconomic status and university students' perceptions of English as a professional language

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Abstract

The study behind this paper aimed to assess the influence of the socioeconomic status (SES) on university students' expectations of English use in their prospective career and their perceptions of English competence as a key professional skill. The sample consisted of 109 students from two Bachelor Degree courses at the University of Málaga (Spain), one in Energy Engineering and the other one in Pedagogy. An ANOVA analysis revealed that there was no statistically significant difference between the three SES groups in the sample as to their expectations and perceptions concerning English competence. However, descriptive statistics show that the participants in the lower SES group have lower expectations regarding the role of English in their future career. Additionally, the students in this group hold a lower perception of English as a key professional skill. These findings lead us to conclude that lower SES students may be less inclined to enrol in partially or fully taught English courses at university, and that their perceptions may actually be a factor in their future career prospects in areas where English is extensively used as a lingua franca.

Keywords: *English as a foreign language; socioeconomic status (SES); English Medium of Instruction (EMI); Higher Education; career prospects; perceptions.*

1. Introduction

In the last decades, there has been a substantial increase of English-taught programmes and courses worldwide (Dearden, 2014; Macaro et al., 2018; Wächter & Mainworm, 2014). To illustrate, a survey of 70 European universities from 11 different countries in 2014-2015 found that 39% of them reported that they offered both individual subjects and fully English-taught under- and post-graduate degrees. More recently, only 7% of the surveyed universities in the study conducted by O'Dowd (2018) were not holding any English Medium Instruction (EMI) courses at all. A typical definition of EMI is this: "English-Medium instruction is when non-language courses in for instance medicine, physics or political science are taught in English, to students for whom it is a foreign language. As often as not, it is also taught by a lecturer who does not have English as a first language (L1). (Hellekjær, 2010, p. 11).

Several reasons lie behind this growth in EMI. Internationalization policies in higher education institutions, the promotion of plurilingualism and mobility by European institutions, competitiveness among universities and the need to equip the students with competences that will increase their employability are among them (Barrios & López Gutiérrez, 2019). It is also unquestionable that English is now the lingua franca for science and that English competence is needed to access, generate and share updated scientific information.

Although research in EMI has run parallel to this growth in English-taught courses, little is yet known about the characteristics and perceptions of the potential future EMI students, and, more precisely, about how the students' SES can impinge on the perceptions concerning English as symbolic and social capital or socially recognised resource (Bourdieu, 1977) that can arguably lead to their interest in English learning and in EMI courses. One of the few studies in this area is the one conducted by Lueg und Lueg (2015), who found that the students of the lower SES in their study did not choose EMI, although they acknowledged their benefits. The authors concluded: "Lower-strata students perceive the barriers to EMI as much higher than they actually are" (p. 21). Another of their conclusions was that the tendency for students to opt for or against EMI is determined not so much by their capabilities in English, but by their conceptions. These results were partially confirmed by the study conducted by Barrios, Linde-Valenzuela and Lopez-Agudo (2020) with the same sample of students as the present study, that found that SES was not related to the students' self-confidence in their use of English in academic situations.

Building on this argument, the present paper aims to assess the influence of the SES on university students' expectations of English use in their prospective career and their perceptions of English competence as a key professional skill, in the conviction that these perceptions may influence the students' choice of English-taught courses.

2. Study design

2.1. Participants

A sample of 109 students from the Bachelor Degrees in Energy Engineering and Pedagogy at the University of Málaga (Spain) participated in the study. Of those, 54,1% were males and 45,9% female. The participants were enrolled in the 1st. year core module 'Chemistry' (n = 60) or in the 3rd. year elective module 'Didactic use of media' (n = 49). Their ages ranged between 18 and 31 years (M = 21,25; SD = 2,60). Concerning their competence in English, aproximately half (48,6%) declared having a B1 certificate in English (37,6%) or a higher competence certificate. Around 60% stated that they used to obtain between 'Excellent' (*Sobresaliente*) or 'Very good' (*Notable*) in English in High School (*Bachillerato*) and only 4 students manifested that they used to fail this subject. Around a third of the sample stated that they were not satisfied with their current level of English and 18% indicated that they did not like learning English.

2.2. Instrument and Data Analysis

A questionnaire was used as data gathering instrument. The first section was aimed at obtaining sociodemographic information. The second section included two scales, the 'Expectations of English use in the prospective career' scale' (3 items) (α = .640) and the 'Perceptions of English competence as a key professional skill' (4 items) (α =.794) (Appendix I). Students rated their degree of agreement with the statements on a 6-point Likert scale between 1 = Strongly Disagree to 6 = Strongly Agree. This questionnaire was created on Google Forms® and completed in the first month of the period in which the modules were delivered.

A synthetic indicator of SES was constructed through a main components analysis based on: (a) the parents' highest education level, (b) the parents' highest level of occupation, (c) the numbers of books at home, and (d) the family household assets. This procedure is similar to the one used in international studies such as PISA. Three SES levels were obtained.

The data were analyzed through descriptive statistics and one-way analysis of variance (ANOVA) with Bonferroni post-test or Dunnett T3 post-test analysis performed for comparisons between multiple groups using SPSS 26 software.

3. Results

Table 1 shows the descriptive results obtained. As can be observed, the participants in the lower SES group (SES level 1) have lower expectations regarding the role of English in their future career. Additionally, the students in this group hold a lower perception of English as a key professional skill than the other two groups. There was not a significant effect of SES

level on expectations regarding the role of English in the future career at the p <.05 level for the three conditions [$F(2, 106) = .706$, $p = .496$]. Likewise, there was not a significant effect of SES level on perception of English as a key professional skill at the p <.05 level for the three conditions [$F(2, 106) = 1.860$, $p = .161$].

Table 1. Descriptive results.

	SES level	N	Mean	Std. deviation
Expectations of English use in the prospective career	1	39	13.33	3.55
	2	36	14.00	2.79
	3	34	14.21	3.52
	Total	109	13.83	3.30
Perceptions of English competence as a key professional skill	1	39	14.59	5.27
	2	36	16.75	4.09
	3	34	16.06	5.43
	Total	109	15.76	5.01

3. Conclusions

The study informing this paper tried to assess the influence of the SES on university students' expectations of English use in their prospective career and their perceptions of English competence as a key professional skill. Although no statistically significant differences have been found as to the effect of SES level on those expectations and perceptions, descriptive statistics reveal that the students in the lower SES group have both lower expectations that they will use English in ther worklife and a lower perception of English competence as a key professional skill than the other two SES groups.

These findings lead to speculate that that lower SES students may be less inclined to enrol in partially or fully taught English courses at university and that their perceptions may actually be a factor in their future career prospects in areas where English is extensively used as a *lingua franca*. Our results are thus in line with those obtained by Lueg und Lueg (2015) and, although more research is needed to confirm our findings, we understand that this reseach is a contribution to the much needed research into how SES factors impinge on university students' enrolment in EMI courses and on their expectations of future career prospects in areas where English competence is a requirement.

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Appendix

'Expectations of English use in the prospective career' scale items:

- When I think about my future job, I imagine myself using English.
- Studying English can be important to me because I think that at some point it will help me find a good job.

- I have to study English because, if I don't, I think I will not prosper in my working career.

'Perceptions of English competence as a key professional skill' scale items:

- Not learning English would have a negative impact on my working career.
- What I want to do in my future career requires the use of English.
- It is important for me to study English because an educated person is supposed to be able to speak English.
- Studying English is important to me because I don't want to be considered an insufficiently educated person.

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When learning Italian as a Second Language, tourism and technology go hand in hand

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Abstract

This paper aims to describe the development of CALL-ER, an application for mobile devices, produced within the CALL-ER project (Context-Aware Language Learning in Emilia Romagna). An ever-increasing availability of applications for language learning that meet the different learning needs of users, as well as the ubiquitous wireless communication, led applications for mobile devices to become gradually more context-aware. This means that language is acquired by users through the direct experience with the local context where they are. An example in this regard is represented by the CALL-ER mobile application, that supports mobility students through the incidental learning of Italian language and culture in the city of Forlì. We will begin this contribution with an outline of the theoretical underpinnings that supported the project and a presentation of the project itself. We will then present the first stage of the project, during which the application was developed before its first testing. At this point, an overall description of the application will be given. A special attention will be paid throughout this paper both to how language learning has been conceived through experiential tourism and to the multimodality of the contents.

Keywords: *Context-aware language learning; Italian L2; MALL; multimodality.*

1. New contexts for language learning

The potential of technology to promote the adoption of specific approaches to language learning has grown over the years and an example of this is the ever-increasing availability of applications for language learning. This paper will describe how technology, namely a geolocalized app for mobile devices, could be useful to promote experiential learning and context-aware mobile learning. The case study specifically regards the learning of Italian as a second language in the urban and suburban areas of Forlì-Cesena. In accordance with the latest innovations in the field of techno-pedagogical innovation (Ferguson et al., 2019), the app will have specific functions to foster meaningful, mobile, context-aware learning of Italian as a second language, as well as to facilitate interaction between groups of users (communities of interest, communities of practice).

The app is primarily targeted at a very heterogeneous audience of "tourist-learners": students coming to Forlì for a short period of study or international students fully enrolled at the University of Bologna (Forlì Campus). These participants present very different linguistic profiles and levels of knowledge of Italian. Moreover, the app topics are designed to be of interest to a second kind of "tourist-learners", that also include native speakers of Italian, who might be interested in a new dimension of interaction with their surroundings. The aspect which will hopefully be shared by all the participants is the desire to get in touch with new places of the town, as well as the to share the experiences with other people through different forms of sharing and/or online peer tutoring.

Palalas (2016, V) specifies that in MALL, learner mobility is combined with: "access to people and resources (both these residing locally on the device and those on the Web), to digital tools (including built-in device capabilities, native and web-based apps), as well as supports and scaffolds mediated by mobile devices [...]". In mobile learning, the concept of context-awareness is defined as the activity of collecting information about one's surroundings to provide a measure of what is happening at a specific time around a user and a device. Mobile devices prove to be an excellent tool for performing activities and delivering content that is particularly relevant in each environment, as by their nature they lend themselves to being available in different contexts and can act as a support for the learner in case of need (Naismith et al., 2004, p. 14).

Incidental learning has been defined in general terms as "a byproduct of some other activity, such as task accomplishment, interpersonal interaction, sensing the organizational culture, trial-and-error experimentation, or even formal learning" (Marsick and Watkins [1990] 2015, p. 12). This definition of incidental learning seems to fit the CALL-ER app1 features. Indeed,

[1]At present, the app has the provisional name CALL-ER, that identifies the project. The development of the final name under which the app will be launched will take place in the later stages of its design.

the main aim of its users will not be that of improving their Italian language skills. Rather, they will hopefully improve Italian in an incidental way, through new oral and written input linked to the places where they are spending a period of their lives. They will be enabled to create a bridge with other people who share the same cultural and social interests, with the aim of building a community of interest. Even if the project is at its initial stages, the main technological and educational features of the app have already been defined. The present research is mainly focused on the description of the challenges linked to the app contents' design: how can we produce good quality and interesting contents with the aims of promoting both touristic places and language incidental acquisition? Given that the download of the app will be free, such a potential heterogeneous and wide target group makes the app design even more challenging; in fact written and audiovisual contents will be available for elementary, advanced and Italian mothertongue participants.

Authoring and designing processes have been facilitated by an important previous experience gained in the Ilocalapp project.

2. Previous experiences

The design of CALL-ER benefits from the cooperation of a few previous projects in the field of technology, multilingualism and language education2. More precisely, the first research network was created in 2010 and it involved a highly international and interdisciplinary network in which social, linguistic, and cultural sciences interact with technology and engineering (Ceccherelli & Valva, 2016). This collaboration has enabled the realization of several European projects aimed at designing technological platforms and devices for the dissemination and learning of less widely spoken languages among which we mention the ILOCALAPP project, in which the UniON! app was developed (Ceccherelli et al., 2016). The project ILOCALAPP3, developed in the period 2015-2018 within the Erasmus+ Programme, Key 2-Strategic Partnerships in Higher Education, is the birthplace of the idea for the CALL-ER app. The evaluation of the Erasmus+ National Agency states "the APP, the main IO of the project, has a huge potential for transfer both at national and transnational level".

The UniON! app, with open-source code, is available for Android and Apple on Google and Apple store, with more than 500 downloads on googlestore only for the Italian version geolocalised in Bologna (Valva et al., 2018). It is a highly innovative solution for incidental

[2]We want to thank all the participants to the CALL-ER project, namely: Federico Garcea, Silvia Mirri, Daniele Negretti and Catia Prandi for the technological parts, Silvia Bernardini, Patrick Leech and Alessia Mariotti for the support in the content development.
[3]Cfr. Ilocalapp - http://www.ilocalapp.eu/ (Incidentally Learning Other Cultures and Languages through an App).

and context-aware learning of less widespread languages, among which, precisely, Italian in Bologna (Cervini, 2018).

CALL-ER takes up the principles at the basis of the design of the Union app (Cervini et al., 2016), orienting the redesign on the communicative, cultural and tourist needs of Forlì, one of the city of the UNIBO multicampus, aiming at a greater interactivity among users and at the valorization of places out of the classical tourist circuits.

3. The CALL-ER app

CALL-ER is a free mobile application for language and culture incidental learning. In order to offer the possibility to get acquainted with the local settings, it is equipped with geolocalisation and context-awareness functionalities, that provide the users with language, culture and practical information related to the city of Forlì and its surrounding areas. Most of the structure and the functionalities of the application is inspired by the ILOCALAPP project. The code used for its design is open source, so it can be reused also for the design of other similar apps.

The contents include both texts and multimedia (images, audio, videos), alongside with links to external resources. They are organized in six main categories, that branch out into several subcategories, containing texts and their related multimedia: 1) Places: culture (museums, historical places), nature (parks, sports, well-being), leisure and entertainment (theaters, music, cinema); 2) Itineraries: Rationalist route, Medieval route, Outside the classic routes, naturalistic route; 3) Events: festivals, fairs etc., divided by season; 4) University life: Studying at Unibo, libraries and meeting places; 5) Food & drink: Romagna's recipes, traditional restaurants and bars, students' favourite places; 6) Services: transportation, walking and cycling; health, housing, money and post office.

As can be seen, the content structure moves from very general topics, such as, Food & drink and so on, to more specific socio-cultural features that are strictly related to the local reality (e.g.: Food and drink > Romagna's recipes etc.). The choice of the general topics is based on retracing the habits of international students both in their daily-life as university students and also as young adults living a new life abroad. For this reason, both institutional places (university, libraries, public offices, etc.) and entertainment ones (cinemas, museums, pubs, etc.) are included.

In addition to these six categories, there are another two functions. The Word of the Day shows everyday a new word (or phrase), including the main vocabulary covered by the app and even some words in the local dialect that are more likely to be heard in everyday conversations, and an instant messaging system, which allows users to chat with each other and create a community.

In order to make sure that the contents of the Call-ER app would meet the requirements of its potential end-users, a participatory approach was adopted. In the early stage of the project it consisted in collecting the opinions and expectations of the potential end-users, i.e., mobility students in Forlì and some tourist organisations and associations involved in promoting the province of Forlì-Cesena, that may use it to make their services better known to the public.

Foreign students were subjected to an anonymous online questionnaire, whereas tourist organisations were given the choice between an anonymous questionnaire and a telephone interview4. The questionnaire for mobility students collected information about the cultural areas of interest, their linguistic difficulties encountered during their stay in Forlì, their knowledge of the territory and background information about the general usage of apps and mobile devices. Moreover, a specific section inquired into their possible appreciation of an application that combined language learning with the discovery of the city of Forlì and an open question for any additional reflections or advice.

To give an overall review of the answers, all the 21 participating students agreed on the need for a greater integration of international students into the Italian-speaking student community. The most desired features for an app that combines knowledge of the territory and learning Italian resulted to be the following ones: geo-localized itineraries with audio guides, photos and images, information in multiple languages and, above all, the opportunity to interact with a community in to turn to for help and support, as well as to make friends and practice Italian. Moreover, the answers also highlighted the need to focus not only on lexicon and phraseology related to daily life and tourism, but also to those situations in which the non-Italian-speakers interfaces with Languages for Specific Purposes, such as bureaucracy, health, rental agreements and so on.

The questionnaire for tourist organisations was mostly focused on how to promote the area of Forlì and their view of an application that combined both promoting the area and learning Italian. The answers obtained by 4 organisations showed the need to improve the promotion of the area, the current lack of adequate plans, events and advertising and a possible appreciation of an application combining tourism and language learning.

After having established the topic area of the main categories on the basis of the results of the questionnaire, the second stage consisted in re-examining the contents of the UniOn! app, in order to see if some of them could fit for the purposes of the CALL-ER app. This was the case, for example of the University Life category, in which a general overview on the University of Bologna, its services and some culture-bound concepts (like ‘ricevimento’ and

[4]We want to thank Enrica Romano, whose Master’s Degree thesis was focused on developing the questionnairs, interviewing the contact persons for the local tourist organisations and on analysing the collected data.

'buchetta') are also adequate to Forlì. Therefore, the texts were kept in their approximately original form and only a few edits were necessary to adapt the contents to the local context of Forlì and to update them with data related to the academic year 2020-2021. The same will be done for the contents related to public services, transports, etc.

Contrary to this, the contents related to places and itineraries have been written from scratch, since they are strictly related to Forlì and its surroundings. While choosing the places of the territory to be promoted through the app, the attention was focused on unusual places that do not fall within the traditional canons of tourist destinations but which are however peculiar to the area. For this reason, it was also taken into consideration the activity of two cultural associations, namely ATRIUM and Spazi Indecisi, with the former having the purpose to investigate and manage the "dissonant" architectural heritage of the totalitarian regimes of the 20th century, and the latter aiming at transforming urban abandoned places into a field of investigation and research for artists, architects, urban planners and so on. This phase of documentation, supported by the consultation of Lonely Planet and Touring Club guides, as well as tourist guides written by local experts, was integrated by the discussion within the research team on the results of the research.

On this basis, it was taken the decision to plan several routes (rationalist / medieval/ naturalistic routes and a special one, named 'Outside the classic routes'). Moreover, a notification system alerts the users when they are near places and activities of interest, showing different options (e.g., cultural places, typical restaurants, entertainment etc.). In this regard, the design of the app would be beneficial for all parties involved: the cultural activities of local authorities and associations would receive greater visibility, reaching the public of international students, with the latter having more opportunities to get to know their host city, its surroundings and traditions.

4. Creation of app contents

The creation of contents for incidental language learning through experiential tourism implies focusing on several aspects: the learning goals to be achieved, the promotion of the area, as well as the framework of the electronic devices on which the application, that runs on both Android and iOS devices, will be working.

As for the learning goals, one of the most challenging issues was the choice to produce contents that are addressed to the whole community, independently from the competence in the target language (i.e., to beginners as well as to more advanced students). This deeply influenced the writing strategies and led to the development of a series of guiding principles.

Firstly, each text will be marked with coloured icons to distinguish easy texts (green icon) from those of medium (yellow) or high difficulty (red). The icons may be perceived as

reading suggestions: it is up to the users to choose texts suitable for their language skills, or to challenge themselves with higher difficulty levels. This strategy is aimed at avoiding the users' demotivation or boredom.

Secondly, techniques for writing highly comprehensible texts have been applied. For example, the texts classified as easy or medium have short and coordinated sentences. Moreover, the lexicon was carefully chosen and composed mainly of high-frequency words. Less frequent words, such as idiomatic expressions or terms belonging to a specific domain (e.g., architecture, bureaucracy etc.) are usually followed by reformulations and/or synonyms, to enhance understanding and in some cases they are hyperlinked to the Word of the Day function. Moreover, the small screen of electronic devices was a key factor in planning short-length contents, ranging from 100 to 300 words.

Finally, a combination of different semiotic resources, such as moving /still image, speech and writing has been exploited to promote the development of integrated skills, to favour different cognitive styles and to create a more involving experience for users. At this point, a significant innovation compared the UniON! app is the integration of written texts with audiofiles containing additional information or short interviews to students and citizens. Moreover, some descriptions are given in oral texts only.

In order to stimulate curiosity, the menu allows for full accessibility of contents at the main category level. The user has the opportunity to start indifferently from any category and to take a look and choose whether to continue or switch to other categories and subcategories. However, in order to promote active participation into the learning process, users may access the first 1-2 texts (or just some paragraphs of a text) of a subcategory, then the subsequent contents would be bound to unlocking activities based on the concept of gaming, such as answering a question or performing an action, like uploading a picture etc. Alongside with gamification, there are also another two strategies to involve users, that represent a significant innovation compared the UniON! app. Firstly, the above mentioned instant messaging system (see § 3) will allow users to chat with each other, thus creating a community in which they can share experiences on the places they visited. Secondly, a periodic launch of thematic challenges (e.g., the most beautiful photo etc.) will hopefully stimulate the interest in visiting the area and accessing an increasing number of contents in the app.

5. Conclusion

In this paper we have described the development of the CALL-ER application. The results collected through the first round of questionnaires show that an app for the incidental learning of Italian through the promotion of the area of Forlì may interest both students and tourist organisations. A previous similar experience was successfully conducted with the app

UniON! designed for context-aware and incidental language learning of international students in Bologna in the period 2015-2018. Since that time, MALL and context-aware apps are increasingly widespread. The innovative sides of the new CALL-ER app lies above all in these three aspects: i) the chance to be part of an online community of students, where sharing comments, pictures, ideas on itineraries; ii) the representation in oral and written texts of a non-standard variety of the Italian language (the Romagnolo dialect), that students can daily listen in the streets or in the city's shops, but hardly found in dictionaries; iii) the introduction of some gamification features in order to increase motivation and to regulate the different stages of learning; iv) a more prominent focus on oral authentic inputs, either recording testimonies from international students and Forlì's citizens or linking on the app contents touristic ans cultural audio-videos.

From this point of view, using the app will be a win-win strategy both for language learning and tourism. It will hopefully enhance the creation of a network between university, local authorities and regional associations, for the promotion of cultural and educational activities outside the classroom.

Current limitations of the app include the fact that its design is still in its early stages. Therefore, it is not yet possible to describe in detail neither its different functionalities, nor users' activities in the app (e.g. outcome of gaming activities) and their opinions. Subequent stages of the questionnaire will be necessary to collect the users'opinions and to integrate any suggested changes in the the app, before its final release. Another interesting research future perspective concerns the observation of how informal contexts of learning (through the app) could mix with more formal contexts, such as at schools or during teachers-led activities. For example, will students feel like using the app for self-study too?

Further investigation will be needed in order to better understand the effects of mobile incidental learning through an app in language and/or culture learning. This will be the object of future developments within the project teams.

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Teaching English Pronunciation Online during the COVID-19 Crisis Outbreak

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Abstract

The abrupt emergence of the COVID-19 pandemic in spring 2020 forced tertiary professors to urgently adapt the face-to-face courses they were lecturing to emergency remote teaching. Researchers of different fields have started to investigate and share their thoughts on which are the best methodologies to guarantee a high-quality learning experience while coping with students' anxiety and teachers' lack of technical background. The present study examines the adaptation of an English pronunciation course at Rovira i Virgili university to the online setting imposed by the outbreak of the pandemic. The students who took the course were asked to fill in a satisfaction survey containing multiple choice, Likert scale and open questions on the different measures taken and the general progress of the course. Results show that students were higly satisfied with the adaptation of the course to the online context, and that the methods adopted and tools provided were useful and sufficient to continue with the adequate functioning of the course. Hence, this study is a sample of how to teach pronunciation remotely in particular, and how to successfully adapt a face-to-face university course to emergency remote teaching in general, guaranteeing students' learning and engagement.

Keywords: *Pronunciation teaching; emergency remote teaching; online learning; English as a foreign language teaching.*

1. Introduction

The outbreak of the COVID-19 pandemic has become one of the greatest defies of last-century tertiary professors worldwide. The sudden lockdown and the still existing preference towards telecommuting to battle the pandemic have obliged teachers to reconsider and redesign the courses they teach in record time so as to adapt to an unprecedent and imminent need for virtual education (Bao, 2020; Hodges et al, 2020; Moser, Wei & Brenner, 2021; Rahiem, 2020; Rapanta et al., 2020). Although the existence of emergency remote teaching, i.e. the temporary adaptation of traditional face-to-face courses to an online setting because of a crisis (Hodges et al, 2020) is not a new concept, its lack of anticipation due to the abrupt emergence of the COVID-19 pandemic forced teachers to change their teaching methods and approaches almost overnight (Rahiem, 2020). Indeed, a lack of initial technical support together with a scarce knowledge of desinging and facilitating successful learning experiences online have made of this adaptation to remote teaching a real challenge for many of them (Bao, 2020; Monser et al., 2021; Rapanta et al., 2020). As the duration of remote teaching due to COVID-19 remains unknown, the research community has thrown themselves into finding applicable solutions that guarantee high-quality learning experiences.

To the author's knowledge, no studies concerning the teaching of English pronunciation to nonnative speakers during the COVID-19 crisis outbreak have been published yet. Despite the fact that nowadays there are several free resources online that can help students improve their pronunciation in English (see Calvo Benzies, 2017; O-Brien et al., 2018; Walker, 2014 for a review), how their use and combination can guarantee prosperous pronunciation instruction in an emergency remote teaching context still needs to be studied. As a first approach to fill this gap, the current study aims at examining how successful the adaptation of an original face-to-face pronunciation course to an online setting was in order to cope with the COVID-19 pandemic crisis. To this end, the study attempts to address the following research question:

> R.Q. To what extent were the measures adopted to adapt the pronunciation course to an online setting satisfactory to guarantee an adequate learning process?

In order to give response to this question, a satisfaction survey was designed and sent to third-year English undergraduates taking a pronunciation course at Rovira i Virgili University (Tarragona, Spain) during the 2019-2020 academic year. Students were mainly enquired about the organization of the course and the teaching activities adopted. The questionnaire was made up of multiple choice, Likert scale and open questions that gathered information about their thoughts on different aspects related to the arrangements performed.

2. Methodology

2.1. Participants

From the 48 enrolled students, 16 participated in the study, 11 women and 5 men. Only 2 of the women were taking the course for the second time; for the rest of the participants it was their first time studying the subject. All of them were in their twenties (6 students were 20; 5 of them, 21; and 4 of them, 22), except for one of the women retaking the course who was 40. Regarding their nationalities, participants were mainly Spanish (10 students), but there were also students coming from other European countries (1 Birtish, 1 Irish and 1 Bulgarian), Arab countries (1 Moroccan, 1 Algerian), and South American countries (1 Peruvian). However, only the British woman was an Erasmus student who did not have a high command of either Spanish or Catalan; the rest of them were natives in one or the two languages, since they were either born or raised in Catalonia.

2.2. Adaptation of the course

Sound System II is a phonetics and phonology course aimed at learning how to transcribe in English and improving English undergraduates' pronunciation. Before taking this course, students have to take *Sound System I* during the first semester, where they start learning how to transcribe phonemes in English and practice how to produce vowel sounds. By contrast, *Sound System II* focuses on the practice and transcription of consonant allophones and suprasegmental features, such as rhythm and intonation. During the academic course 2019-2020, students took *Sound System I* entirely at university, while they could just take the first part of *Sound System II* in class, i.e. consonant instruction; the rest of the course, mainly concentrated on suprasegmentals, had to be taken from home due to the COVID-19 lockdown. At that time, no continuous assessment exams had already been taken, so the adaptation of the subject to an online setting implied facing important challenges as far as instruction and evaluation were concerned (see Table 1).

A mixture of synchronous and asynchronous teaching was adopted: Theory letures were substituted by weekly PowerPoint presentations on which the teacher recorded her explanations. Students were asked to watch and listen to the PowerPoint document during the week and ask questions or doubts through the Moodle's forum, where both the teacher and the students could participate in the discussion. Regarding practice sessions, the teacher recorded herself pronouncing the exercises out loud while providing tips to improve their pronunciation. Students had to watch the videos to practice for their recording submissions and the oral test. On the other hand, the teacher taught students to transcribe with their computers using a free online transcription tool called Type It (https://ipa.typeit.org/full/). Students were asked to transcribe a series of sentences and words every week and send it to the teacher before Friday: the teacher chose some of the exercises from different students and

recorded a PowerPoint presentation correcting them and explaining the different mistakes. On Friday, students were asked to watch the PowerPoint presentation and connect to an online meeting where students could ask the teacher about their doubts on both the practice and the theory they had worked on. Besides, during the online meetings the teacher provided support form them to keep up with the course and encourange them not to give up.

Table 1. Measures taken to adapt the course to an online setting.

	Theory	**Practice**	**Assessment**
In-person	Theory Lectures	Production and transcription exercises	3 written exams (T1: 20%; T2: 10%; T3: 15%) 1 oral test (15%) 10 recordings (25%) Attendance (5%) Participantion (10%) Passing grade: 60%
Online	Narrated PowerPoint presentations	Production: Videos Transcription: Online transcription keyboard; PowerPoint presentations	1 written exam (45%) 1 oral test (15%) 10 recordings (25%) Attendance (5%) Participantion (10%) Passing grade: 50%

Regarding the assessment, the original plan was maintained as much as possible, but some rearrangements had to be made: The three tests became just one final test that had to be taken online via a Moodle questionnaire so as to give students time to adapt to the new learning context. It included theory questions, analytical questions where students had to identify and explain transcription issues, and the transcription of a text using *Type It*; the oral test was carried out via videoconference; the recordings continued being submitted via Moodle on the original dates; the attendance grade was made up of their weekly interaction with the PowerPoint presentation, and their attendance to the online meetings; participation was assessed by the submission of the transcription exercises and their interaction in the forum. In addition, the passing grade was lowered to a 50% from its intial 60% to cope with the anxiety the setting changes were causing to the students and compensate their fast adaptation to use online tools they were not supposed to employ for the original course.

Table 2. Students' academic performance (%).

	Excellent	**Notable**	**Pass**	**Fail**	**Non-assessable**
SSII 19-20	4.35	21.73	36.95	13.04	23.91
SSII 18-19	1.72	12.07	39.66	32.76	13.79

As displayed in Table 2, the measures taken did not negatively affect the students' academic performance: Compared to the previous year, the number of students who took the continuous assessment and failed the couse dropped, and the number of learners who achieved an excellent or a notable grade rose. The number of students who did not follow the assessment increased a 10.15%, but only one student withdrew due to the pandemic.

2.3. Survey

The survey was designed using Google Forms and sent to the participants once the final grades were published via the message board of the course's Moodle space. Students were informed about the willingness to use the results of the questionnaire for research purposes and they participated voluntarily and anonymously. The survey consisted of eight different sections: background information, theory lectures, practice sessions, extra activities, exam training session, assessment of the course and general opinion on their experience with online learning. The four first questions were used to outline the participants' profile, while the others were examined to analyze their opinions on the virtual adaptation of the course.

On sections 2-5, students answered the same questions for the different measures adopted: a yes-no question about how satisfactory was the use of that element to adapt the course to the online setting; a 5-point Likert scale evaluating the usefulness of the element; and two more yes-no questions asking whether that measure was enough and whether there could have been better measures to be taken. Two open questions were also included so that students could justify their answers when they thought the item had not been a good option and recommend possible alternatives. On the other hand, sections 6-8 focused on the course assessment and the general learning process. Section 6 examined the additional supporting material: via yes-no and open questions, learners were enquired about whether they found the extra activities used motivating and they could suggest other activities to enhance motivation. On section 7 students had to answer several yes-no questions about the adaptation of the assessment and justify their answers. Finally, section 8 contained yes-no questions regarding technological difficulties they may have experienced and whether they felt demotivated and willing to drop out during the course, and two 5-point Likert scale questions on their global satisfaction on the course and its virtual adaptation.

3. Findings and discussion

As far as theory is concerned, all the ones polled found the narrated PowerPoint presentations a satisfactory tool to adapt the theory lectures to the online setting. As displayed in Table 3, they considered them higly helpful (M = 4.56; STD = 0.61). Although all of them thought these were enough to keep up with theory, two students suggested that it would have been useful to have some virtual classes to further explain some of the concepts tackled, or include exercises where the theory was applied to sharpen their reasoning skills.

Table 3. Means (*M*) and standard deviations (*STD*) of the 5-point* Likert scale question: "How helpful was the tool to keep learning from the course?" on sections 2-4.

Theory		**Practice**				**Doubt-Solving**							
Narrated PowerPoint Presentations		Transcription exercises		PowerPoint transcription correction		Weekly Online meetings		Moodle's Message board		Moodle's forum		Email communication	
M	*STD*	*M*	*STD*	*M*	*STD*	*M*	*STD*	*M*	*STD*	*M*	*STD*	*M*	*STD*
4.56	0.61	4.27	0.68	4.13	0.48	4.4	0.61	4.13	0.88	4	0.87	4.69	0.58

Regarding practice, 15 out of the 16 learners enquired considered that the transcription submissions were a suitable method to practice transcription. However, the one who did not agree explained: "I think they were, but the time to hand them in was not enough." Students had to submit their exercises by Thursday so that the teacher could prepare the PowerPoint presentation with the corrections for Friday morning. As students also had to work on other courses during the week, perhaps they would have appreciated to also have the weekend to complete the exercises. However, they still found them highly benefitial (M = 4.27; STD = 0.68). As for the PowerPoint presentations with the corrections of the transcriptions, all of them thought they were satisfactory and very helpful (M = 4.13; STD = 0.48).

Due to the general uncertaintity that the COVID-19 crisis caused, it was also important to evaluate the teacher-learner communication. All the students believed that the online meetings, the Moodle's message board and forum, and email correspondence were adequate tools to solve doubts and guarantee communication. As shown in Table 3, all the different measures had a mean of 4 or above, which means that students found these tools very useful. Although there was one student who answered there could have been better alternatives to solve doubts, that person did not specify which ones.

The exam training session was analyzed separately on section 5. An online meeting was conducted to explain the different parts the exam would contain, and practice the transcription of a text using the online keyboard. Although 15 out of 16 of the participants though it was a satisfactory tool to practice for the exam and a highly useful approach on average (M = 4.2; STD = 0.75[1]), some students thought that they would have liked to have another session and practice other exam exercises apart from transcription.

As for the the extra activities, the rhythm questionnaire was highly rated; it was not only considered motivating by 81.25% of the students, but 100% of the learners who answered

[1] 5-point Likert scale scale question (0 being "not at all", 5 being "very useful"): "How helpful was the exam training session to practice for the exam?"

the question also considered it a useful tool for self-assessment. When asked if they would like to have more extra activities like the ones used, 87.5% replied they would.

Regarding the course assessment, all the students considered that the evaluation of the course had been adapted successfully to the online situation. In addition, 15 out of 16 of the participants thought that the written exam met the requirements of the course and there were no better alternatives provided. The person who did not agree just said that there were better applications to carry out the meetings. However, the application to use was not chosen by the teacher, but provided by the institution.

When enquired about more general issues, 31.25% of the students claimed that they experienced technological problems. Some of them stated that their equipment was not powerful enough and had to buy a new computer, or that their Internet connection at home was limited. The same amount thought that online learning could have negatively affected their performance in the course: some of them explicitly said that they thought they learn more and they can retain more information in face-to-face sessions. In fact, 37.5% confessed that they felt demotivated and willing to drop out at some point during the course. Among the reasons, many of them claimed episodes of anxiety: "Sometimes I couldn't follow the course as much as I would in class because I experienced some bad weeks of anxiety and nerves due to lockdown;" "Because it was not easy to work from home with all the things happening. I felt like more pressure." However, 60-70% of the participants followed the course without suffering from either technological or emotional breakdowns. Besides, all the students were highly satisfied with the adaptation of the course to the online setting (M = 4.44; STD = 0.61) and the course itself (M = 4.34; STD = 0.7)[2].

4. Conclusion

Besides the fact that students' results showed a satisfactory academic performance despite remote learning, learners believed that the pronunciation course was successfully adapted to the demands of the situation: both theory and practice tools and methods were considered highly useful to keep up with the course in spite of the emotional distress caused by the abrupt emergence of the COVID-19 pandemic. According to the teacher, the success of the implementation of remote learning in this course might have been thanks to a willingness to balance both synchronous and asynchronous teaching and modifying just those aspects of the original teaching plan that were not doable online, trying to maintain its initial framework. In addition, students were taught how to use the new digital tools that they needed to continue with the normal progress of the subject and their needs and doubts were listened to, offering

[2] 5-point Likert scale scale questions (0 being "not at all", 5 being "very satisfied"): "How satisfactory was the adaptation of the course to an online setting?" "From a global perspective, how satisfied are you with this course?"

them support and solutions to their problems (Moser et al. 2021). However, as remote teaching will continue being the general rule during the 2020-2021 academic year, it would be interesting to study whether synchronous transcription practice is maneageable, especially for those courses where students have no previous knowledge on how to transcribe. On the other hand, some of the activities, tools and teaching methods adopted could still be used when resuming face-to-face lectures: for instance, students might still find video practice or pre-test review questionnaires helpful to practice on their own. Moreover, online tools could offer those students who cannot attend classes regularly due to labor or medical reasons the opportunity to follow the course remotely. This study, hence, should be seen as an initial roadmap for practitioners who now face the setbacks of teaching pronunciation remotely, and who will have to keep readjusting their methods to the digital transformation higher education is experiencing, which has come to stay.

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From *saying it right* to *doing it right*: a model of pragmatic competence development

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Abstract

This article discusses the need for the explicit pragmatic instruction and proposes a pentaphasic model of pragmatic competence development designed for leaners of different language backgrounds and social groups. The model includes five steps of free and guided analysis and production with specific goals and tasks. The aim of the model is to develop a student's agency as a leaner and to raise their metapragmatic awareness by guided discovery procedures, explicit discussions and self-assessment. It was tested on a group of Italian language learners in order to understand their motivational and cognitive demands when approaching speech act focused instruction. Although they were actively engaged into guided discussions, the learner-centred procedure and raising awareness activities prove to be unfamiliar for learners who are used to more traditional form-focused learning sessions. Despite these difficulties, the model provides a flexible framework that can bridge the gap between research considerations and teaching experiences.

Keywords: *Pragmatic awareness; sociopragmatic assessment; pragmalinguistic tools, pragmatic competence development.*

1. Introduction

It goes without saying that the communicative competence includes the ability to engage in conversational exchanges motivated by personal, career or educational aspirations. A large number of courses and textbooks offers goal-oriented samples of linguistic behaviour based on different communicative situations. However, it has already been explained elsewhere that the ability to interact effectively and appropriately in various communicative settings is challenging for teaching given the intrinsic variability of sociopragmatic tendencies. In fact, pragmatics as the study of how contextual factors interact with linguistic meaning (Sperber &Wilson, 2005) reinforces the need to analyse interactional principles and to recognise sociocultural and contextual variation when making conversational choices.

After a brief state of art, in this paper we are going to present a teaching model of pragmatic competence development which can be used with students of different language backgrounds and social groups. Finally, we will describe a pilot testing of the model with a group of Italian language learners followed by some preliminary results. We believe that the proposed model can be adopted for different speech act sets and can be integrated into a successful learning process.

2. Theoretical underpinnings of pragmatic teaching

To begin with, empirical and corpora-based studies, which stem from the contrastive tradition of cross-cultural pragmatics (Blum-Kulka et al. 1989), prove the existence of norms and standards of what is appropriate and acceptable in a certain socio-cultural context. Since one's native sociopragmatic habits are mostly taken for granted, the only exposure to the research data or to the L2 input is not always sufficient for a successful acquisition. In order to avoid pragmatic failures, misconceptions and misunderstandings, the guided instruction on functional aspects is highly recommended.

According to the noticing hypothesis of Schmidt (1993), the central place of pragmatic teaching is occupied by joint reflection on the link between linguistic form and pragmatic function needed for a specific communicative situation (Martinez-Flor & Usò-Juan, 2010). Moreover, the zone of proximal development of Vygotsky (1978) prompts a significant role of explicit instructions and guided discovery procedures in raising learners' awareness of a contextual variation and perlocutionary effects of pragmalinguistic choices (Alcon Soler & Martinez-Flor, 2008; Ishihara & Cohen, 2010; Tatsuki & Houck, 2010; Cohen, 2020). In such a way, both social and cognitive perspectives of the learner are exploited for a significant learning experience which can be delivered within a specifically designed teaching model.

3. Pentaphasic model of pragmatic competence development

After having analysed L2 acquisition models for pragmatic competence development (Olshtain & Cohen, 1991; Judd, 1999; Tatsuki & Houch, 2010) we decided to propose a new pentaphasic model for pragmatic teaching and learning (Trubnikova, Garofolin 2020). It can be used in a wide range of formal teaching settings and be adjusted to the needs of different age groups.

The aim of the model is to develop a student's agency as a leaner and to raise their metapragmatic awareness by guided discovery procedures, explicit discussions and self-assessment. Followed by the motivational boost, both reflection and production phases lead the learner to become a researcher of communication experiences while guided by both implicit (recasts and input enhancement) and explicit feedbacks of the teacher. The sociopragmatic assessment is at the core of the learning progress enhanced by the use of authentic materials only.

The model provides the guidelines for teachers who are welcomed to create and accommodate the tasks to the personal needs and characteristics of their students. The Table 1 specifies the goals of each phase and provides some examples of teaching techniques and tasks that can be used for each specific purpose.

Table 1. Penthaphasic model of pragmatic competence development

Phase	Goals	Tasks
1. Motivation	- Introduce and contextualise the topic; - activate existing knowledge; - anticipate the following steps.	Brainstorming, group discussion, concept cloud making.
2. Free analysis	- identify speech act sets and their functions; - analyse the context.	Matching, true or false questions, grid compilation.
3. Guided production	- put into practice pragmalinguistic recourses; - use different social variables.	Discourse completion task, role-making.
4. Guided analysis	- compose form and function mappings; - manipulate pragmatic variables (power, social distance, costs and benefits, rights and obligations); - carry out cross-cultural analysis.	Cloze, gap filling, grid compilation.
5. Free production	- produce extended speech units; - self-assess pragmatic appropriateness.	Role-play, notes taking of real life conversations.

4. Pilot testing of the model

In order to apply the designed model in a classroom setting, a group of non native Italian speakers was recruited for an interview on their learning experiences followed by an experimental speech act related lesson.

The students were four female Russian native speakers based in Italy, learners of Italian L2 at the Dante Alighieri Association courses being self-assessed at A2-B1 competence level. During the preliminary talk they admitted that they were never explicitly instructed on how to communicate appropriately and efficiently. They were also surprised that the proposed session was not form-based and we were not going to tackle any grammatical aspect. The last observation of one of the students was about a more traditional model of language teaching that she expected, with a central role of the teacher and explicit grammar rules explanations followed by drill exercises. Unfortunately, according to these comments, we can testify that a rigid grammar-translation method is still widely applied in the Russian academic setting the students are from.

The classroom talk during the lesson on the request speech act was recorded, transcribed and analysed in order to verify the following learners' aspects:

- socio-psychological dimension;
- cognitive dimension.

We are going to briefly illustrate them below.

4.1. Socio-psychological dimension

We can infer that the learners were little motivated to work with functional aspects of the language. In fact, they felt confident using a certain number of pragmalinguistic recourses such as conditional mood and modal verbs to convey a request. During the guided analysis they associated the highest rate of mitigation devices to "good manners" proving to be unaware of a strategic nature of politeness. Moreover, the learners felt uncomfortable during the raising awareness procedures as they claimed no need to tailor their requests for different settings and interlocutors ("I don't use all of these potreste at home with my husband").

4.2. Cognitive dimension

One of the difficulties a teacher might encounter while applying the guided discovery procedure is the need to reconcile their own expectations and experiences and the learners' attention and motivation towards functional features. For example, the learners don't seem to recognise the need to focus their attention on a speech act and prefer to fix grammatical aspects. However, the learners use compensation strategies and apply fixed unanalysed expressions that they just "heard somewhere" when it comes to interactional needs. In other words, pragmalinguistic means they use don't receive a sociopragmatic assessment. It's

needless to say that the reflection on interpretation keys and pragmatic strategies is a very delicate activity, especially because the memorization of fixed formulas is a more familiar cognitive task for this group of language learners.

However, metapragmatic reflection was triggered when unequal encounters were analysed. During the guided analysis the learners noticed that:

- Politeness marker of please is more frequent in Russian than in Italian;
- Modal verbs want and can are both modifiers of the illocutionary force;
- Request is often supported by external moves such as apologies or explanations.

We transcribed and translated from Italian the discussion that took place between the teacher (V.T.) and two learners (V. and A.) during the free analysis when the learners were asked to match an appropriate expression with a picture. The excerpt below is about a service encounter at the restaurant:

V.T. – You chose "Bring me a glass, come on"! So if the waiter doesn't bring you a glass, could you express your request this way?

V. – Yes, but it depends on the restaurant, here the restaurants are not so much restaurants, how could I say. I've been here once, so they are not as they are in Russia, where they are beautiful, there are lights, carpets, and here there was this huge table and that was it.

V.T. – So does it mean that if the setting is not posh you can express your request directly?

V. – Yes, because it's their job. And I heard that they can say it like that, bring me a glass, they are informal.

A. – Indeed, at the supermarket they say "give me 200 grams of ham", while I try to be polite and to say at least "please".

V.T. … ok, it seems though that this waiter is older than you are, would you say it in the same way?

V. – Ok, here I would say "could you bring", I'm an educated person, with elderly people I'm on formal terms.

First of all, we can notice the importance of physical setting ("it depends on the restaurant") and the exclusion of interpersonal considerations during social encounters ("it's their job"). Secondly, the sociolinguistic dimension ("with elderly people I am on formal terms") is more easily brought into discussion than pragmatic variables, such as face needs or cost and benefits considerations which were not mentioned here. Finally, a typical native speaker behaviour is stereotyped ("they are informal"), paving the way towards prejudice reinforcements and pragmatic failures.

Despite the lack of enthusiasm at the beginning, at the end of the session the learners were able to describe their pragmatic choices in strategic terms and expressed the need for explicit instructions on how to diversify their verbal behaviour.

5. Conclusion

As far as this particular classroom experiment is concerned, the leaners, previously exposed only to a traditional form-focused instruction, struggle to understand the usefulness of pragmatic awareness. Considering this drawback, the pentaphasic model of pragmatic competence development should be integrated with the grammar content delivery in order to gradually familiarise the students with interactional strategies.

We can conclude that the model can be applied in a classroom setting if preliminary interviews on learners' previous experiences and expectations are conducted. Although the utterances are judged mostly along formal and informal scale, it only proves the need to introduce more pragmatic variables through reflection procedures and raising awareness activities. We believe that the memorisation of unanalysed chunks and imitation of native like models should be abandoned in favour of the understanding of sociopragmatic principles and pragmalinguistic tools expansion. We also believe that the importance of cognitive and psychological aspects of learners is at the centre of the acquisition process, so the teaching sessions should be tailored to the motivational needs of students. Despite the difficulties that can be encountered, the model proves to be a flexible framework being able to bridge the gap between research considerations and teaching experiences.

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Social Systems in Higher Education: Collectivities and Technology

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Abstract

This study investigates the core concepts and views that underlie the theories of social systems as explained by four theorists. It critically assesses and analyzes the role of the higher education system within society, as well as the role of the educator within this social system as defined and articulated by Durkheim (1956), outlined and explained from a hierarchical perspective by Parsons (1951), identified as an integrative process by Bertalanffy (1968), and viewed as a web of relationships by Capra (1996). Major themes from each theorist are analyzed with respect to what role social systems play in higher education and how educators are affected by internal social subsystems and collectivities. An example is presented on how collectivities exist online and use technology to continue at a university during the COVID-19 pandemic.

Keywords: *Social systems; higher education; collectivities; technology; autopoiesis.*

1. Introduction

Synthesis of four seminal systems theorists is crucial to understanding the relationships between social systems and higher education institutions as they are formed and applied as collectivities. Comprehensive analysis of Durkheim's (1956), Parsons' (1951), Bertalanffy's (1968), and Capra's (1996) approaches to and explanations of social systems provides critical information about the role that a higher education institution plays within society as a whole, as well as the role that the educator fulfills within its academic community. In relation to the COVID-19 pandemic, the shift of social systems from in-person to online learning in the form of classes, meetings, and collaborative decision-making, the creation of groups or collectivities of professors and students have continued due to innovative technology.

2. Social Systems and Higher Education

Pondering, exploring, and examining in-depth the profound question of how life exists within a social system, and drawing from the perspectives of their specific disciplines, Durkheim (1956), Parsons (1951), Bertalanffy (1968), and Capra (1996) observed and recognized the need to understand life's underlying substance and form, which resulted in the development of their corresponding systems theories. Each theorist sought to identify the fundamental structures and patterns that comprise the network of systems visible within society. And, each theorist presented one or more pieces of crucial information that advanced the field of systems thinking. As systems thinkers, they understood the theory of social systems and its impact on education. In varying degrees and levels of comprehension, they articulated the role that the concepts of pattern, organization, wholeness, and relationships played within educational social systems, including academic collectivities. Higher education provides critical collectivies that have been established traditionally, such as in-person classes, seminars, and discussion groups that include professors and students. However, with the creation of online learning collectivities that have developed as a result of the pandemic, these traditional social structures are being reassessed within the context of innovative online learning technology such as livestreaming.

2.1. Theorists – Conscience Collective

Durkheim (1956) examined how the institution of education had influenced society. He introduced the concept of the group mind or "conscience collective" which viewed human minds as one holistic thought pattern (p. 8). Unlike Durkheim, Parsons (1951) focused on "institutionalized roles and the motivational processes organized about them" (p. vii). He observed how societal evolution had shaped social systems, their structures, and their functions, and argued that a social system required a written language in order to continue to evolve (1985, p. 69). Education fulfilled this important linguistic role in developing social systems. He applied the theory of functionalism in his explanation of his social system theory,

viewing society as an assembly of hierarchical systems, subsystems, and individuals who performed various functions. He, also, introduced the concept of "collectivities" which he defined as societies of individuals found within a social system (1951, p. 394). However, Parsons' approach was generally mechanistic and focused on the roles and functions of the parts within the hierarchy of a social system. His work included minimal discussion with regards to viewing the system as a whole rather than a collection of parts and how the interrelationships between these parts were critical in establishing the system's form or pattern. Yet, Parsons' work was an example of how the gradual shift from the mechanistic to the systems thinking approach began to occur during the twentieth century. "The shift from function to organization represented a shift from mechanistic to systemic thinking, because function was essentially a mechanistic concept" (Capra, 1996, p. 27). This paradigm shift was fundamentally advanced when Bertalanffy (1968) proposed his seminal model of "open systems" which defined and outlined a framework of organization common to all living systems (p. 43).

2.2. Theorists – Open Systems

Bertalanffy's (1968) "open systems" model created significant discussion within the disciplines of biology, psychology, and physics. His concept of *Unity through Diversity* was published in his two-volume book *Festschrift* (p. 8). He proposed that living systems dynamically exchanged materials and resources between their internal and external environments. His theory also considered the interchange that occurred between other systems, suggesting that a system maintained a constant "steady state" within its boundaries by using these continual exchanges to support the integrity of the system. Without these exchanges, the system would become stagnant and compromise its ability to exist. His "open systems" view countered the "closed" systems view that was currently held by physicists who believed that a system functioned independently of others and was in a state of equilibrium where no dynamic exchanges occurred. Bertalanffy argued that living systems must remain open to actively receive materials or they would potentially expire. University online learning classes or collectivities of students and professors are an example of Bertalanffy's open system model, which allows for participants to exchange knowledge and information as a collective whole. Professors and students establish an online framework for the class by using learning technology (e.g. e-Class) that offers visual and verbal cues for learning, discussion, and social connection. The exchange of knowledge, the establishment of a learning framework using online learning technology, and the social connection provided through livestreaming can be applied to maintain a constant steady state within the boundaries of the online course.

2.3. Theorists – Ecosystems

More recently, however, Capra (1996) added to this knowledge base by describing life systems as a web or network of interrelated "relationships." He viewed communities and societies as "ecosystems," which to the author were similar to what Parsons (1951) defined as "collectivities," a compilation of societies within a social system (p. 394). However, dissimilar to Parsons' focus on function and structure, Capra emphasized the importance of understanding the substance and form of a social system by examining the comprehensive integration of its parts and the interrelationships between them. "The behavior of every living member of the ecosystem depended on the behavior of many others. The success of the whole community depended on the success of its individual members, while the success of each member depended on the success of the community as a whole" (p. 298). He presented the concept of "deep ecology" which meant that all communities as social systems needed to follow the basic principles of ecology so that they could realign their system values within them—interdependence, recycling, partnership, flexibility, and diversity (p. 304). Higher education institutions epitomize deep ecology in their structure and form. Online learning technology has provided innovative methods and approaches to support the deep ecology of collectivities within universities by enabling classes, student groups, university wide decision councils, and symposiums to continue within the structure and form of these social systems with the aim of minimizing the disruption to these academic communities.

3. Educator's Role in the Higher Education Social System - Collectivities

The educator's role in the higher education social system is critical to the success of a university and fulfills an important part of this holistic system. What effect does the social system of a university have on the educator's role? How critical is the educator's role in sustaining the steady state of relationships that exist within and outside of the social systems and subsystems of a university? How has innovative online technology supported these systems, as university professors are being faced with shifting and rethinking their approaches to virtual teaching, learning, and decision-making situations as a result of the pandemic?

3.1. University Open Social System

The university social system is essentially an open system, exchanging knowledge, materials, and resources within its boundaries and sharing this information with those social systems located within external communities. Within this system, educators act both individually and collectively to respond to the demands of research, teaching, and service workloads, and to establish interrelationships with local groups. The interchange of information between the university and the external community is one example of what identifies it as an open system and which also allows for the educator's role to become a critical part of the university social

system. As a result of this exchange, the educator is able to fulfill both the self-orientation and collectivity-orientation needs within the university. For example, two or more individual educators are required to form groups or "collectivities" (Parsons, 1951, p. 142) within a university. Assembling a critical mass of educators who are experts in their field would create a foundational collectivity where their wisdom could be applied when discussing the university's internal and external institutional challenges. This type of collectivity would comprise discipline-based specialists who would contribute their specialized knowledge to assist in resolving issues. However, it is important to note that while they are restricted in their contributions relative to the questions allowed by their disciplines, any involvement in solving an issue would be viewed as a gesture of collaboration and cooperation.

3.2. University Collectivities

While Parsons (1951) did not discuss whether this type of *collectivity* was closed or open in its form and substance, Bertalanffy (1968) would have argued that it was an open system, even though it may have appeared to be a closed system based on the fact that its internal social structure or hierarchy consisted of all university professors deriving from only one sector of society. Closer inspection of this collectivity would have revealed that there was a dynamic exchange of information and resources between the university professors who strove to maintain a steady state while completing their work. Hence, an open system may not always be obvious or evident to external viewers, especially if it is based on minimal knowledge about the collectivity's activities. However, the existence of this type of collectivity could potentially be in jeopardy at some stage, because of the lack of external resources accessible to its growth and success. To remedy this situation, the collectivity could also include individuals who were external to the university's social system, such as professional engineers, medical doctors, or artists who could contribute to the solution of the problem. The constant influx of professional experts from various disciplines would provide a steady state of new knowledge and perspectives from which the collectivity would use to support its long-term continued existence within the social system of a higher education institution. As a result of combining these two groups of authorities within society, problems would be approached from a broader spectrum of knowledge, allowing educators as participants of the university social system to achieve solutions from a holistic perspective. An academic symposium, conference, or special interest group are examples of how university professors collectively gather to exchange their knowledge, information, experience, and connections with other academics (local, national, international), and with community groups such as charitable organizations, artists, businesses, governments (e.g. UNESCO).

3.3. University Collectivity of Professors

In addition to these external individuals providing a constant input of resources, the university *collectivity of professors* could improve the flow of information and materials by soliciting feedback from the greater external community. Additional resources from various other collectivities within the broader community would provide sources of knowledge and practical experience that could potentially influence the decision-making processes of an educator both as a professor in the classroom and as a member of a committee. Any information that was not relevant to the collectivity and its decisions would be accepted or rejected based on the collectivity's needs. Depending on the type of problem that required a solution, potential examples of greater external collectivities would include the chamber of commerce, police stations, financial institutions, medical clinics, education board of trustees, theatrical companies, and ecological organizations. As an open social system, the collectivity of university professors would maintain their presence both within the university as well as in the professional and greater external communities. If Parsons (1951) viewed education as a series of collectivities supported by hierarchical levels, and Bertalanffy (1968) viewed higher education as being integrative and open in its exchange of information and resources, how did Capra (1996) view a university's social system and its effect on the educator's role?

3.4. University as an Organized Whole - Autopoiesis

Capra (1996) argued that humankind needed to reconnect with the other communities that comprise the web of life. Similar to Bertalanffy's (1968) concept of a "steady state," Capra recognized that the importance of creating and maintaining sustainable communities was critical to developing hierarchy and organization within social systems. His idea of the collective human spirit as being one part of the whole within a societal collectivity coincided with Durkheim's (1956) concept of the "conscience collective." Based on his concept, Durkheim's perspective on education was that of a "system of ideas, sentiments and tendencies which express in us, not our personality, but the group or different groups of which we are part" (p. 29).

Hence, is it possible for a university to achieve a "steady state," "an organized whole," or an established "ecosystem" within its social system boundaries? The concept of deep ecology is the embodiment of a systems theory where a university social system could achieve its numerous goals at many levels. If the university stakeholders were willing to understand, accept, and implement this concept within a higher education environment, then Parsons' (1951) concepts of universalism-particularism and institutional types, and Bertalanffy's (1968) open systems theory would be integrated into what Capra describes as a "web of life," the "whole," and the "ecological worldview" approaches to systems. "Autopoiesis" is one such view that has been presented which explains how the substance (matter, structure, quantity) and form (pattern, order, quality) of an object are considered as a combined system

rather than ones that are separate. Capra (1996) agreed with Maturana's and Varela's concept of autopoiesis, or "self-making" which made "it possible to integrate structure-oriented models of self-organization" (as cited in Capra, p. 99). As a result of this concept, both mechanistic and systems thinking approaches to living systems were combined, bridging the chasm that had existed between these two systems approaches. Capra further explained that the organization of a living system was based on the relationships between the components that identified it within a general class (e.g. committee). The structure of a living system was based on the relationships between the components that it constituted which defined the specific type or kind of organization within this class (e.g., Curriculum, Sustainability, Student Success). Therefore, the organization of a living system was supported by all of the components that were found internally and that were continually being replenished by new resources from the external environment. Bertalanffy's (1968) open systems theory supported this concept.

In relation to higher education, the concept of autopoiesis can be applied in several ways and at various levels of a university's organization. A university is self-making in that its overall organization is sustained by a general pattern of internal collectivities and communities of educators that are present within its academic social system. The descriptions of the relations between these groups are fundamental to maintaining the university's organizational form. For example, in order for a university to function, it must include a general set of relations that meet the criteria of what constitutes a university. The required collectivities and academic social communities located within a university create the general organization of an academic social system. Therefore, collectivities such as the finance, registrar, and academic affairs departments, and academic communities such as the faculty association, curriculum committees, and general faculties council are the general descriptions of classes located within the social system of a university. The relations between these classes create the organization of the university. The structure of a university is developed through the relationships that are found within these classes or departments. As an example, the Registrar department constitutes many components within its class boundaries: staff members, administration, information technology, academic policy, tuition fees, and integrity officer. The relations between each of these components constitute the substance or structure of a university.

Autopoiesis is also evident in the increasing number of programs that have arisen within universities that address integrative education. Programs such as Women's Integrative Studies, and Communications Interdisciplinary Studies are self-making and self-regulating in that they offer comprehensive discourse and integrative teaching that reach into the combined disciplines, providing flexibility throughout the program of study. This deep ecological approach to education supports Capra's (1996) web of life concept where networks within networks of knowledge are leveraged to sustain the insatiable curiosity of

researchers, educators, and students engaged in learning (p. 99). The in-depth overlapping of information, experience, and wisdom creates a multi-layered and multifaceted understanding that is based on the whole.

3.5. Establishing an Online University Collectivity–International Education Departmemt

MacEwan University's International Education department is mandated with establishing connections with other universities globally by signing a memorandum of understanding (MOU) with universities that have similar programming so that student exchange, faculty visiting scholars, and international research projects are created. Prior to the COVID-19 pandemic, students and faculty travelled abroad to participate in these teaching, learning, and research opportunities. However, the travel and health restrictions in many countries have limited and/or closed these opportunities of collaboration between the professor and student collectivies that would otherwise occur in-person. In many situations, these exchanges have continued due to the innovative technology that is available for students to continue to learn and interact with students and professors from other countries and cultures. Livestreaming lectures and discussion groups have enabled students and professors to continue crosscultural sharing of knowledge. While this learning does not replace the in-person experience of a culture, the technology has provided the two collectivities (students and professors), as well as the two universities participating in the MOU to continue their exchange of knowledge as an open social system.

4. Conclusion

While the analysis of Durkheim's (1956), Parsons' (1951), Bertalanffy's (1968), and Capra's (1996) theories, philosophies, and concepts of systems thinking has revealed similarities and differences in their approaches, all four theorists added their knowledge and insight to how social systems, higher education, and educators are interrelated. The social system and subsystems of a university are a complex set of relationships that support the dynamics between the systems and the educators who perform within these systems. Each relationship, individual or group, assists in establishing the patterns that constitute a university's social system. The university contains a plethora of collectivities or ecosystems that support this dynamic exchange between its internal and external form and substance, each interdependent in its role. The roles of higher education and the educator continue to affect the conditions within their own and other social systems. As such, systems thinkers will continue to research the complexities of social systems and higher education and their enduring relationships.

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Analogy-based Instruction for Effective Teaching of Abstract Concepts in Computer Science

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Abstract

In the analogy-based learning method we map a concept that is being learned to a well-understood concept. An analogy is mainly useful when learners lack prior knowledge of the topic being learned. Computer Science (CS) is a subject whose concepts tend to be highly abstract and therefore difficult for undergraduate students to understand. Analogy-based instruction can greatly reduce a student's burden of learning these abstract CS concepts. Role of analogy in teaching CS topics has not been adequately explored. In this paper we discuss analogy-based instruction in computer science and its advantages. Over the last decade we have developed analogies for a large number of difficult CS concepts and extensively used them in the classroom at our institution. We list these analogies and as an illustration discuss one of them (from the subfield of operating systems) in detail. We also present the evaluation of our analogy-based instruction method. Our results indicate that our techniques are quite effective in improving student learning outcomes.

Keywords: *Analogy-based instruction; CS; improving learning outcomes.*

1. Introduction

Teaching Computer Science (CS) concepts effectively to undergraduate students is a challenging task. Students find CS concepts hard to understand for two primary reasons: (i) most students are not exposed to CS concepts during their pre-university education. Even if they learn to program in high school, they will not be exposed to concepts such as how an operating system works; (ii) most CS concepts are quite abstract, as almost everything is based on interpretation of data expressed in bits and bytes; students are not used to this type of abstract representations and thinking. In this paper we outline our efforts in communicating abstract CS concepts to undergraduate students in an effective manner based on use of analogies. We have employed analogy-based instruction in the classroom now for more than a decade for teaching a large number of core CS concepts. Analogy based teaching maps abstract CS concepts (target concept) to concrete everyday concepts known to students (base concept), resulting in better understanding of the target concepts.

Analogies play a major role in "problem solving, decision making, argumentation, perception, generalization, creativity, invention, emotion, prediction, explanation, conceptualization and communication" (Wikipedia Contributors 2021). Our focus is on using analogies for effectively communicating information pertaining to CS concepts. Analogy-based teaching has been proposed for communicating complex concepts in the past (Gentner 1983, Gentner & Colhoun 2010, Hofstadter 2001). Our analogies for CS concepts follow the tenets of structure mapping theory (Gentner 1983). The structure mapping theory describes psychological processes involved in learning from analogies. The theory describes how familiar knowledge about a base domain can be used to understand a less familiar or an unfamiliar idea in the target domain. A domain consists of objects, their properties, relationship and interaction between the objects, and properties of those interactions. Analogical reasoning then involves recognizing similar structure between the target and the base domains. The closer the correspondence between the domains, the stronger the analogy. For example, one can understand the flow of electrical current by mapping it to flow of water where electric current corresponds to water, pressure differential (that causes water flow) to potential difference (that causes electric current flow), narrowing of a pipe to increased resistance, etc.

With the structure alignment theory in mind, we have designed a large number of analogies for advanced CS subject in the last 10+ years. We have observed that these analogies resulted in improved student learning outcomes. In particular, we have developed detailed analogies for these nine key advanced topics in CS: (i) Pipelining and Parallel Processing in Advanced Computer Architecture (ii) Process states in Operating Systems; (iii) Virtual Memory in OS; (iv) Chomsky's Hierarchy in Automata Theory; (v) Asymptotic Notations in Design and Analysis of Algorithms; (vi) Lists, list processing and stacks in data structures (vii) almost all topics of Software engineering; (viii) Design of CPU, Control Unit, and Cache in

Computer Architecture; (ix) Macros, Compilers, OS in Systems Programming. In this paper, we describe one of the analogies in detail. Analogy based instruction leads to better learning outcomes as students now learn by building upon their existing knowledge of everyday life. Our own extensive experience in the classroom bears this out.

2. Analogy-based Instruction in CS

Teaching CS concepts to undergraduate students is a difficult task. A major problem is that most students are unfamiliar with these concepts as they have not been exposed to them prior to attending a University. Even if they have taken programming courses in high school, they would have not been exposed to CS concepts such as those related to operating systems, compilers, computer architecture, etc. Most of the students encounter these concepts for the first time when they take CS courses as part of their undergraduate curriculum. Good examples of such hard-to-understand concepts are the notion of process and process scheduling in operating systems, cache memory and memory hierarchy in computer architecture, and the Chomsky hierarchy in automata theory. Most CS concepts tend to be rather abstract in nature, making them even harder for students to understand when they encounter them for the first time. A good pedagogical technique is to *teach students by building upon what they already know*. Due to abstract nature of CS concepts, teaching them by building upon what students already know becomes quite challenging, as their knowledge of advanced CS is minimal.

Research indicates that illustrating abstract concepts through concrete representations and drawing direct connections between them helps students understand abstract concepts better. If purely abstract terms are used, then students have difficulty in fully grasping the concept. At the same time, teaching a new concept in an exclusively concrete manner limits a student's ability to generalize and apply the concept in other contexts. In CS, most of the concepts are themselves quite abstract to begin with as they are represented using bits and bytes (for example, the concept of a process in operating systems). There is really no concrete version of these concepts. Concretization of CS concepts, hence, can *only be achieved by resorting to analogies*. Thus, the difficulties in communicating CS concepts to undergraduate CS students can be mitigated by employing an approach based on using analogies. These analogies employ everyday concepts that students are already familiar with and that they can easily relate to. The benefit of using analogies is well established (Gentner 1983, Hofstadter 2001, Gentner and Calhoun 2010). Use of analogies for teaching CS concepts has two benefits: (i) Abstract concepts become concretized, making it easier for students to understand them. Since in CS, even concrete concepts are quite abstract, resorting to analogies that map these abstract concepts to concrete concepts in other areas greatly helps in achieving better learning outcomes. Research indicates that understanding abstract concepts directly is significantly harder (Newby & Stepic 1987). (ii) Analogy based teaching

reinforces the principle of pedagogy that says that a new concept should be taught by building upon the foundation of existing knowledge that the student possesses. The abstract concept's analogy to an everyday concrete concept indeed allows students to understand new concepts more easily by building upon existing knowledge.

3. Related Work

Analogical reasoning plays an outsized role in everyday life: in teaching, communication, and in research (Bertha 2019, Wikipedia contributors 2021). In the classroom, analogical reasoning can be a catalyst for achieving excellent learning outcomes, yet it has not been widely employed in CS education. Gentner (Gentner 1983) has developed the structure mapping theory to describe the processes involved in analogical reasoning. Our analogies are based on this structural mapping theory. Glynn (Glynn 1994) has developed a theory of teaching with analogies and developed six-step process of teaching with this method. The analogies we have designed for CS concepts also conform to Glynn's methodology. We have made elaborate efforts to ensure that our analogies works for minutest of details and do not break down. Gadgil and Nokes (Gadgil and Nokes 2009) showed that analogy supports collaborative learning, especially when conceptual understanding is essential. Ruef (Ruef 2011) developed a method of teaching that uses analogies in the classroom to explain topics. In this methodology, one always considers the question, "what does this topic remind you of?" The program is designed to build critical thinking skills through analogies. This method is applicable to simpler topics, perhaps at the grade school and middle school level, and hard to use for CS topics.

We next illustrate a detailed analogy for the concept of process scheduling in operating systems. Here we attempt to explain to the students how processes are scheduled on a CPU. The scheduling process is quite complex, as it involves the secondary memory (disk), the main memory, and the CPU. There is a short-term scheduler and a long-term scheduler, both of which work in tandem to produce optimal results. The concept of a process itself is quite abstract for beginning students to understand, and their difficulty in understanding is further compounded by having to deal with the scheduling of these processes for execution on the CPU. Details of process scheduling can be found in any Operating Systems textbook.

4. Concept of Processes and Process Scheduling

First, we explain the concept of process scheduling in Operating Systems. A program in secondary memory is in a sleeping state, until activated by the user or by the system when it changes to a process. At a given moment all the activated programs (which are now processes) are scheduled by the long-term scheduler which forms a job queue. Some processes of the job queue are scheduled by long-term scheduler to be residing in main

memory and this results into a ready queue (they wait in ready queue for their turn, they are scheduled by short-term scheduler and CPU is allocated to them). As processes are generated, a PCB (Process Control Block) is created for them. A PCB has (a) process state (b) Program counter (c) CPU registers (d) CPU scheduling information (e) Memory management information (f) Accounting Information (g) I/O status information.

A short term scheduler picks one of the processes from the ready queue and allocates the CPU to it. Which process will be selected is based on the job scheduling algorithm (FIFO, Round robin, Priority selection, Shortest job first). This process is executed by CPU till either this process is interrupted by OS, I/O occurs for the process, or the process terminates. Process may carry out I/O bound activities and its state, flag register and other register values are saved in PCB. Next process is scheduled by short-term scheduler and CPU starts executing this process. This process may either be I/O bound or is fully executed by CPU and terminates. Once the I/O for the process finishes, process comes back in the ready queue and is once again in contention for CPU. The processes which are interrupted by the OS are also waiting in the ready queue. Some processes are partially executed, (due to long duration of I/O) they are swapped out of the RAM to the hard disk and are out of active contention of the CPU (no more in ready queue). These processes are scheduled for a later time when they will be again brought into memory; their execution continues from where it was interrupted. Scheduling of these processes is performed by medium term scheduler.

Switching the CPU to another process requires saving the state of old process and loading the state for the new process. This task is known as context switching. The context of a process is available in the PCB of a process, it includes the value of the CPU registers and the process state. When a context switch occurs, the kernel saves the context of the old process in PCB and loads the saved context of the new process scheduled to run. Context switching is a pure overhead because the CPU does not do any useful work while switching. If a process after moving through various states is over, it exits the system and is available in the hard disk with some new generated results.

We next give an analogy to CPU process scheduling using the example of a hospital. There is a close (one-one) mapping between various attributes of the two domains.

4.1. Analogy for Process Scheduling

A hard disk is like a residential colony in which we have people living in villas or in building flats. Each normal person is like a program. When he/she becomes ill due to some disease he changes to a patient (process). All such patients call the hospital (O.S.) and a manager at front desk (long-term scheduler) schedules these patients and creates a list of patients (job queue). Also, for each patient a file (PCB) is created which contains patient id (process id) patient state (new, suspended, waiting), patient's appointment time with doctor (program counter)

his previous illness history (data in registers), his current medical state, and some current medication (data in open files). The doctor corresponds to the CPU, the long-term scheduler corresponds to the front-desk person, and the short-term scheduler corresponds to a nurse.

The front desk manager (long-term scheduler) schedules a few patients (processes) to come and wait in hospital lobby (list of such patients forms the ready queue). Number of patients called in a specific session (morning or evening) who wait in hospital lobby for their turn depends upon how many patients will the attending doctors examine in a session (degree of multiprogramming). These patients, who are waiting to be scheduled to enter the doctor's chamber, are scheduled by a nurse (short-term scheduler) who has her own criteria (FIFO, priority basis, shortest job first, round robin) for letting the patient enter the doctor's (CPU) chamber. A patient enters the doctor's chamber and is being questioned and examined (CPU executing the process, process in running state). Doctor (CPU) with the help of previous medical history in patient's file (PCB) examines the patient (process in running state). While doctor is examining, some emergency patient (high priority process) or a senior doctor calls this doctor (O.S. interrupts), then the current patient is asked to go back and wait in lobby (process interrupted) and he/she will be called back once the doctor has attended the emergency patient (high priority process) or attended the call of senior doctor's call (O.S. generated system call).

The doctor after examining the patient, asks him to gets certain tests done, e.g., blood test, sugar test, etc., and come back with the test results. These tests are done in various rooms of the hospital (I/O taking place). Other patients are also waiting in these I/O queues, their files (PCB's) arranged in a sequential manner (linked lists of PCB's); patient waits for his/her test to be over and waits for its report (I/O gets completed or I/O event takes place). Patient goes back to the ready queue and waits for his/her turn to meet doctor (process which was interrupted will get executed for the remaining leftover part of process). Short-term scheduler keeps track of the processes, whether they are new or they are ones referred for tests, and schedules them accordingly. Those who went for tests are given priority over new patients.

For certain patients, the doctor prescribes some tests for which the reports may be available after some days (an I/O event which takes a long time to execute) in such a case the patient (process) is asked to get his test done, go back home (process gets swapped back to the hard disk, freeing the RAM for other processes to come in) and come back once his reports are available with him. This patient is scheduled by a junior doctor or a manager at hospital to come back on the day when his reports are available (I/O process is over or a called subroutine is done), this junior doctor (medium term scheduler that performs a task called swapping back) keeps track of such patients (processes incomplete and swapped back to hard disk) as to when they are scheduled to come back to hospital and get examined

Whenever the doctor is being interrupted by an emergency call from the emergency department, the patient who was being attended by the doctor is temporarily suspended (context switching takes place) and asked to once again wait in the ready queue. Such a patient's file is updated (contents of Process control Block are saved) and removed from the doctors desk for the time being by a nurse or a junior doctor. A new file of the emergency patient is opened up for the doctor (the new processes PCB is opened up) and the doctor starts attending this new patient (this new process is now being executed). Temporarily closing the old file (saving old PCB) and opening up of new file (opening new PCB) in front of the doctor are the activities that are performed by the junior doctor or nurse (kernel of OS) whenever an emergency patient comes to hospital (an interrupt or system call occurs; these are the activities performed by OS during context switching of processes).

As one can notice, the analogy between OS process scheduling and patient scheduling in hospital is extremely close. It greatly helps in understanding the topic, as students are much more familiar with the latter. Unfortunately, due to lack of space, we are not able to include figures that visually show the close correspondence between the two concepts.

4.2. Evaluation

The first author has been teaching CS concepts using analogy-based methods for the last 10+ years. In fact, the various analogies mentioned earlier have been developed, through considerable investment of effort, once the benefit of teaching CS students via analogies was realized. We invested effort in developing analogies that were realistic and structurally strongly aligned. These analogies have been refined over a number of years. Our observation and evaluation confirm that analogy based instruction produces excellent learning outcomes. Students prefer to register for classes of instructors who use analogies.

We have evaluated our analogy-based teaching methods through feedback from students. We sent a questionnaire to all 60 students who were taught operating systems course in autumn of 2020 at our institution. These students are now seniors (final year students), and will graduate in spring of 2021, and thus are free to speak their minds. Two major concepts in this course were taught using analogies: (i) process scheduling (described earlier) and (ii) virtual memory & memory hierarchy. The questions asked were as follows:

1. Q1: The doctor's office analogy helped you understand the topic of "Processes" better.
2. Q2: The library analogy helped you to understand "Virtual Memory" topic better.
3. Q3: You found topics for which an analogy was given easier to understand.
4. Q4: You found topics for which an analogy was NOT used, harder to understand.
5. Q5: You would like all topics in CS to be taught by giving concrete analogies.

Table 1: Summary of Student Responses.

	Q1	Q2	Q3	Q4	Q5
Mean	4.9	4.5	4.4	3.6	4.5
Median	5	5	4	3	5
Mode	5	5	4	3	5

Response were designed in the Likert scale (Strongly Disagree = 1, Disagree = 2, Neutral = 3, Agree = 4, Strongly Agree = 5). 32 responses were received. Table 1 shows the mean, median and mode for the five questions. Clearly, students found analogies from everyday life for teaching advanced CS concepts (processes & virtual memory) to be quite useful for understanding (Q1 and Q2). Students showed clear preference for analogy-based instruction (Q3, Q5). These results are consistent with student feedback, who expressed considerable appreciation for being able to understand a complex topic taught via an analogy.

5. Conclusions and Future Work

We reported on our experience teaching advanced CS concepts using analogies. We listed the analogies that we have developed and used over the last 10+ years for teaching core CS concepts. Our qualitative and quantitative evaluations show excellent results with respect to learning outcomes achieved. We plan to continue developing analogies for more core topics, as well as refine the ones that we have already developed. We plan to publish a compendium of these analogies. We would also like to quantitatively establish that analogy-based instruction leads to improved learning outcomes. Thus, in the future we plan to perform more extensive evaluation based on giving exams and having a control group where analogy-based instruction will not be used (though we will re-teach those CS topics to the control group again using analogies, to ensure that they do not miss out on the benefits of analogies).

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Promoting Intergenerational Engagement Within the College Classroom: Faculty Training Needs

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Abstract

Institutions of higher education are increasing efforts to focus on ways to meet the growing needs of older adult learners. Many institutions are addressing these needs by joining the Age-Friendly University (AFU) Global Network. Affiliated institutions are required to promote intergenerational learning to facilitate the reciprocal sharing of expertise between learners of all ages. However, these institutions will need to provide instructors with the training to ensure that intergenerational engagement is being actively fostered. In this study, we examine the perspectives of faculty members who have opened their classrooms to older adult auditors. The research question was: What types of training do faculty recommend to promote intergenerational engagement in the classroom? In-depth face to face interviews were conducted with 27 faculty members. Qualitative content analysis of the data yielded the following four themes: 1) Provide accessible training to teach faculty their role 2) Educate faculty about the importance of becoming aware of generational time periods/context 3) Learn to approach auditors with a mindset that they are adults and have had careers/experiences, and 4) Train faculty on how to foster discussion. These findings show a need for training focusing on intergenerational curricular and multigenerational classroom management.

Keywords: *Intergenerational learning; multigenerational learning; engagement; faculty training; Age-Friendly University; in-depth interviews.*

1. Introduction

Institutions of higher education are increasing efforts to focus on ways to meet the growing needs of older adult learners within their respective communities. Colleges and universities are not only poised to create and foster opportunities for continued learning and engagement, career training, and community service for this aging demographic, but for traditionally-aged students as well (Montepare, 2019). Enhancing students' levels of aging literacy and improving attitudes toward aging are issues of great importance as people continue to live and work longer than ever (Whitborne & Montepare, 2017). One way of doing this is by promoting intergenerational learning in multigenerational classrooms.

Growing numbers of colleges and universities are formalizing their commitment to address these needs by joining the Age-Friendly University (AFU) Global Network. This initiative presents a series of ten principles designed to help higher education institutions develop more age-friendly programs and policies (Dublin City University, 2020 ; O'Kelly; 2015).

Principle Four for the AFU initiative calls for the promotion of intergenerational learning to facilitate the reciprocal sharing of expertise between learners of all ages. This type of learning can be generally described as methods to promote meaningful exchanges of information, perspectives, and learning opportunities between members of older and younger generations. More specifically, Sanchez and Kaplan (2014) define intergenerational learning as "learning between generations stemming from an awareness of differences amassed through individual and group affiliation to diverse generational positions" (p. 475). These authors clarify that 'multigenerational' classrooms are those learning environments in which there are learners from more than one generation present. However, intergenerational learning is specific to the exchanges or interactions between the generations. This point is critical to the success of Principle Four as the course instructor and respective pedagogy of the course have significant influence on the opportunities, promotion, and support of intergenerational engagement.

In a recent study exploring the role of faculty in fostering intergenerational learning, findings revealed that while instructors identified benefits of having an older adult learner in the classroom, they did not change their teaching style or pedagogy to foster intergenerational learning (Heffernan *et al*., 2019). There was also evidence that some faculty did not see it as their responsibility to provide support for older learners, but that the older adult should seek assistance, or the institution should provide more support to address their learning needs.

As more institutions of higher education work toward adopting and implementing the AFU principles, especially Principle Four, these institutions not only require buy-in from faculty, administrators, and community stake-holders, but need to provide instructors with the resources and ongoing assessment to ensure that intergenerational engagement is being actively fostered, cultivated, and recognized within all courses (Andreoletti & June, 2019).

In this study, we examine the perspectives of faculty members who have opened their classrooms to older adult auditors—those who can participate in a course, but do not receive college credit. The primary research question is: *What types of training do faculty recommend to promote intergenerational engagement in the classroom?* This research builds upon the initial work published by the authors (Heffernan *et al*., 2019). It involves in-depth face to face interviews with faculty members about their experiences.

2. Materials and Methods

2.1. Context of the study

In 2016, a medium-sized public liberal arts college in New York State embarked on an initiative to engage community-dwelling older adults in the classroom as 'auditors.' Auditing allows an individual to register for a course, engage in class learning activities as much or as little as desired, without the receipt of college credit. The State University of New York (SUNY) allows state residents aged 60+ to audit any college course for free as long as they have permission from the course instructor and there is space in the class (SUNY, 1992). While some SUNY institutions charge a nominal registration fee for auditing, there is no fee at the authors' institution. Other benefits associated with auditing include reduced-rate parking, creation of a college email account and access to all college technology, library privileges, and membership discounts for the college fitness center.

Each semester, the College's Director of Multigenerational Engagement works with faculty across campus to gain permission to add a limited number of 'seats' to select face to face classes for older adult auditors; between 30-40 courses are promoted each semester. This list is disseminated in the form of a brochure that is mailed to community members and alumni and is also available electronically. Potential auditors then register for the college's Lifelong Learning Orientation where they register for 1-2 classes on a first-come first served basis and participate in a 'tech talk' to assist auditors with accessing college email and technology as well as other supportive services. The orientation also covers various educational programs offered by the college that are open to lifelong learners and community members. Prior to 2016, approximately six older adults enrolled as auditors. Auditing was not promoted by the college and tended to be limited to retired faculty familiar with college registration procedures. Since promotion of the program, enrollment has increased dramatically. In the 2019-2020 academic year, over 80 older adults have enrolled in courses.

2.2. Study design

This paper is based on the analysis of qualitative data collected from faculty member interviews conducted between February-May 2019. The purpose was to collect in-depth information from faculty who had granted permission for an older adult to enroll as an auditor

in at least one of their courses since the fall 2016 semester. A semi-structured interview guide was developed to collect demographic information from faculty (e.g., age, gender, department, rank, etc.), to inquire specifically about the faculty member's perceived benefits and challenges associated with having older adults in the college classroom, determining what levels of intergenerational learning may be taking place, and to identify best practices to foster intergenerational engagement.

2.3. Participants

Based on a report from the college's registrar, a total of 43 faculty members had at least one older adult auditor enrolled in at least one of their courses between Fall 2016 and Spring 2019. Each of these faculty members were sent an email from the Director of Multigenerational Engagement describing the interview study and apprising their interest in being interviewed by a graduate assistant. If they were interested in participating, their contact information was sent to the graduate assistant who scheduled a convenient day/time to interview the faculty member in their respective offices. During this meeting, participants were provided with a letter of informed consent that was reviewed by the graduate assistant. Following consent, interviews were recorded and transcribed using a phone-based application entitled 'Otter' (Otter, 2019). This research project was reviewed and approved by the college's Institutional Review Board (IRB).

2.4. Data analysis

Data from the face-to-face interviews with faculty members were analyzed using qualitative content analytic approach. As an analytic tool for verbal data, qualitative content analysis makes it possible to summarize large amounts of text into themes or categories that represent similar meanings (Sandelowski, 2010). This methodological approach was utilized for this study because of its usefulness in gaining detailed understanding of the topic being investigated (Hsieh & Shannon, 2005). Specifically, qualitative content analysis was useful in facilitating the development of knowledge regarding the types of intergenerational engagement taking place in the classroom. It also helped in shedding light on the faculty reports of best practices regarding training needs.

To begin the content analytic process, the data obtained from the face-to-face interviews with faculty members were transcribed verbatim using Otter (Otter 2019). The authors independently read all the interview transcripts to achieve robust understanding of the data obtained from the interviews with the faculty members who participated in this study. Following the completion of the data immersion process, each of the three authors wrote down words or codes from each interview that seemed to capture important thoughts or concepts. The three authors met periodically to compare codes, finalize the initial coding

scheme, and to sort the codes into emergent themes that represent the key findings from the face-to-face interviews with faculty members.

3. Results

Table 1 presents participants' demographic information including rank, education level, and years teaching. A total of 27 of the 43 faculty participated in this study for a 62% response rate. Participants represented ten different academic departments. Nearly all described their race/ethnicity as white/Caucasian (89%, n=24) and most were female (67%, n=18). The overall teaching experience ranged from 1 year to 49 years with an average of 15.6 years (SD: 8.76). The average age of faculty participants was 49.2 years (SD: 10.6) and ranged from 30 to 74 years.

Research Question: What types of training do faculty recommend to promote intergenerational engagement in the classroom?

Faculty interviewed for this study articulated the importance of adequate training in promoting intergenerational engagement within the college classroom. Faculty training needs were organized into four themes: 1) Provide accessible training to teach faculty their role in fostering intergenerational learning 2) Educate faculty about the importance of becoming aware of generational time periods/context of both auditors and the students, 3) Learn to approach auditors with a mindset that they are adults and have had careers/experiences, and 4) Train faculty on how to foster discussion, particularly with older adult learners present.

Supporting Quotes for Theme 1: Provide accessible training to teach faculty their role in fostering intergenerational learning

"I would love to have other professors…ones that have had really good experiences, like what are the ways to cultivate that. Kind of like, you know, a panel discussion of the people that have had a lot of these students." (Interview 12)

"*If anything, I would suggest that, you know, you could have a webinar or something for faculty that might help them to understand what their roles and responsibilities are. But that's very straight.*" (Interview #7)

Supporting Quotes for Theme 2: Educate faculty about the importance of becoming aware of generational time periods/context of both auditors and traditional students.

"…perhaps some training on diversity and thinking about, especially for classes, that have controversial material that might be sort of controversial having students at different generations" (Interview #4).

"The professor should be aware of the life experiences and educational experiences in their discipline were likely to be for the adult learners." (Interview #19)

"I have had a couple of times where auditors have maybe said something that is generationally different from their time to how students behave now. And then I think it takes a little while for students to probe why someone said something that they think is maybe inappropriate and understand the motives of the auditor. So guiding that process along is, I think, how I dealt with it…" (Interview 28).

Supporting Quotes for Theme 3: Learn to approach auditors with mindset that they are adults and have had careers/experiences,

"Our job is to tap into what auditors can bring and that is life experience that even we, as professors, don't necessarily have." (Interview #17)

"…I think, you know, anytime, even in a lecture setting if you can involve people and have them relate their own personal experiences, some you know, have so much to inform the topic matter, they've experienced it, they lived it" (Interview #2)

Supporting Quotes for Theme 4: Train faculty on how to foster discussion, particularly with older adult learners present in the classroom

I think just being able to foster discussion. I mean, I think that that is how we can be better trained [talking about the differences between generations] (Interview #9).

"…So some kind of at least discussion and sort of techniques for making sure that students, younger students in the class aren't intimidated, but are actually inspired…by viewpoints that are expressed by someone from a much older generation." (Interview #11)

Table 1. Participant Demographic Data.

	M	(SD), %	n
Age	49.2	(10.6)	26
Gender			
Female	67		18
Male	33		9
Race/Ethnicity			
White non-Hispanic	89		24
Hispanic	4		1
Asian	4		1
Other	4		1
Education/Highest Degree			
Doctorate	78		21
Masters	19		5
Other	4		1
Years teaching	15.6	(8.7)	27
Academic Rank			
Professor (full)	7		2
Associate	59		18
Assistan	15		4
Lecturer	7		2
Adjunct	11		3

4. Discussion

In analyzing the narrative responses to the question: What types of training do faculty recommend to promote intergenerational engagement in the classroom?, we uncovered four inter-related themes. In the first theme, faculty appear eager to foster a good experience for all students in their classrooms, however, it was clear that some did not understand how this could look different in a multigenerational classroom. Some indicated that they taught the class as usual, while others acknowledged that having familiarity with the tenets underpinning intergenerational learning would be helpful (Corrigan, *et al*., 2013; Dauenhauer *et al*., 2021; Heffernan *et al*., 2019). The other three themes identified, spoke to the importance of first understanding that generational differences exist, and then developing skills to use these differences to help students learn, and accept, that there may be more than

one way to interpret the same content; bringing up the idea of multiple realties. Biggs and Lowestien (2011) also argue the importance of allowing for multiple perspectives as a way to increase generational intelligence. They define generational intelligence "as the ability to reflect and act, which draws on an understanding of one's own and other's life-course, family and social history, placed within social and cultural context" (Briggs & Lowenstein, 2011, p. 2). Being able to recognize the importance of differing or alternative perspectives, depending on where someone is at with regards to their generational development, appears to be equally important as understanding how to foster culturally sensitive discussions between the different generations. Additionally, many faculty were aware of the knowledge and experience brought by the auditors, however, they were not always sure how to use this experience without making the traditional students feel intimidated. Future training for faculty teaching in multigenerational classrooms should include helping them to understand the principles as well as benefits of intergenerational learning. Further, helping faculty understand the concept of generational intelligence may help facilitators reflect on their own life course development, and how this influences their way of thinking about the content they teach in order to better understand the perspective of those from a different generation. Issues of how to use the expertise of older adults and still allow equal time for younger generations to discuss their experiences without feeling intimidated are not new. Future training for faculty interested in learning how to promote intergenerational learning must focus on both intergenerational curricular design as well as multigenerational classroom management (Montepare & Farah, 2018; Dauenhauer *et al*., 2021).

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Stakeholders in curriculum development – case of Supply Chain and Logistics programme

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Abstract

Higher education institutions involve various groups of stakeholders that can affect strategic and operational actions in various ways and extents. Understanding the relevance of particular stakeholders in regard to an organization is therefore of key importance. Previous research has shown the importance of involvement of different groups of stakeholders in the curriculum development. The main purpose of this paper is to present a conceptual framework for inclusion of various stakeholders in curriculum development cycle for graduate business programmes. This is done by applying the stakeholder map to curriculum development cycle to form the conceptual framework. The framework is then applied to a case of a Supply Chain and Logistics graduate programme curriculum development.

Keywords: *Stakeholder theory; curriculum management; curriculum development; higher education institution; business logistics; supply chain management.*

1. Introduction

Higher education institutions (HEI) involve various groups of stakeholders, from internal such as students and faculty staff, to external such as various governmental entities, donors, communities, competitors, employers etc. (Jongbloed *et al*., 2008). These stakeholder groups can affect or are affected by the organization's purpose and strategic goals (Freeman, 2010). Different groups of stakeholders can affect strategic and operational actions in various ways and extents (Jongbloed *et al*., 2008). Understanding the relevance of particular stakeholders in regard to an organization is therefore of key importance to managers and policy-makers (Chapleo & Simms, 2010).

Curriculum development is a set of processes that involves many academic and professional stakeholders, who are crucial at identifying competencies of the graduates (Al-Jubran, 2020). Previous research has shown the importance of involvement of different groups of stakeholders in the curriculum management. While some studies give special attention to specific activities such as curriculum development (Matkovic et al., 2014), others focus more on specific delivery methods such as e-learning (Wagner et al., 2008) or specific industries (Lagoke et al., 2020). The latter should be further emphasized as different knowledge domains might require different groups of stakeholders with multiple agendas involved in curriculum development. This is also important because curriculum development can be costly, risky as a strategy and potentially time consuming, while on the other hand the directly and indirectly derived benefits can be far higher than the investments (Khan & Law, 2015). Therefore, identifying key stakeholders for participation in curriculum development is crucial.

The main purpose of this paper is to develop a conceptual framework for inclusion of various stakeholders in curriculum development cycle for graduate business programmes. This is done by applying the stakeholder map to curriculum development cycle by using an example of a Supply Chain and Logistics graduate programme development, where different groups of stakeholders are involved in the curriculum development process.

The structure of the paper is as follows: in the next section the central concepts of curriculum management and stakeholders in higher education are presented. This is followed by developing a conceptual framework of stakeholder mapping on curriculum development and applying it to a case of a graduate Supply Chain and Logistics programme in the third section of the paper. In the conclusion of the paper the limitations and further research ideas are presented.

2. Stakeholder involvement in curriculum development

Curriculum management is defined as a collection of the school's processes and organization for development, design, and implementation of programme's structure, organization, content, assessment of outcomes, pedagogy etc., and should be soundly managed with faculty engaged in the ownership of the process, while fostering and promoting innovation (AACSB International, 2020).

One of the major processes in the curriculum management is how the curriculum is planned, implemented and evaluated (Ornstein & Hunkins, 2009). Several different approaches can be used for curriculum development. In this paper a widely used and adopted curriculum development model is used: the ADDIE model (Morrison *et al*., 2019) which consists of five phases: analyze, design, develop, implement and evaluate. This approach is used throughout various fields from natural and social sciences. The model is shown in Figure 1.

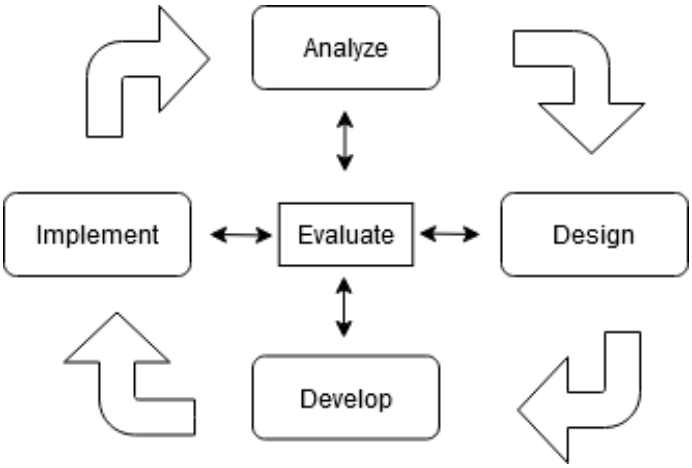

Figure 1. ADDIE model of curriculum development. Source Morrison et al. (2019).

In the analysis phase the current situation is assessed, the needs of the learners are evaluated and learning goals and objectives are defined. This is followed by design phase where an overview of the course or programme design is developed and a blueprint created. The development phase consists of concrete practical plans that follow the generally defined scope in the design phase. In the implementation phase the course or programme is delivered. In the evaluation phase the feedback is obtained and adjustments to the programme and the courses are made. In practice, the evaluation phase is being executed continuously throughout the entire curriculum development process which enables partial loops to be executed, for example analyze and design loop before going to the development phase.

Kettunen (2015) developed a stakeholder map for higher education institutions where key stakeholders are separated into internal and external stakeholders. The map is shown in

Figure 2. Internal stakeholders include personnel of the HEI and its students, while external stakeholders are classified into partners and customers groups. Furthermore, the stakeholders are separated into four perspectives: process and collaboration, external impact, financial perspective, and organizational learning perspective. All groups of stakeholders are identified as providing an important feedback on curriculum development, regardless whether they are internal or external and which of the aforementioned perspectives they apply to.

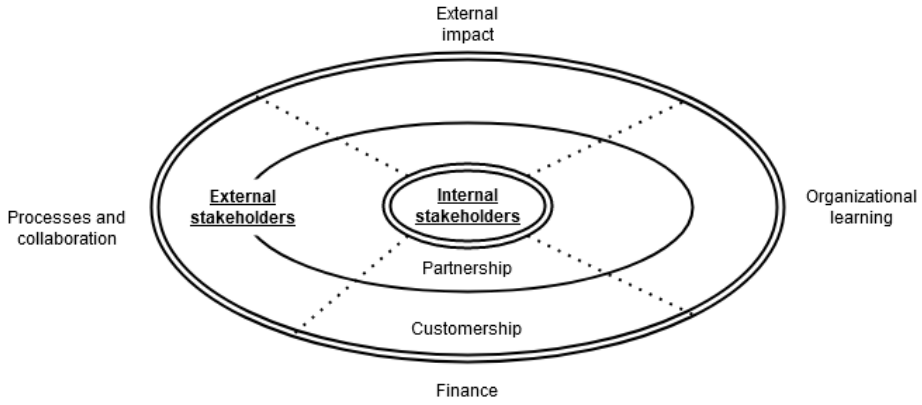

Figure 2. Stakeholder map. Source Kettunen (2015).

Previous research (Matkovic *et al*., 2014) has shown the importance of stakeholders involved in curriculum development, while also developing a process model tool for identifying them. Other authors (Khan & Law, 2015) have pointed out the importance of inclusion and participation of all interested stakeholders in the curriculum development. Documented approaches including stakeholder inclusion in curriculum development have been used in several different fields such as nursing and health sciences, engineering, biomedicine, tourism, hospitality and events education and others (Benckendorff *et al*., 2012; Fagrell *et al*., 2020; Keogh *et al*., 2010).

As stakeholder involvement is important through phases of curriculum development, the necessity for mapping the appropriate stakeholders on each of the phases arises. Therefore, the next section presents a conceptual framework for mapping stakeholders through all the five stages of curriculum development and applies it to a case of Supply Chain and Logistics graduate programme.

3. Conceptual framework and case discussion

In this chapter the conceptual framework of stakeholder mapping on curriculum development stages is described, which is proposed based on the ADDIE model and the stakeholder map presented in previous chapter. Then it is followed by an example of a graduate Supply Chain and Logistics programme.

Stakeholders involved in curriculum development are key informers and drivers of the content, methods of delivery, evaluation requirements and the scope of curriculum that qualifies for a certain profession (Matkovic *et al*., 2014). It is therefore essential that they are identified and assigned to the appropriate phase of the curriculum development process with their role clearly defined, before the process is executed. The conceptual model is shown in Figure 3. What this model emphasizes is that each of the curriculum development stages needs to have its specific stakeholders involved.

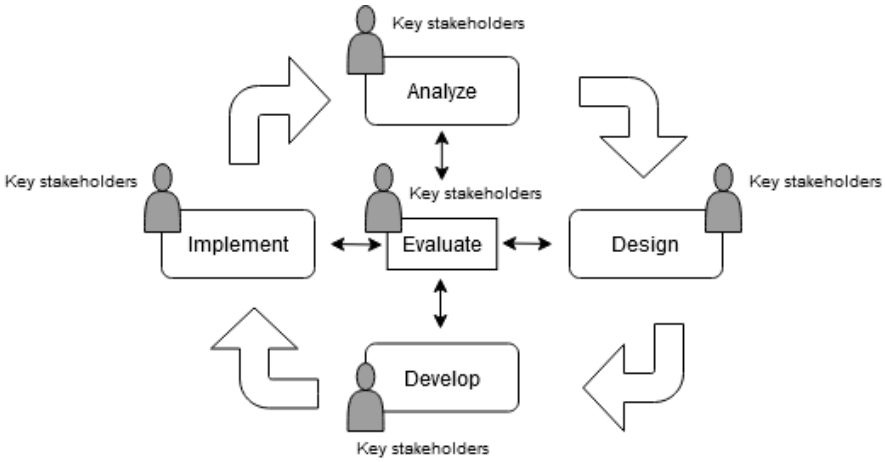

Figure 3. Conceptual model of stakeholder mapping on curriculum development stages.

In the next step the above approach has been used for Supply Chain and Logistics graduate programme. In the last two decades the programme has evolved from being mainly operations research focused in the beginning, through being focused on business logistics, while in the last few years the programme shifted to a broader area of supply chain and logistics, hence the current name of the programme. During the evolution of the programme, various internal and external stakeholders have been involved in its development and the development of its curriculum. The major reevaluation of the programme happens every three to five years which is in line with recommendations in literature (Khan & Law, 2015). The following analysis is focused on the last such reevaluation and identifies the stakeholders that were involved in it.

Out of internal stakeholder groups the academic staff are involved in every step of the curriculum design. While some phases such as analysis include only a smaller group of academic staff from the key domains covered in the programme led by the management (vice-dean for teaching), the latter phases include academics with the expertise from the fields covered in the programme. Another key internal stakeholder group are administrative staff, especially the quality assurance office and student's affairs office, providing the relevant information about the boundary conditions set either by external stakeholders such as the

governmental regulators, accreditation agencies or internal rules, especially in the analysis phase and to some extent the implementation phase for the purposes of curriculum accreditation. Heads of academic departments together with human resources office are another key stakeholder, working with the curriculum development team on assessment and analysis of staff capacity during the implementation phase.

Several external stakeholders are also a part of curriculum development. Current students are a part of quality assessment activities during the implementation and evaluation phases. These assessments are twofold. One type are the student surveys taken at the end of each course during the evaluation phase, while the other type are students as members of the programme steering committee which provides feedback about the programme during design, development and evaluation phases. The steering committee also includes representatives from other external stakeholder groups: employers, employment agencies, alumni and professional associations. Besides being members of the formal bodies (such as a steering committee), particular groups of external stakeholders are also informally consulted throughout analysis, design, development and evaluation phases. These stakeholders are usually employers, employment agencies, non-governmental organizations and professional associations, as they can provide the most relevant feedback on labor market needs for a particular domain area.

Ensuring success of such engagement requires providing an environment in which stakeholders, especially external ones, will willingly participate. One of such strengthening mechanisms is engaging external stakeholders with the programme through other means first, such as through guest lectures, student projects, alumni, competence centres, professional events etc. This might be more easily accomplished in certain disciplines and programmes, such as business education, and the lack of such activities might provide a serious barrier for stakeholder engagement in curriculum development.

4. Conclusion

In this paper a conceptual framework for inclusion of various stakeholders in curriculum development cycle for graduate business programmes is developed by applying the stakeholder map to curriculum development cycle. This is an approach that can further enhance the curriculum development phases by identifying the key stakeholders for each phase ex-ante and including them in the actual process of curriculum development. The main desired outcome of such close ties between curriculum design and stakeholder engagement is an opportunity to close the gap between the contents of a specific programme and the market needs. Opportunities for further research lie in validating the proposed framework on different graduate programmes while also including engagement mechanisms in the framework and exploring barriers for actual stakeholder involvement.

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A learner-centered approach to design a Computational Finance module in higher education

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Abstract

In this paper, we describe our design of ACM30070 "Computational Finance", a core module in the BSc in Financial Mathematics in the School of Mathematics and Statistics. The over-arching purpose of this module is to help students to develop mathematical, statistical and coding skills, along with significant knowledge and critical thinking, that allows them to effectively construct, manipulate and visualize financial datasets and to build financial mathematical models. The use of computation and a FinTech software (FinCad Analytics) are pointed out as essential to facilitate sensemaking in computational finance. More broadly, we discuss the education-research based rationale behind the "learning by doing" and "flipped classroom" institutional models that we have chosen for ACM30070, and we show how the modern "inclusive" definition of computation has been embedded into the learning activities. An accurate description of the design principles and implementation is also presented. At the end of the paper, we briefly introduce a discipline-based education research that will follow from this module design.

Keywords: *Computational finance education; financial modelling; data analysis, learning by doing.*

1. Introduction

In the last few decades, the need for data analysis and computational modelling skills have become critical to success in both industry and academia. Workers and researchers should be able to successfully analyze and interpret datasets and use computational modelling in most of the branches of modern science. Given the importance of computation in science, the number of computational undergraduate modules within traditional science programmes is increasing. In particular there has been increased attention on computation in mathematics subjects (Lockwook *et al*., 2019), and consequently traditional undergraduate education has been adapted in different ways. Whilst some researchers refer to a body of literature in Finance Education (Diamond & Smith, 2011), (Hoadley *et al*. 2015), (Hoadley *et al*., 2016) only a limited portion of these specifically investigate the *Computational Finance curriculum*; thus, the area is under-researched. This is because Computational Finance is a relatively new discipline, is highly interdisciplinary and very often considered as a sub-section of the Finance curriculum. In this paper, we describe the design process and the final version of ACM30070 Computational Finance, that has been delivered in Spring '21. We focus on the enquiry-based and student-centred learning educational-research model chosen to design it, along with the importance of computation in sensemaking to the subject. What we describe here is the result of a long process started in 2016 that went through several improvements. Taking into account the experience of Covid-19 disruptions, we also show how all the designed practices can be implemented in both f-2-f and blended/online delivery.

2. Course Design and Implementation Plan

2.1. Design Process

The broad goals of ACM30070 "Computational Finance" come from the creation of a new BSc in Financial Mathematics in the School of Mathematics and Statistics, started in 2015/16. In 2016/2017 we have in fact been asked to design this module, ACM30070, core in stage 3 semester 2, with the aim to make it the "jewel" of the programme, providing at the same time a practitioner-oriented and deep mathematical education in implementing financial models for derivatives pricing. We jointly worked on the big picture of BSc design and the module outline. Therefore, we designed the module with the purpose of activating prior and integrative learning (Norman & Schmidt, 1992) and vertical and horizontal coherence within the programme (Blackshields, *et al*., 2014). We closely worked with other STEM researchers, and we agreed on designing practices and activities in order to reciprocally use computational thinking to enrich the financial mathematics mastery and the financial mathematics context to enrich the computational learning. To embed real-world experience and make the study of computational finance as authentic as possible, a similar set of discussions took place with representatives of financial companies. New graduates should be able to manipulate and

analyze data to extract usable information from it, to capture the salient features of a financial system, to critically build a model, and to communicate outcomes to co-workers and supervisors. Finally, being part of the "University Discipline-Based Education Research in STEM" and of the "Community Engaged T&L" groups, we felt the need to create a module that exemplified the current best practices in the undergraduate research literature. The module was delivered on a pilot basis in Spring '18, then it was improved after critical reflections on the first outcomes. The current redesign integrates the definition of *inclusive computation* (Caballero *et al*. 2018) and the computational practices in the *Weintrop et al. Computational Practice Taxonomy* (2016): computation in ACM30070 is no more a simple skill but it represents one of the constitutive pillars to master financial mathematics.

2.2. Learning Goals

The purpose of ACM30070 is to provide a practitioner-oriented education in implementing financial models and embed computational thinking in mathematics and finance contexts, with the aim of bringing current educational efforts in line with the increasing demand for problem-solving and quantitative skills. Students will learn how pure & applied mathematics and coding can be harmonically integrated to solve a real-world financial problem. The learning goals have been set-up referring to the principles of *backward course design* (Wiggins & McTighe). Upon successful completion of the module students will be able to: apply financial mathematical theory and quantitative methodologies to real-world situations; understand the industry practice; identify salient features of a financial system that can be translated into a model; judge the suitability of model, critically understanding its limitations; write computer codes to solve common problems in the financial sector; collect, create, manipulate, analyze financial datasets; understand basic numerical methods and use them to solve problems; synthesize and communicate outcomes of a scientific computing problem.

2.3. Theoretical Framework and Pedagogical Motivations

To design the overall course structure, we have referred to the *Seven Research-Based Principles for Smart Teaching* described in (Ambrose *et al*. 2010). Those principles focus on how people learn starting from empirical evidence; for this reason, they can be easily applied in classes where students have a modest background in a subject. This is the case of students enrolling in ACM30070, since they have little coding and financial modelling experience. Among the seven, we have selected the following principles:

Students' prior knowledge can help or hinder learning: students build new concepts on robust prior knowledge, looking for links between previously acquired and new knowledge, that help them construct increasingly complex structures. For this reason, we have built the syllabus of ACM30070 referring to the ones of the two pre-requisite modules "PDE for FM" and "Stochastic Models" and of the concurrent core module "Foundations for FM".

To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned: since the way knowledge is organized influences how students learn, all new concepts have been presented in a scaffolded manner, and related practices have consequently been designed and integrated between each other. To drive students in this path, pre-class, in-class, post-class activities have been designed. As an example, students are asked to implement the Black-Scholes model in Python at home, taking a similar VBA code as a reference. In class, they bring their codes and work in groups, making comparisons, debugging, doing input/output data analysis. After the class, they do a homework in which more complex modelling and data analysis are involved, under scenarios where they have to take critical decisions on modelling, starting from acquired knowledge.

Students' motivation determines, directs, and sustains what they do to learn: the module is offered timely with students' internship summer programme. In order to match the context, map the module outcomes to external drivers and provide students with relevant experience and motivation, practices have been designed to be pertinent to their future profession (Barrett & Moore, 2011), (Schmidt *et al*. 2009). The embedding of Fincad (FAS) software in the activities has also been essential. Indeed, FAS is a financial software library widely used in the industry but also very helpful in education, since it is intuitive to use and very well documented on both theory and computational side, which is essential for self-study.

Goal-directed practice coupled with targeted feedback enhances the quality of students' learning: to improve student engagement and satisfaction and provide multiple options for self-regulation, each assignment addresses one or more learning objectives and have different goals. In-class formative assignments are developed in groups of 4-5 students during the labs (*knowledge as process of construction between peers*). Homework are tailored to individual reflection, critical and creative thinking and problem-solving skills. The final group project is intended to develop the "*system thinking practice*" category in the Computational Practice Taxonomy and also to stimulate long-life skills like creativity, teamwork, project management, communication, negotiation and ethical behavior. Written and oral feedback are provided for each summative and formative assessment component.

To become self-directed learners, students must learn to monitor and adjust their approaches to learning: in all assessment components students are encouraged to go beyond thinking about the single tasks; we propose reflective and critical questions (based on *why* instead of *what*, or *provide an example* of instead of *reproducing a proof*), practical open-ended exercises (e.g. design a strategy to hedge the risk of your portfolio), inclusive coding activities like completing a piece of code, inspecting and comparing computational outputs, check the suitability of a financial model through computation.

2.4. Module outline

Starting from the learning goals and theoretical framework, we referred to the available literature on *threshold concepts* in Finance for choosing the course contents and develop its structure. Diamond and Smith in (Diamond & Smith, 2011) focus on approaches to teaching threshold concepts in Quantitative Finance, with five concepts suggested. Hoadley *et al*. in (Hoadley, Wood, Kyng, & Tickle, 2015) and (Hoadley, Wood, Kyng, & Tickle, 2016) have further investigated the Quantitative Finance curriculum using threshold concepts as both a theoretical framework and a research methodology. They have identified ten concepts (including the Diamond's five) that are clearly endorsed as "*jewels in the Quantitative Finance curriculum*". Within this list we distilled the followings - Pricing and Valuation, Arbitrage, Expected Value, Change of Measure, Risk Neutrality, Ito's Lemma and Brownian Motion, Hedging. Also, we have considered the results in (Khalo & Bayaga, 2015), where the most common errors committed by learners in Quantitative Finance are identified. We have mapped the above selected threshold concepts into the Computational Practice Taxonomy and we have accordingly designed activities referring to the Kolb's learning cycle (Kolb, 1984), taking the "concrete experience" as the start and the end of the cycle. Weekly course contents & progression are shown in Table 1.

Table 1. Course Contents and Progression.

Week	Modelling Concept	Context/Application	Computational practices	Summative Assessment
1	Arbitrage, Martingale	Derivatives Pricing	Fincad intro	
2	Black Scholes	Vanilla Opt Pricing	Procedures & Functions	
3	Greeks and Impl Vol	Implied Volatility	Loops, if/else condition	
4	Binomial Model	Vanilla Opt Pricing	Loops and data analysis	
5	Binomial Model	American/Exotic Opt	Loops, if/else	Hw 1
6	Ito's Processes	GBM	Random Numbers generators, plotting	
7	Monte Carlo Method	Risk-Neutral Pricing	Evaluating Conditionals	
8	Monte Carlo Method	Greeks Estimate	GBM and Indicators	Mid-term
9	Monte Carlo Method	Variance Reduction	Arrays Manipulation	
10	Finite Difference	Expl/Impl Methods	Discr Approx. and grids	Hw 2
11	Finite Difference	Crank-Nicolson	Arrays Manipulation	
12	Finite Difference	Barrier Options	Arrays Manipulation	G P

2.5. A typical week of class

Students attend 4 slots of 50 minutes each per week (two lectures, one tutorial, one lab). To pre-activate individual learning and reflection, materials are uploaded on the course management system a couple of days before the classes. The materials typically include slides, notes and short videos for what concerns the lectures, and proper formative assignment like short, guided programming activities and/or working questions for the tutorials. The lectures are devoted to the financial modelling part, so they usually begin with a brief discussion on the reading materials to allow students to address questions/doubts, then the instructor moves on to the topic of the day. Tutorials and Labs are intended for several computational practices and problem-solving activities. Tutorials start with a walk-through of particular pieces of the pre-class assignment, which helps put each student on equal footing before starting the day's activities. Then, computational practices (see Table 1) are performed both individually or in small groups, so that students learn through problem-solving and comparison with peers. To further enhance the "flipped-classroom" and "learning by doing" models, Lab activities are fully student-led and the lecturer, the tutor and the teaching assistant facilitate the practices. There is no pre-class assignment, practices are entirely covered in class; students can download working questions only one hour before the class to read them. Labs start with students working in groups on modelling, pseudocoding, data analysis and other related activities. After 30 minutes, each group choose a representative to present their outcomes. The lectures and the tutor do one-two checkpoints during the first part of the lab to get students to think critically about the outcomes, then drive them in getting conclusions in the second part. The teaching assistant acts as a moderator in groups dynamics and takes field notes. Groups are constructed by the lecturer and stay the same for the term. Groups' components have similar overall capability on average; gender and possible minorities balance are taken into account. Finally, post- class annotated slides, question solutions and full working codes are provided.

2.6. Course Technology, Staff Selection and Logistic (in class and blended activities)

To reach the learning objectives and implement the pedagogical principles described in section 2.3, we had to leverage a variety of digital technologies and certain course logistics. In terms of programming languages, students learn VBA, Python and Fincad. In the financial industry, in fact, VBA and Fincad are frequently used to create complex financial spreadsheet models. Python programming is easy to learn, the code is compact and in general highly readable. When it comes to numerical or financial algorithms, the syntax is close to mathematics. There is a wealth of powerful libraries available and it is free and open source. Codes are developed in Spyder notebooks, which constitutes a critical component of the module since they allow raw code, easy access to the results of its execution throughout, plots and powerful data analysis. Beyond the technology, also the "physical" classroom space has been crucial. All activities take place in A.L.E. rooms, equipped with round tables, movable

whiteboards and plugs for laptops so that students and instructors can easily collaborate. To adapt this class format to off-campus teaching, the classes are live-streamed on Zoom and they are recorded, to take into account students' connections issues. The round tables and class discussions have been substituted with the "breakout rooms" and "pool" features in Zoom and practices are currently designed so that they can be delivered either f-2-f or online. Finally, the choice and training of the tutor and the teaching assistant have been essential to develop a collaborative learning environment. The tutor attended the module on 18/19, being one of the best-performing students. He was a teaching assistant in 19/20 and started a PhD in 20/21. He contributed to the design of lab practices, bringing in his perspective of former student and then assistant. The teaching assistant is following the same pattern, he attended the module on 19/20, and received the training to be assistant in 20/21.

2.7. Assessment: summative and formative

In addition to the various forms of formative assessments we described above, we built multiple mechanisms for summative assignment. The breakdown is: two homework (20%), midterm (20%), group project (10%), engagement grade (10%) and final exam (40%). Homework, midterm, final exam focus on reflective and critical questions, practical open-ended exercises and coding activities. The group project relies on a financial problem that is entirely new for students. Only starting references are provided, students have to conduct their own research and propose a modeling solution. The deliverables are: a python code, a report and an oral presentation. Finally, students are expected to be participative, mutually supportive and responsible for both their own and each other's learning during the labs. After each lab, they are invited to fill out a Google form survey to critically reflect on the day practice. Each completed survey is worth 1%, up to a total of 10% of engagement grade.

3. Conclusions

It is well known that students can progress through computational and applied mathematics courses, sometimes with good grades, and still lack understanding of the underlying principles, relations and concepts. In this paper, we have described the ACM30070 design process. The over-arching purpose of this module is to help students to develop a robust knowledge in financial modeling and both quantitatively and qualitatively compare models' outcomes with real-world data. The use of an inclusive definition of computation, along with an enquiry-based educational model have been central to master the subject. At the moment, the practices are "module delivery" independent, since they are effective and easily adaptable in both f-2-f or live streaming format. We are currently conducting an evidence-based research study to evaluate the impact of the proposed methodologies and practices on students significant learning, engagement and sensemaking to financial mathematics. Ethical Approval for this research study was obtained in Jan '20 and data has been collected since

Jan ’21, with very positive outcomes. Unfortunately, we are not presenting here the research results because data cannot be reported in any publications until final grades are officially released.

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Embracing the digitalization of research education? How social science research education was influenced by the COVID-19 pandemic

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Abstract

The COVID-19 pandemic led to a strong digitalization push at university level teaching. The latter had to be converted to distance modes quickly. This paper discusses the consequences of these developments for the field of social science research education, a discipline where the personal interaction between lecturers and students traditionally plays a major role in the transfer of knowledge and competences. Accordingly, we ask whether lecturers accepted distance learning as part of their work and if they will implement the associated digital teaching modalities into their regular teaching repertoire in the future. Furthermore, indicators shaping the acceptance of future distance teaching are explored.

The article is based on a continuous online survey of lecturers (n = 169) who teach social science methods and methodology at Austrian public universities. The results of this study show that more than 40 % of the sample with or after the experience of distance teaching will retain some aspects of it in their teaching due to the CODIV-19 pandemic. In particular, the evaluation of the preparation effort, the interaction with students and the attitude toward new didactic methods play a central role in the acceptance of distance teaching.

Keywords: *Digitization; social science; research methods; distance teaching.*

1. Introduction – How Research and Methods Education Changed Overnight

Academia has been entrenched in controversial discussions about the potential consequences of relying on distance learning and teaching in tertiary education for a long time (Marshall, 2018). However, those discussions have been halted during the COVID-19 crisis of 2020 and 2021 because the pandemic made distance teaching and learning common at most universities. Thus, it can be argued that now, perhaps more than ever before, the long-term future of higher education has become linked to the digital transformation, where all hypothetical ifs and buts have been replaced by the reality of distance education, based on online lectures and assessments (Ali, 2020; Tømte *et al*., 2019).

While this abrupt change has been an unusual experience in many ways (Watermeyer *et al.*, 2020), it also had different effects on the equally different scientific domains and disciplines. The following paper engages with the consequences of those developments in the field of social science research education. Consequently, it will be discussed whether lecturers are *(1) accepting distance learning as part of their job* and *(2) if they are going to implement the related digital teaching modalities* into their regular future teaching repertories. Following up on the results of this descriptive analysis, characteristics influencing educators' opinions will be identified.

The domain of research methods education in social sciences is of great interest because of two principal reasons: Firstly, bestowing students with the abilities to conduct research and providing them with the skills necessary to distinguish between trustworthy empirical claims and invalid assertions is a key takeaway from social science studies and often one of the more practical and employment-relevant aspects of university graduates in the related disciplines (Nardi, 2018; Prandner & Tabakovic, 2019). Therefore, it is central for students to develop a strong grasp of the underlying concepts. Secondly, courses dealing with such issues are commonly among the most challenging in university teaching for both students and lecturers (Earley, 2014). Because of this, such classes rely heavily on in-person teaching, personal interaction during tutorials and close proximity when it comes to data analysis sessions. This expands to many forms of data collection (e.g. interviews, face to face surveys) which are typically part of social science research training. However, because of the restrictions put in place during the COVID-19 pandemic teaching in person or even engaging with others for data collection purposes became much harder or even impossible.

The empirical foundation for this discussion is based on a case study from Austria which has (currently) two waves of quantitative data to draw upon. The population of the study are social science research lecturers in Austria who teach at public universities. Section 2 will introduce the current state of research and theoretical arguments, while section 3 will give an overview of the empirical material. Subsequently, the results will be presented (4) and a discussion closes the paper (5).

2. Social Science Research Education, What Is Expected from It and How Does This Relate to the Digitalization of Education?

Despite the fact that online education had been on a steady increase even before the COVID-19 pandemic struck, digitalization of both university level education and distance teaching are highly contested topics in debates about higher education (Ali, 2020; Zhang *et al*., 2020). There has been an institutional resistance in academia to adapt to online teaching, especially when it comes to more application-based content that demands a high level of student and lecturer interaction, citing quality concerns as primary reasons (Ivancheva *et al*., 2020). In this regard, it has to be stated that the introduction of technology and systemic change is always a challenge. This is also true for online teaching in higher education, with several factors influencing satisfaction and acceptance (Ali, 2020; Bolliger & Martin, 2018). Many of those factors relate to the assumption that online teaching is time-consuming and demanding in preparation, requires higher efforts to build a relationship between educator and student, and the perceived success is often tied to the lecturer's media literacy and skills to engage with students online (Bolliger & Martin, 2018; Zhang *et al*., 2020). Previous publications additionally illustrated that accepting online teaching is highly dependent on individual factors. A high teaching load and long experience in a traditional teaching environment typically result in a skeptical position towards online teaching (Bolliger & Martin, 2018). When it comes to demographic characteristics, younger female educators were more open to online teaching before the pandemic hit (Horvitz *at al*., 2015). Most of these assessments are likely to be present in the field of social science methods education as well.

Furthermore, previous studies have shown research methods education to thrive when it is possible for lecturer/student interaction, elaborate feedback procedures and exercises to work together (Michaelsen & Sweet, 2008; Prandner & Tabakovic, 2019). It has been monitored over decades that tutorials and applying gained knowledge are necessary for students to develop methods skills. It also became evident that – despite the fact that regularly expected methods skills can be generalized – there is no homogenous pedagogical style that has been established to teach them, resulting in a generally higher burden for those who teach courses that deal with such a content (Nind & Lewthwaite, 2018; Prandner & Tabakovic, 2019).

3. The Dataset and the Methods Used

The survey that is the background of this case study is part of Digitize!, funded by the Austrian Federal Ministry for Education, Science and Research. The survey is meant to constantly monitor the digitalization of social science research method education in Austria beginning in 2020. While the project was meant to start in September 2020, the COVID-19 pandemic and its influence on the universities forced the researchers to accelerate their

timetable and begin in March 2020. Furthermore, the project no longer has to observe a field that may slowly adapt to new teaching methods but one that has been radically transformed in recent months.

The population for the study was defined as university level educators who teach social science research courses and method classes in the four core disciplines of the social sciences at the public universities of Austria: *Sociology, political science, communication studies* and *educational sciences*. The corresponding individuals were identified via the lecture registers for bachelor and master programs, published by the public universities of Austria. Regarding the first wave, 182 individuals teaching social science research courses and method classes could be identified. Regarding the second wave, 126 additional educators became part of the population (total n = 308 for both waves). They were contacted via an individualized e-mail addressed to their official university e-mail accounts. Those were sent in March 2020 for the first wave and in September 2020 for the second one, with an additional reminder following after two weeks. Participants were given information about their rights in accordance with the *General Data Protection Regulation*. The questionnaire used closed questions to gather information about relevant demographic information (e.g. discipline, gender, years of experience, position) before identifying the respondents' pedagogical strategies, and feelings and experiences with online teaching and assessments.

The survey was piloted initially in mid-March, mostly consisting of established scales from the educational sciences. The online survey itself was conducted via the German provider *Socscisurvey*. Items and scales used for this paper and their distribution can be found in Table 1. The independent variables used are tied directly to the influences discussed in section 2. The response rate for the first wave was a surprisingly high 58 % (n = 105). The second wave had a response rate of 21 % (n = 64), more in line with other online surveys.

Sixty-three percent of social science methods instructors surveyed are women, with an average age of 43 years. Seventeen percent are junior scientists (e.g. predocs, assistants, project assistants). A quarter are tenured. The teaching average is about 5 units of 45 minutes per week, while the participants have an average of 11 years teaching experience in methodology or empirical methods. Prior to the COVID-19 pandemic, there was hardly any experience with distance teaching. Eighty-five percent of the respondents teach courses where students are continuously assessed, resulting in a high level of interaction between educators and students and among students. More than half of the respondents have tried many new didactic methods (e.g. use new online-teaching tools and communication platforms to engage with students), which can typically be seen as a proxy for media competency. However, distance teaching is perceived by a large proportion of respondents (81 %) as more time-consuming in terms of preparation and follow-up. More than half of the respondents also find interaction with students in a distance mode more challenging.

Table 1. Dependent and Independent Variables

Dimension		Variable	Scale	Mean (st.Dev.) /Median/ percent[1]
Acceptance of distance teaching[2]	Temporary solution	Distance teaching is only a temporary solution (n = 142)	1 – strongly agree to 5 – strongly disagree	3.00
	Permanent implement-ation	I will continue to implement aspects of online teaching after the pandemic (n = 139)		3.00
Teaching experience	Teaching units per week	How many teaching units did you teach per week this semester? (n = 155)	metric (nr. of units)	4.86 (3.53)
	Extent of teaching experience	How many years have you been teaching empirical research methods and/or methodology? (n = 149)	metric (no. of years)	10.91 (8.36)
		How many years have you been teaching empirical research methods and/or methodology via distance teaching? (n = 141)		0.93 (2.20)
Course type	Continuous assessment in class	Did you teach courses with seminar, project, or practical course character? (n = 169)	multiple answer recoded into 1 = yes; 0 = no	85.2
Assessment of the situation	Openness to new didactics	I try out many new didactic methods. (n = 146)	ordinal scales; recoded into 1 = (strongly) agree; 0 = neither agree nor disagree, (strongly) disagree	54.1
	Perception of additional preparation	I currently need more time than usual to prepare and follow up my lessons. (n = 142)		81.0
	Interaction with students	I find interaction with students via distance learning is harder to organize (n = 143)		53.8
Control	Female	With which gender do you identify? (n = 144)	1 = female 0 = male	62.5
	Age	How old are you? (n = 142)	metric (no. of years)	43.03 (10.36)
	Junior scientists	How would you describe your current professional position? (n = 144)	1 = junior scientists 0 = others	17.4
	Tenure	My current employment contract is … (n = 169)	1 = tenured 0 = temporary	25.4
	Survey wave	(n = 169)	1 = fall 2020 0 = spring 2020	37.9

Source: Digitize!-Panel-Study on Methods Education (2020).

[1] Percentage always states the amount of answers coded with 1.

[2] Factor solution for linear regression: 1 factorial solution – extracted variance: 82.37/ eigenvalue: 1.65; Cronbach's alpha: 0.78

4. Who Embraces the Digitalization of Research Education?

The fact that nearly all lecturers were forced to adapt to the new circumstances during the COVID-19 pandemic resulted in a situation where the majority had a (strong) opinion on whether distance teaching is just a stopgap or if it should be kept after the pandemic. In this regard, it can be reported that about 15 % of the respondents agreed strongly that they consider distance teaching to be an emergency solution, while another 28 % somewhat agreed. Nine percent do not consider distance teaching as a temporary solution at all. Fifteen percent of respondents are certain that they will continue to offer some of their teaching over distance, even after the pandemic ends. Another quarter are likely to do so as well. Sixteen percent cannot imagine a future implementation of distance teaching at all (see Figure 1 for details).

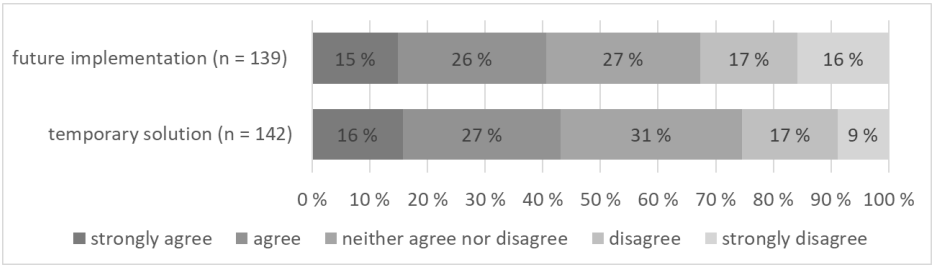

Figure 1. Attitudes towards distance learning. Source: Digitize! Panel Study on Methods Education (2020).

A more detailed look emerges when considering the results of a linear regression on the acceptance of distance teaching by social science methods instructors. Two models were calculated to do this. The first model deals with the extent of teaching and the teaching experience and the mode of the courses and evaluation of the situation were included. In a second model, sociodemographic data were also included to check for their influence. A variable identifying the timing of the survey was included in both models.

Results show that neither the extent of traditional nor that of online teaching experience have a significant impact on the acceptance of distance teaching. This is also true for the question whether an instructor taught courses that require continuous assessment of students or not. The number of teaching hours has only a tendency to positively influence the attitude towards distance teaching when sociodemographic variables are not considered. However, educators who are open to new didactic approaches are also more positive about distance teaching. Following the assumption that trying new didactic methods in online teaching requires the media literacy and skills to engage with students online, parallels to the literature can be seen here. As expected, the perception of a longer preparation time for distance teaching compared to face-to-face teaching and the negative experience regarding the difficulty of interacting with students have a negative impact on the acceptance of distance teaching.

Age, gender and whether someone is in a temporary or permanent employment relationship do not directly affect the acceptance of distance teaching. Considering these variables, however, makes a tendency toward lower acceptance for distance teaching among in junior researchers ($p < 0.10$) evident. The survey timing also plays a significant role in the acceptance of distance teaching. In both models, distance learning is viewed more favorably during the second survey in the fall of 2020 when compared to spring 2020. This seems logical, as lecturers had time to come to terms with distance teaching, after a rather abrupt change in the spring. Educators and students had already adjusted to the new situation and gained experience. It is also likely that there had been a significant investment regarding the change to distance teaching, therefore, the desire to retain parts of it even after the pandemic ended may have increased.

Table 2. Acceptance of distance teaching

Linear regression for: Acceptance of distance teaching (regression constant)			
Independent Variables		**Model 1** Std. Beta	**Model 2** Std. Beta
Teaching experience	Teaching hours per week	0.157~	0.158
Assessment of the situation	Open-mindedness to new didactic concepts	0.209*	0.198*
	Perception of additional preparation	-0.166*	-0.190*
	Interaction with students is harder	-0.198*	-0.211*
	Junior scientists	-	-0.161~
	Survey wave	0.197*	0.178*
n =		124	122
R^2		0.24	0.27
R^2 change			+0.03

*~ p < 0.10; *p < 0.05; **p < 0.01; Only significant effects reported. There was no significant influence by the extent of teaching experience (online and general), the type of courses taught, the age of the participants, their sex or if they were tenured. Source: Digitize! Panel Study on Methods Education (2020).*

5. Discussion

The COVID-19 pandemic made distance teaching a reality at most universities worldwide. The results of the Austrian case study on social science method educators show that more than 40 % of the sample are going to keep some aspects of distance teaching in their (methods) lectures after this unusual experience. However, an equally sizeable part remains sceptic. Furthermore, in the level playing field of the pandemic, previous assumptions about gender or age bias were proven insignificant. The same was true regarding the type of course – and, thus, content – taught. It can be seen that experiences during the pandemic are of relevance instead: Those who feel an additional burden – be it in preparation or student interaction – are more likely to reject distance teaching, while those who have the competencies or interest in tinkering with their teaching are more likely to embrace a future with distance teaching. This is an important assessment: Trying out new techniques and

teaching methods will improve online teaching and may lessen the stigma it experiences in highly interaction-based disciplines – such as the social science methods education researched.

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Use of Movies in an accounting class as a teaching technique to promote learning about financial reporting and ethical issues

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Abstract

This study presents an innovative experience using movies in an accounting class. The learning experience was found interesting and useful for the learning process in three groups in University XXX. The students voluntarily watched three movies and answered a test for each one, containing questions about the ethical and accounting concepts in the film, as well as their satisfaction with the methodology. Non-parametric tests have been computed to assess if those students that watch a movie obtain a higher exam mark as compared to those that do not follow the methodology, as well as for the other accounting and ethical questions. Our results show that there is a particular film that evidences a significant effect on the final exam mark for more questions than the other films. In general, the results are valuable as they show that students get engaged with this methodology and this can help students to improve their exam result.

Keywords: *Films; motivation; ethics, accounting.*

1. Introduction

Current methods of assessing learning have not usually kept up with changes in the learning approach and the transformed technological infrastructure of today's classroom (Serva and Fuller, 2004). It is evident that the ways to retain and process information depend on both the students and the learning tools. Nowadays, students have more different concerns and interests than ever before. Times are changing, so learning methodologies should be adapted to the new possibilities and to the new teaching environment. The knowledge gap between students and lecturers is often remarkable and challenging (Carrasco-Gallego, 2017; Morreale and Staley, 2016), which stresses the importance to include new and more attractive methodologies in the classroom so as to enhance and increase students' participation (Al-Bahrani *et al*., 2016) and promote critical evaluations (Díaz-Vidal *et al*., 2020). In this sense, the role of media as a teaching tool to help retention and metacognition is supposed to favor learning processes (Wooten, 2020).

Economics or Business classes are generally thought to be quite demanding (and sometimes boring) so sometimes it is difficult to grab students' attention. Classes might seem a bit far from reality because its foundations are typically based on theoretical and tricky economic concepts (Colander, 2006) and maybe deficient learning methods are employed (Lombardi *et al*., 2004). Consequently, students can lose interest and do not engage in the subject. For this reason, many academics in this field and researchers advocate for the use of film clips, videos and movies, both in class and online, as a modern pedagogical approach to integrate knowledge, develop economic contents, promote students' attendance and facilitate students' participation (Mateer *et al*., 2016; Mateer and Vachris, 2017; Acchiardo and Vachris, 2018). Furthermore, some studies (e.g. Wooten, 2020) highlight the convenience, versatility and quickness of using digital platforms (Youtube, Netflix, Amazon, HBO) that incorporate old and recent films and documentaries on all matters.

Despite the extant literature on the Economics and Business field and the use of media teaching tools, as far as we know, little prior research (Bay and Felton, 2012, Biktimirov and Cyr, 2013; Werner, 2014) refers to this approach in accounting classes. These studies analyse the characters' behaviour in terms of ethics and corporate governance, but they are not focused on the specific link of films' content and some accounting issues, especially from 2008 financial crisis. As an information system, accounting is the process aimed to identify, record, and communicate the economic events of an organization, by issuing its financial statements to a broad range of stakeholders interested in the business. Its general function is to provide useful information to enhance decision-making, so the adequate analysis and interpretation of accounting information become crucial since its effects may influence worldwide markets and peoples' lives in many respects (Zorio-Grima and Merello, 2020a and 2020b). As a consequence, the way accounting is taught to students will probably trigger the sense by which they understand and are able to convey useful information to decision

makers around the world. Therefore, if the teacher does not take action to try and avoid losing interest by students who are not being participative in classrooms the consequences can have terrible effects on the learning outcome and the student's satisfaction with learning achievements.

In addition, with the setting up of the European Higher Education Area (EHEA), European universities must be focused on the ethical learning of students, which has become a relevant matter in recent years. As ethical development is considered to have a decisive global impact (Scott, 2006), European universities should assign to ethical learning in general and to professional ethics in particular the same importance as higher education should promote cognitive, functional and personal development (EC, 2006). Eventually, as the number of students who combine their studies and work increases through life-long learning, the whole community will benefit from a more direct professional approach by universities, which also implies an advantage in terms of acquiring ethical skills, making students face ethical dilemmas in the workplace, and improve their confidence in their ethical development (Callender, 2008). In Spain, there seems to be a need to rethink ethical learning at universities. Even though ethical development models are starting to be promoted, there is still much to do, evaluate and consider regarding ethical learning by students, in order to completely align the Spanish policy in the educational field with the various existing projects conducted by several European universities. In addition to the Tuning Project that includes instrumental, interpersonal and systemic generic competences related to ethical commitment, the EHEA provides us with an excellent opportunity to learn more from other university institutions that invest generous capital in teaching (Solbrekke and Karseth, 2006), putting in value the effort on the ethical development of students.

Our study makes the following contribution to existing literature. First, we have examined the role of media tools (movies) on the Accounting area and detected a gap. Unlike Economics classes or more general Business (e.g., Marketing or Management) classes, the Accounting discipline implies a more professional approach for students, as the reported information is aimed to be useful and have an impact on decision makers. Second, we present an innovative experience in an accounting class, where the students are provided with three abstracts for each film focussing on different dimensions (filmographic, accounting and ethic) and with different length (250, 125 and 60 words) to help them develop their synthesis skills. Last but not least, we run subsequent analyses to provide evidence of the usefulness of this learning tool for academics and researchers working at universities who also consider ethical development a significant role of higher education. We look at pertinent variables such as the age, gender, parents' studies, enrollment mark to access the university, employment status, and the time spent in digital technologies during leisure time. We also assess the students's perception on the adequacy of this media approach in the learning process from different perspectives.

2. The teaching experience

This learning experience has been implemented during the first semester of the academic course 2020-2021 in three groups with different language (English, Spanish and Valencian) of the subject Financial Accounting of the Bussines Administration and Management degree in University of XXX (from country XX). The full sample is composed by 195 students, from three groups (57 English, 68 Spanish and 70 Valencian) and two different lecturers, one for the English and Spanish group and a second lecturer for the Valencian group. A 50.7% of the students are women, 92.3% are less than 20 years old, 17%, 26% and 48% of the parents of the students have secondary, bachelor and university studies, respectively; 48%, 38% and 9% of the students dedicate daily to the digital and information technologies around 2-4 hours, 4-6 hours and more than 6 hours, respectively; finally only 13.3% of the studens also work. As regards to the exam, 30% of students in the sample got a "satisfactory" grade", 40% " good" and 4.6% "excellent". Because of the COVID-19 crisis, the weight of the continuous assessment in the subject was increased from 20% to 40%, while some classes had to be moved to online format. In this context, the final mark of the subject was obtained as 60% the final exam mark and 40% the continuous assessment mark. The latter is composed by practical and theoretical tasks and exercises and three voluntary tests (one per film) related to the ethical, financial and accounting concepts discussed in three movies. The movies selected are described in Table 1.

Table 1. Movies description.

Movie	Acc. and Financial issues	Ethical issues
Margin Call (2011)	– Subprime crisis. – Fair Value and Assets Impairment. – Volatility.	– Greed and professional ethics. – Ethical decisions-making. – "Gold Rule" breach.
The Big Short (2015)	– Credit Default Swap (CDS). – Rating Agencies. – Oversight system.	– Greed / interest / manipulation. – Public Interest's jeopardize. – Ethical decisions-making.
The Wizard of Lies (2017)	– Pyramidal fraud. – Share price / quoted market. – Investment.	– Regret and guilt. – Ethical decisions-making. – Professional ethics.

Each movie test counts 0.5 points out of 4 in the continuous assessment mark (out of 10 points as continuous assessment, which is 40% of total mark). Each movie test includes 9 questions in total. Three questions request to identify whether each of the abstracts provided to the student (a 250-word abstract, a 125-word abstract and a 60-word abstract) highlights either the filmographic, accounting or ethical side the film. The filmographic abstract (base answer) is set in order to check if the students identify accounting and ethical concepts, so,

if not, they will choose the base answer. Moreover, there is one question on ethics and another one on an accounting issue, each of them with three possible answers, being only one correct. The summary of student's answers are shown in Table 2.

Table 2. Percentage of students who highlighted the implications of the film more with filmographic, accounting or ethical, and percentage of students with a correct answer for the accounting and ethical questions.

		Margin call	The Wizard of Lies	The Big Short
250-word abstract	Filmographic	11.79	23.08	15.38
	Accounting	27.18	23.59	25.13
	Ethics	61.03	53.33	59.49
125-word abstract	Filmographic	31.28	24.10	30.26
	Accounting	17.95	25.13	32.31
	Ethics	50.77	50.77	37.44
60-word abstract	Filmographic	46.67	30.77	30.77
	Accounting	26.67	29.23	44.62
	Ethics	26.67	40.00	24.62
Accounting question		61.54	82.05	34.87
Ethics question		58.97	49.23	61.03

Table 2 displays an interesting outcome. Students perceive ethical issues as more understandable when the abstract is longer, whereas filmographic abstract is more attractive when it is shorter. That evidences the absence of ethic theory knowledge and the need of integrating business ethics in the curriculums in order to be sure that students are aware of this issues, specially in accounting and finance field where financial scandals from the past should not be repeated anymore. In addition, four more questions were included in order to assess the methodology itself: (i) I think the movie is interesting, (ii) I think the movie is easy to understand, (iii) I think the movie has helped me understand an accounting or financial concept and (iv) I consider that watching movies I learn in an entertaining way. We employ a Likert 5-point scale for the answer ranging from totally disagree to totally agree.

3. Results

3.1. The student's perceptions about the methodology

The descriptive statistics evidence that in all the questions and movies a very high percentage (mostly around 70-80% in the majority of them) of the students agree or totally agree with the positive statements regarding the interest, easiness to understand, helpfulness toward learning an accounting/financial issue and entertaining while formative. In addition, the answers of the students to these subjective questions about the methodology are all significant (1%) and positively correlated. Thereby, those students that felt the movie was interesting, normally also found it easy to understand, as well as helpful towards achieving the learning

objectives. Furthermore, we find a significant and positive correlation between answers through the different movies, with some little exceptions. This suggests that in general, those students having a good attittute towards this methodology maintain their engagement for the three films.

3.2. The effect of the methodology on the final exam

Non-parametric tests have been computed in Stata 12 software. Table 3 shows the results for the U-Mann Whitney test with dependent variable the exam mark. We run 9 tests for every movie: (i) one for checking if those that watch the movie obtain a significantly different mark in the exam, (ii) another two tests to assess if those answering correctly the accounting or ethical question achieve a significant different mark; and, finally, (iii) six tests to determine if those selecting the accounting or ethic test for every movie achieve a different exam mark.

Table 3. Non parametric tests (U-Mann Whitney).

	Margin Call		**The Wizard of Lies**		**The big short**	
	Z	**p-value**	**Z**	**p-value**	**Z**	**p-value**
Watch the film	-3.785	0.000***	-3.503	0.001***	-3.672	0.000***
Accounting question	-0.578	0.563	-1.502	0.133	2.105	0.035**
Ethical question	-1.033	0.302	-1.020	0.308	-1.733	0.083*
250-word abstract						
Accounting	1.420	0.156	1.539	0.124	0.982	0.326
Ethics	-2.039	0.041**	-2.139	0.033**	-2.095	0.036**
125-word abstract						
Accounting	1.312	0.190	1.008	0.314	-2.277	0.023**
Ethics	-0.401	0.689	-1.417	0.157	-0.066	0.947
60-word abstract						
Accounting	-1.311	0.190	0.351	0.726	-1.848	0.065*
Ethics	1.192	0.233	-0.460	0.645	-0.112	0.911

According to the results, those students that watch a movie obtain a higher mark than those that do not follow the methodology. The methodology seems interesting as it is related to a higher exam mark for all the movies. However, we can not affirm a direct causality as this relation can be also explained by the engagement of those students with the whole course. In order to assess if the accounting or ethical issues of the movies relate to the acquisition of some skills evidenced in the final exam we pay attention to the different test questions for each movie. In addition, we can point out that the ethic 250-word abstract evidences a significant positive effect for all the movies. This suggests that a longer abstract gives more detail to identify the ethical/unethical behaviours for those students more sensitive to the issue.

Particularly, we can identify one of the films, The big short, that evidences a significant effect on the final exam mark for more questions than the other films. The students that correctly answer the accounting and ethic question of that film evidence a significant different

performance in the final exam. However, while answering correctly to the ethics question relates to a higher mark in the exam (exam average equals to 6.30 and 5.70 for the students answering correct and incorrect, respectively), the accounting question evidences the opposite effect (exam average equals to 5.60 and 6.30 for the students answering correct and incorrect, respectively). This particular effect of the accounting question, evidences the difficulty of the good students to understand the Credit Default Swap concept, as they have no previous knowledge about financial derivatives. This movie also evidences a positive significant effect for the accounting 125- and 60-word abstract on the final exam mark.

4. Conclusions

This study shows that students seem to generally agree with the idea that films can be useful for gaining an understanding of complex accounting and financial issues, and achieve learning in a more motivational environment. The study is valuable as it can inspire other accounting professors to introduce films in their classes to help their students understand the ethical side of the accounting profession as well as learning new accounting technical concepts. We evidence that students get engaged with this methodology and further research is needed to assess if it help students to improve the exam result.

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Online teaching and learning: a year later what has changed?

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Abstract

The world is currently experiencing the covid-19 pandemic that has been going on for almost a year and which has transformed the way of carrying out the economic activities that support contemporary societies. The education sector is precisely an example of this abrupt change. The face-to-face teaching-learning process was converted to an online format, so students, teachers, schools and families had to adapt immediately to this transformation. There was no time to provide schools and persons with digital equipment and tools, nor with educational agents for training oriented to the practice of online teaching. Everyone had to do their best, adapting, learning autonomously and with their peers and solving their own problems. This research was developed with the support of the case study methodology in a Portuguese educational institution and aims to understand, through the Dynamic Digital Competence Reference Framework (DigComp), the evolution of students in terms of digital skills in the period of the covid-19 pandemic. The results show that students acquired a set of digital skills that allowed them to participate and interact with stakeholders in the online teaching-learning process. In addition, a set of suggestions is also presented for the acquisition or improvement of other students' skills.

Keywords: *DigComp; digital skills; online teaching; students; teaching-learning process; technologies.*

1. Introduction

Considering that the growth of information and its accessibility through networks is increasingly evident, consequently, it is also a fact that the teaching-learning process will be increasingly linked to learning networks. It is, therefore, essential that all educational agents (students, teachers and school administration) continuously monitor this change and, through it, manage to develop skills and acquire new knowledge, which will allow them to have an effective practice with information and communication technologies. However, any change has associated, directly or indirectly, several obstacles, which prevent it from happening, for example: the fear of failing in front of colleagues, difficulties in using technologies, lack of technical support to solve problems, decrease in social communication skills of individuals, lack of adequate and functional infrastructures, lack of adequate training in the use of technologies, among many others. Despite the obstacles to the integration of technologies in educational environments, it is essential that investment in the training of educational agents in the field of ICT, so that, thus, it is possible to contribute to the improvement of the quality of education, namely, to the improvement of quality teaching-learning process. In literature there is much talk of this theme, but essentially from the perspective of the teacher, but very little in relation to the student. Thus, in the present study, we seek to speak about the digital skills that students must have to operate in online education in times of pandemic. The results show that most of the students acquired new digital skills that allowed them to participate in online teaching. In addition, a set of suggestions is also presented for the acquisition or improvement of other students' skills. It should be noted that these suggestions emerged from the data collection process and, in general, aim to contribute to the digital literacy of educational actors, in particular students of the 21st century - digital natives. In addition, the importance that these suggestions may have as a contribution to the discussion in the scientific and academic communities.

2. Online teaching: training in digital skills

A preliminary analysis of the literature shows that many issues related to online teaching are still not adequately clarified, perhaps due to the constant changes that are felt in education or perhaps because it was never clear. We believe that all these questions deserve to have urgent and clear answers, that are truly useful, duly supported scientifically and, especially, that allow to change the current paradigm of the way and methods of online teaching.

Recent decades show steady growth in online education, with institutions providing more online courses and programs (Allen & Seaman, 2013, 2016). In fact, we have good examples at the international level of higher education institutions that have been quite successful in implementing online teaching in some of the curricular units they offer, for example: Queen's University, Massachusetts Institute of Technology (MIT), National Taiwan University,

Stanford University , University of Melbourne, Duke University, The Chinese University of Hong Kong, University of São Paulo, among many others. At national level, not many institutions offer training in online teaching, but the work developed in this area by the Open University (UAb) is recognized. Perhaps because there is still little use of online education, for exemple the Portuguese government has set as goals to train around 3,000 people by 2023 and up to 50,000 people by 2030 in distance learning (Governo de Portugal, 2019). Based on the assumption that these goals are really to be fulfilled, it becomes urgent to address this issue, because: if the number of students in online education increases, more teachers are needed to train these students. Thus, although scholars in the field have identified many techniques, methods, and approaches to aid in the training and support of online instructors (Lackey, 2011), now can be improved to match the objectives defined by the Portuguese government (Governo de Portugal, 2019) and the objectives for sustainable development identified by the United Nations (Assembly, 2015), especially with regard to the substantial increase in the supply of qualified teachers. Although the qualification of teachers can occur at different levels, we believe that it is urgent to qualify these professionals to teach online effectively and efficiently. The urgency in this type of training and qualification has to do with the fact that online education is growing significantly both in the educational field and in the field of training in the workplace. This means that there is an urgent need for a clear commitment to the training of teachers for online teaching, as it is only with this training that it is then possible to train and prepare students for this practice.

The urgency of training teachers and students in digital skills for the 21st century is foreseen in several European and governmental programs, publications by specialists in the field, documents and agreements. However, due to a set of constraints, many of these formations seem to never be realized or else due to their delay they do not really contribute to the acquisition of digital skills of individuals. Digital Competence is understood as “the set of knowledge, skills, abilities, strategies and attitudes necessary to use digital technologies and media” (Commission, 2018). The delay we are referring to has to do with the difficulty in keeping up with the growth of technologies in the market and with the implementation of these training actions for citizens in general and for students and teachers in particular. In addition to the increase in the supply of qualified teachers foreseen in the “Sustainable Development Goals of the 2030” (Assembly, 2015), Portugal launches the Dynamic Digital Competence Reference Framework (INCoDe.2030, 2019), an instrument for assessing the digital skills of the population. This document is based on the European Digital Skills Framework for Citizens (Carretero et al., 2017) and has three objectives: to support the definition of policies and strategies; design education programs; and evaluate and certify competences, either by self-diagnosis or by certifying entities.

Considering the importance of the Dynamic Digital Competence Reference Framework (DigComp) (INCoDe.2030, 2019) for citizens' digital literacy, the following are the five

competencies that support this model: Information literacy, Communication and citizenship, Content creation, Security and privacy, and Development of solutions. As part of the European Commission's DigComp initiative, the European Digital Competence Framework for Educators - DigCompEdu, has just been launched, in Portuguese (Lucas & Moreira, 2018).

3. Methodology

This research was developed with the support of the case study methodology in a Portuguese educational institution and aims to understand, through the Dynamic Digital Competence Reference Framework (DigComp), the evolution of students in terms of digital skills in the period of the covid-19 pandemic. For this we want to identify the digital skills of students at the beginning of the covid-19 pandemic and the skills acquired after a year in the context of online education. Comparing the results obtained it will be possible to understand the evolution of students regarding the acquisition of digital skills in online education.

It is important to note that the option for the case study methodology had to do with the fact of explaining a situation and describing an object or phenomenon: "It is an investigation that is assumed to be particularistic, that is, that deliberately looks at a specific situation that is supposed to be unique or special" (Ponte, 2006, p.2), in this specific case, the online teaching-learning process at a school in Portugal.

The educational institution has a total of 147 students, among them, 123 (83.67%) are female and 24 (16.32%) are male. The percentage of female individuals is very high when compared to the male gender. These results may have to do with the fact that the courses offered by this school - health and social sectors - are more conducive to the participation/attendance of female individuals.

To develop the research three data instruments are used that seem to be absolutely essential: the questionnaire survey, the semi-structured interview and the participant observation. The questionnaire survey was used in two phases: the first, at the beginning of the pandemic (in March 2020) to determine students' initial digital skills; the second phase for the application of the survey was in February 2021, also with the objective of identifying digital skills - one year after the beginning of the pandemic. Both inquiries were sent to the institutional email to all students at the school. The questionnaire survey answered 78.94% of the female gender and the rest of the male gender (17.89%). In order to complement the data from the questionnaire survey, a number of students were asked to participate in a semi-structured interview. In the semi-structured interview 66.66% of the female gender participated and the rest of the male gender (33.33%). The questionnaire survey was developed with support at DigComp (INCoDe.2030, 2019), namely, through the five competencies (information literacy, communication and citizenship, content creation, security and privacy and

development of solutions), the proficiency levels and their descriptors. In order to ensure uniformity, the script for the semi-structured interview was also supported by the DigComp board (INCoDe.2030, 2019). Participant observation (investigator's diary) took place during the e-learning period and was used to identify and understand students' digital skills in a virtual context. The information collected was essential to articulate with the data from the questionnaire survey and semi-structured interviews.

It is important to mention that, in the data triangulation process, namely through the semi-structured interview and the questionnaire survey, it was possible to find a set of suggestions that can contribute to the improvement and acquisition of students' digital skills. These suggestions emerged through questions to students and categories resulting from the data analysis process.

All data from participant observation (investigator's diary), semi-structured interview and questionnaire surveys submitted to students were properly analyzed in Microsoft Excel through a careful and rigorous analysis.

4. Search results

This section presents the results obtained with the development of this study that focus on the digital skills of students at the beginning of the pandemic and the skills acquired after a year in the context of online education. This presentation is based in the Dynamic digital competence reference framework, in which, for each area of competence, a list of competencies are shown. Four levels of proficiency are also listed, presenting examples of use that integrate knowledge, skills and attitudes. In the following two sections we present briefly the digital skills of students in the initial phase of online education (in March 2020) and in the final phase (in February 2021).

4.1. Digital skills of students at the beginning of the covid-19

Below are the data for each of the areas of digital competence held by students before the pandemic.

- Information literacy: (1) identify an information search engine; navigate in digital environments in order to obtain necessary information; (2) Recognize useful and appropriate information and data, obtained in digital environments; (3) Recognize the procedures associated with organizing, storing and retrieving data in digital environments.

- Communication and citizenship: (1) Identify and use simple means of communication appropriate for a given context; Identify and use digital technologies to interact with others; (2) Identify appropriate digital technologies to share data, information and digital content; (3) There is no competence in this area; (4) Identify and use digital tools and technologies

for collaborative processes; (5) Identify appropriate standards of behavior when using digital technologies and when interacting in digital environments; (6) There is no competence in this area.

- Content creation: (1) Identify programs / applications that make it possible to create digital files; (2) There is no competence in this area; (3) There is no competence in this area.

- Security and privacy: (1) Identify risks and threats in digital environments; (2) Identify risks and threats in the use and sharing of personal information; (3) There is no competence in this area; (4) There is no competence in this area.

- Development of solutions: (1) Identify simple technical problems when operating devices and using digital environments; (2) Identify needs; (3) There is no competence in this area; (4) There is no competence in this area.

The low level of skills or their total absence can be justified by the limitations mentioned by the students in the interview, which were later confirmed by the researcher as an observer, for example: Lack of access to digital (hardware / software); Lack of access to the network outside the school; Limited user skills, due to the lack of contact with ICT; Absence of practice-oriented training with technologies; Family and social environment inhibiting the practice with technologies.

4.2. The skills acquired after a year in the context of online education

The data for the areas of digital competence held by students after the pandemic:

- *Information literacy:* (1) Navigate digital environments in order to obtain the necessary information; (2) There is no competence in this area; (3) Identify appropriate tools for organizing, storing and retrieving data in digital environments; Choose documents of different formats, organizing them in custom folders; Apply appropriate tools for organizing, storing and retrieving data.

- *Communication and citizenship:* (1) Indicate and use at least one digital technology to interact appropriately; (2) Distinguish appropriate digital technologies for sharing data, information and digital content; (3) Recognize the need to respect digital accessibility standards; (4) There is no competence in this area; (5) Recognize aspects of cultural and generational diversity to be taken into account in digital environments; (6) Identify a digital identity and learn about ways to protect my reputation; Recognize data I produce through digital tools, environments or services; Recognize the difficulty of eliminating my footprint.

- *Content creation:* (1) Recognize the format of a digital file; Create simple content using specific programs or applications; Distinguish different digital media that allow me to express myself through the creation of digital content; (2) Identify the programs / applications that

can be used to modify or integrate new content and information, in digital files, giving rise to other new and original items; (3) There is no competence in this area.

- *Security and privacy:* (1) Identify ways to protect my devices and digital content; Follow pre-defined safety and protection measures; Follow ways to respect reliability and privacy; (2) Recognize personal information that can identify me or that can lead to the identification of others; (3) Identify digital technologies for social well-being and inclusion;

Recognize the importance of ergonomics in the use of digital technologies; Identify risks and threats from the use of digital technologies for health and physical and psychological well-being; (4) Identify the environmental impacts resulting from digital technologies and their use; Follow ways of protecting the environment.

- *Development of solutions:* (1) Identify simple solutions to solve them; (2) Recognize simple digital tools and possible technological responses to solve them; Identify simple ways to adjust and customize digital environments to personal needs; (3) There is no competence in this area; (4) There is no competence in this area.

There is a general evolution of students regarding the acquisition of digital skills in an online context, however, they do not seem to be statistically significant. There are actually a number of students who manage to reach DigComp's intermediate proficiency level, however, most remain at the basic level, showing that the evolution is very low.

4.3. Suggestions for the acquisition or improvement of students' digital skills

From the triangulation process of the data collection instruments, particularly the semi-structured interview and participant observation, a set of suggestions emerged that can contribute to the acquisition or improvement of students' digital skills:

- Use the latest, appealing and intuitive technologies that encourage students to participate and actively collaborate in online classes. It is essential that teachers choose the most appropriate technologies for each learning context;
- Train students to acquire digital skills. These trainings can, eventually, occur before the beginning of online classes, thus providing students with greater digital dexterity during a module, discipline or course;
- Provide teachers with digital skills, through training actions inserted in their professional development - continuous teacher training;
- Adopt, in the context of online teaching, synchronous tools that enable students to communicate, interact and collaborate in real time;
- Use gamification to motivate behaviors and make complex content into more accessible materials, facilitating the learning processes;

- Promote the constant updating of the content of the Subject of Information and Communication Technologies (ICT) and other that involve digital tools;
- Provide educational institutions with recent and useful technologies for learning and make technological equipment available to students free of charge.

5. Conclusions

In this study we identified the digital skills of students at the beginning of the covid-19 pandemic and the skills acquired after a year in the context of online education. We can say, beginning the pandemic, students had a very low level of digital skills - the largest group held basic DigComp skills. The remaining students were practically unaware of digital tools, their domain or their use. These questions seem to be related to a set of conditions that inhibit students' practice with digital technologies. During the period of online teaching, students were able to obtain a set of digital skills, however, they only managed to reach at most the intermediate proficiency level, staying almost always at the basic level. This means that during this period the students limited themselves to using technologies absolutely essential for carrying out the activities and tasks of the subjects in an online context. In general, students did not feel motivated and interested in investing time in the acquisition of more advanced digital skills, remaining only with the basic skills in the user's perspective.

Finally, the results identify a set of suggestions that can contribute to the acquisition or improvement of students' digital skills. These suggestions are related to the use of the latest technologies, the promotion of training actions for students, the adoption of tools that enable collaboration and the use of gamification to motivate behaviors and make complex content into more accessible materials. In addition, the value that these suggestions may have as a contribution to discussion in the scientific and academic communities.

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Assessing Database Development Skills using an On-line MCQ: Reflections on Test Design and Academic Integrity

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Abstract

This paper reports on the experiences of assessing a large postgraduate module in Database Systems using an on-line MCQ test under COVID-19 conditions with no remote proctoring. While the technology and the "higher order thinking" assessment worked well, analysis of response patterns suggested that, despite the use of randomised questions, time pressure and an honour pledge, a substantial number of students formed mini-networks during the test and colluded with each other to discuss the answers. No differences by gender or age were observed as regards tendency to engage in this behaviour, and domestic students were just as likely as international students to do it. Notably, domestic and international students seemed to stay apart, colluding almost exclusively with others of their own nationality.

Keywords: *Academic integrity; plagiarism; culture; MCQ tests; on-line examinations; database systems.*

1. Introduction

The practical difficulties of assuring academic integrity during the COVID-19 pandemic are by now widely acknowledged (Asgari *et al*., 2020; Senel and Senel, 2021). They are further compounded when cultural issues (Hayes and Introna, 2005; Maxwell *et al.*, 2008) and complications of on-line learning (Harris *et al.*, 2020) are added into the mix alongside the many other individual factors than can contribute to plagiarism (Moss *et al.*, 2018).

This paper reports on the experiences of assessing a postgraduate Database Systems module at an Irish university in the 2020/'21 academic year. The method of assessment was a Multiple Choice Quiz (MCQ) test which was administered on-line. Although the technology worked very well, problematic issues surfaced during the analysis of response patterns, suggesting that collusion may have taken place during the test.

2. Teaching Context and Assessment Method

"Database Systems Development" was taken by 167 students spread across three separate programmes, commencing in September 2020. The class was 36% female and 64% male, made up of 12 different nationalities, of which Ireland (38%), India (44%) and China (11%) were the biggest cohorts, with the remainder (7%) coming from Nigeria, Cameroon, USA, Mexico, Brazil, France, Ukraine, Pakistan and Indonesia. The median age was 25.4 years. The majority of the international students arrived in Ireland prior to semester and took up accommodation on or near the university campus, but a few remained in their home countries. Under normal circumstances, this module would have been taught in a lecture hall and assessed by means of an invigilated end-of-semester test in an examination centre. However, eight days into the academic year, it was announced by management that all teaching and learning would be conducted on-line for the remainder of the semester, with the sole exception of essential campus-based activities. This module was therefore taught on-line across 11 weeks, with a regular 1.5 hour slot on Microsoft Teams each week.

Because of public health guidelines, no examinations could take place in centralised indoor venues. The alternatives available under university emergency regulations were either an assignment, which students should complete in their own time and submit by a specified deadline, or a scheduled on-line examination of limited duration. For this module, the latter option was chosen as it was deemed to be more appropriate and trustworthy. It was initially proposed that the examination would be subject to remote proctoring. However, students were quite anxious about this and many of them expressed concerns:

"I live in an apartment with several others. It is not a quiet environment and it's beside a busy road so if I leave my mic turned on, it could disturb other students during the test."

"I have an unreliable internet connection and share it with other members of my household, including children doing home schooling because of COVID. What will I do if my webcam takes up all the bandwidth and the test freezes?"

"I don't have a webcam on my laptop. It is quite old and I cannot afford to buy a new one at the moment. I am worried that the on-line test might time out on me."

"It's very stressful being locked up at home and studying like this. I don't like the idea of being remotely watched in my own bedroom, it freaks me out, it's just too much."

Similar problems have been observed in other institutions (Asgari *et al*., 2020). In view of these legitimate issues about privacy, internet connectivity and additional stress at an already difficult time, it was decided not to proceed with remote proctoring. Instead, following Nguyen *et al.* (2020), candidates were required to declare in advance of the test that they had read the rules "and pledge, on my honour, to fully abide by them". To allow for possible connectivity problems, students were assured that there would be a degree of leniency with the examination duration, with a 30 minutes grace period before shut down.

All students were issued an email one week in advance of the examination, clearly setting out the format and rules that would apply. This included a notice that algorithms would be used to detect suspicious activity and a strict warning was served not to communicate or collude with others during the test.

The test consisted of 50 multiple choice quiz (MCQ) questions, each with four possible options of which one and only one was correct. It was assumed, given the absence of remote proctoring, that students would use their notes, even if asked not to do so. The test was therefore designed on this basis and students were told that it would be "open book". However, so that they would be under no illusions, they were advised that the questions would be "set in such a way that you need to understand concepts and apply your knowledge, not merely memorise material". As such, given the time constraint of the examination (two hours), if students had to resort to consulting their notes frequently, they would place themselves under pressure and this was made known to them.

The first half of the test examined knowledge of database design concepts. Most of these questions put forward four assertions and the candidate was required to use his/her understanding of the theory to decide which assertion was true or false. A few other questions in this section presented data modelling scenarios with four possible choices, again requiring the candidate to consider options and make a decision, thus requiring higher order thinking skills at the Analyse→Synthesise→Evaluate end of the Bloom *et al.* (1956) taxonomy. Such higher order MCQ questions have been found to be effective in science education (Nguyen *et al.*, 2020).

The second half of the test was based on knowledge of the Structured Query Language (SQL). The questions used a database schema that students were given in advance and asked to print out. The lectures and course exercises also used this same database so students were familiar with it and were expected to have practiced upon it. Instead of being asked to write SQL code from scratch, students' knowledge was assessed by other means: (1) "fill in the blanks" questions that required them to complete an SQL query by inserting the correct missing words in the correct order, (2) being asked to evaluate four different ways of solving a problem and selecting which of these ways is valid or not valid, (3) inspecting code snippets and being asked to detect which line(s) contain errors, if any, and (4) inspecting code and being asked what output it would generate. Students were told that they were not permitted to use an SQL interpreter during the examination. However, it was assumed that some of them would do so; accordingly, the queries to be evaluated contained logical errors (not just basic syntax errors) and used parameters that would return no results against the sample data set that had been provided. Therefore, if students attempted to cheat by asking the SQL interpreter to find the answer, it would be of little help.

The quiz was administered using Microsoft Forms, which required users to authenticate themselves using their university Office365 account credentials. Several days in advance, they were given a "mock" test with 10 sample questions and the precise rules and instructions that would apply. The purpose of this was to familiarise students with the interface and also to detect any technical issues that might arise. Based on student feedback on this mock test, two changes were made to the software implementation.

Firstly, instead of using radio option buttons, they were changed to checkboxes. This was because it was discovered that a student's selected answer could inadvertently be changed if he/she used the down-arrow key to navigate to the next question; by using checkboxes, this problem was solved. Although it was then permissable to select multiple answers, students were told that only one option was correct and multiple selections would be a zero mark.

Secondly, students suggested that all of the questions should have a "mandatory" validation check so that they accidentally did not miss or skip any. Literature on the design of MCQ tests suggests that negative marking should be used to dissuade candidates from random guessing (Roberts, 2006). By enforcing a mandatory rule on questions, it might encourage guessing. However, on any other assessment format, students are encouraged to attempt all parts and are not penalised for writing something that is a bit of a guess; therefore, the fairness of negative marking on MCQ tests is debatable. Zhao (2006) demonstrates that the likelihood of passing a MCQ test of four-option questions by guessing is highly improbable for tests with large numbers of questions. Furthermore, on all other forms of assessment, students are given partial marks for providing incorrect answers that are nearly right. On a well-designed MCQ test, the correct answer may not be too far removed from very similar incorrect answers. Based on this rationale, it was decided not to use negative marking for incorrect

answers, and also to award partial marks for questions where there was a statistically skewed distribution of incorrect responses, similar to the approach suggested by Grunert *et al.* (2013).

Guidance on the avoidance of cheating on MCQ tests recommends to present questions in a randomised order, one at a time, and not to allow back tracking. In this test, the questions and options were randomised but all questions were presented on a single screen and back tracking was permitted. This was again informed by student suggestions; as one student put it by email, "*In an exam, I sometimes skip past tricky parts and come back to them later, and I also like to check back over all my answers at the end of the test if I have time, so I hope we will be allowed to do this in the Databases MCQ test*".

3. Findings and Discussion

In advance of the test, there was quite a degree of trepidation amongst students about it being MCQ format and being a timed examination (all their other modules, with just one exception, used take-home assignments). In anonymous feedback captured at the end of teaching but before the test, one of them commented that *"the decision to have MCQ as a final test was a bit disappointing. I was expecting some sort of project where we could put into practice what we have learned for the module*". However, another remarked that "*it was made clear why we would be doing an MCQ so I am happy to be doing this*". Students were provided with a test bank of preparatory exercises to work on, but without the carrot of credit going directly for this, many of them did not feel incentivised to complete the exercises. After the test, the feeling was much more positive. One student said that *"My overall experience with the exam was really nice, I enjoyed each and every question asked, they were certainly tricky but it's just required to use a bit of brain and knowledge. I would say that if a student has gone through your class notes that you've shared all along and did the exercise queries, they can achieve an excellent score in it".* The performance scores on questions were very strong, with just 8 of the 50 having less than 50% correct. The median across the test was 79% correct, ranging from 10% on a question that only a very few students got right up to 100% on one question that they all answered correctly. Although this level of performance might suggest that the test was easy with a low level of discrimination amongst the possible answers, it can be alternatively explained by the fact that many of the students had some prior knowledge of databases and had obtained first class honours undergraduate degrees.

With a MCQ test in a class of high performers, it can be difficult to detect collusion because the majority of students will consistently pick the correct answers. Instead, it can be revealing to compare patterns of incorrect responses (Ercole *et al.,* 2002). In theory, the probability of two students randomly picking the same incorrect answer from two four-option questions is (3 matching pairs) / (9 possible combinations) = 0.33. Therefore, if students have five matching incorrect answers, the probability is 0.33^5 which is less than a 1 in 250 chance.

However, this is not a random process; incorrect answers do not have equal probability of being chosen because some may be easier to eliminate than others. Mogull (2004) uses a different basis for computation of probabilities, based on the number of students who correctly answer any given question. This approach is flawed in that it assumes that if 9 out of 10 students were to get a question right, that the probability of any given student getting it wrong would be 10%; but for a weaker student amongst stronger peers, this does not hold. Furthermore, it omits to consider the effect of two or more students who share the same misunderstandings because they study together. For the purposes of this exercise, it was therefore assumed that a threshold of 10 similar incorrect responses would be used, or 8 similar in the cases of persons who shared accommodation with one or more classmates (which was about a third of all students).

The MCQ test responses were exported from Microsoft Forms into a MySQL database, where they were transposed and a paired-list of possible collusion suspects was generated. Additionally, data on age, nationality and gender were linked to the responses. It was assumed that students took the test at their registered addresses so those details were converted into latitude and longitude coordinates using Google Maps and also imported.

The highest number of shared incorrect responses was 16. The statistical probability of this occurring (based on equal weighting for each option) is about 1 in 50 million so, if going just by mathematics, it would be an absolute certainty that this pair of students colluded. However, these two students were in two different Masters programmes, live thousands of kilometres apart and, to the best of the examiner's knowledge, have never communicated with each other. Both students failed the test and had several other incorrect responses.

Out of a class of 167 students, 35 had ten or more similar incorrect answers to other students. Of those 35, a few had ten or more similar incorrect answers in common with more than one student. The results of the similarity analysis were then exported from MySQL and imported into a Neo4J database, where graph queries were executed to detect suspicious clusters. This revealed several mini-networks of students who had numerous identical incorrect responses. Not surprisingly, six clusters were found amongst cohabiting students, including one group of four and another of three. Amongst students that were geographically distributed, several clusters of four or more students with similar answer patterns were also identified. Interestingly, these clusters were mostly of the same nationality, with Irish students and Indian students not mixing but rather forming their own groups. Chinese students and those of other nationalities barely featured at all, seemingly keeping to themselves (which might be because most of them were not in Ireland). While the presence of these clusters cannot be taken as absolute proof that collusion took place during the test, and perhaps the excuses of "I and my friend both got it wrong because we studied together" or "we both picked the second most likely options" can explain some of the similarity, it does seem quite likely that, even though students were seeing the questions in a different random order, some of them

were in communication with each other during the test and comparing responses. As regards gender and age, no differences were observed; males and females were just as likely to engage in this behaviour, as were younger students and mature students. Of course, it should be borne in mind that COVID-19 is a great leveller, with everybody feeling the pressure and perhaps behaving out of normal character.

4. Conclusions

MCQ tests are prone to cheating (Manoharan, 2019), and indeed this was previously experienced in this module, with students using pre-devised signals to communicate to each other in examination halls. Problems when going on-line were therefore anticipated, especially with no proctoring and students living together or connected virtually. The lessons learned from implementing an on-line MCQ test with randomised order suggest that this could work effectively if administered in an invigilated examination centre. It could also function well if the on-line class were geographically distributed, unlike the very unusual situation that occurred during COVID-19 where international students travelled abroad, only to become engaged in distance education while actually living on or near campus with other international classmates.

The comparison and clustering algorithms that were used to identify collusion suspects in this study are not complex but demand technical know-how to implement. Further time is then required to follow-up individually on each suspected breach. This places a very substantial overhead on examiners if all cases are to be pursued. Preventative measures must be the way to go on this rather than costly detection. It is likely that many of the teaching and assessment practices which were hurriedly adopted during COVID-19 will be refined and retained. Further study is required on the phenomenon of "classroom culture", and how students from diverse backgrounds coalesce to form on-line learning communities with shared social norms, ethical values and honour codes (Shafaei *et al*., 2016).

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Active learning in digital communications with low-cost software defined radio

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Abstract

Digital Communications have been traditionally taught in laboratory sessions from a theoretical point of view, using simulation platforms. However, current Academic Accreditation includes the dimension of "what students are expected to be able to do", which poses the need of decreasing the gap between standard simulated laboratory sessions and more practical and realistic approaches. In this paper, we propose a methodology to enhance the learning of practical aspects related to Digital Communications courses, as well as increasing the student's engagement, via the use of low-cost software defined radio devices. This methodology has been applied in the Degree in Telematics Engineering at the School of Engineering from the University of Valencia, Spain. With the aim of improving the engagement of both master and undergraduate students, a project based learning methodology has been implemented. In the paper, the methodology is described, several laboratory activities based on the 802.11 standard are presented, and recommendations for practice are given.

Keywords: *Software defined radio; SDR; digital communications; signal processing; HackRF One; USRP.*

1. Introduction

Telecommunication Engineering degrees, as well as Electrical and Electronic Engineering Degrees, include Digital Communications as one of the core blocks of their curricula. In the case of the School of Engineering at the University of Valencia (ETSE-UV), Digital Communications and Signal Processing for Communications stand for a 20% (24 European Credit Transfer System (ECTS) units) of the mandatory subjects and a 10% of the Degree in Telematics Engineering (DTE) (240 ECTS). Traditionally, these core blocks have been taught from a theoretical point of view, using the basic blocks of communication systems as a story line, i.e., source models, source coding/decoding, channel coding/decoding, modulation/demodulation, channel models and sink as described in Proakis and Salehi (2009).

Digital Communications courses usually include standard laboratory sessions where students can simulate parts of the system using Matlab, Python or C interfaces. In this paper, we discuss the potential of Software Defined Radio (SDR) platforms to narrow the gap between theoretical and practical implementation aspects in the framework of Digital Communications systems. The concept of SDR, Mitola (1992), establishes a new educational paradigm in the field of telecommunications, enabling the implementation of many components of radio communication systems using software, which, in addition, can be reconfigured in real-time. There is a broad range of SDR devices with different capabilities, as well as several software programs (e.g., LabVIEW, Matlab or GNU Radio (www.gnuradio.org/)) to support and manage these platforms. Universal Software Radio Peripherals (USRP) (https://www.ettus.com) are the most used and versatile devices. However, in general, USRP are quite costly devices, and several institutions are working towards low-cost solutions. For example, Stewart, Crockett, et al. (2015) developed an open courseware with RTL-SDR very low-cost devices (https://www.rtl-sdr.com/) (less than $20). In this case, MATLAB and Simulink were used to model digital communication systems. Work by Linn (2012) also targeted a communications laboratory with low-cost SDR capabilities. In this solution, Xilinx Spartan 3A Field Programmable Gate Array (FPGA) was considered (unitary cost of $200 each).

In the case of the DTE, each undergraduate course usually comprises 4 laboratory groups with 16-20 students each, which stands for an average of 40 SDR devices needed per course (courses can run in parallel). In our case, RTL-SDR devices have been used together with GNU Radio in introductory Digital Communications courses to increase the engagement of the students within an affordable budget as shown in Soriano-Asensi (2019). However, RTL-SDR devices pose some reliability problems, especially when connected during larger times due to power dissipation problems. Due to this, HackRF One devices from Great Scott Gadgets (greatscottgadgets.com/hackrf/), with a unitary cost of around $300, have been acquired and integrated into more advanced courses at the Master's Degree in

Telecommunications Engineering, with a lower number of students (around 15 students in average). In this paper, we propose a Project Based Learning (PBL) methodology to improve the learning of practical aspects related to Digital Communications courses via low-cost SDR, which has proven to enhance the engagement of both master and undergraduate students. More precisely, we explore the use of HackRF One from Great Scott Gadgets with an open source software tool such as GNU Radio.

2. Methodology and materials

The methodology used in this paper is based on the analysis of the requirements of the theoretical-practical development of laboratories for different subjects at undergraduate and master levels. Digital Communications contents are distributed in the different courses (undergraduate and master levels) at the ETSE-UV's Telecommunication studies in a bottom-up approach: digital modulations (in baseband and passband), channel equalization techniques to avoid monocarrier and multicarrier inter-symbol interference (ISI), source coding and channel coding techniques, synchronization techniques, diversity and spread spectrum techniques, etc. Student's perception of the use of SDR was caught by a poll launched in different courses in the academic year 2015-2016 as shown in Segura-Garcia (2016). In this survey, students were asked about their perception regarding the practical knowledge gained via the use of the SDR, trying to assess the need of a higher experimental load. The introduction of the SDR concept supported a better perception of these courses allowing a reduction of the abandon rate.

In this contribution, we explore the potential of the combination of low-cost SDR devices with a PBL strategy. In the academic year 2019, master students registered in the Advanced Signal Processing for Communications course were asked to develop projects based on GNU Radio and HackRF peripherals. With the aim of benefiting from a peer instruction-like scheme, these projects were later adapted by the master students to be performed as laboratory sessions for their undergraduate colleagues at the Digital communications course. Note that standards such as WiFi (802.11), IEEE (2016) are very useful, since their functional blocks show a good overlap with the contents of the courses participating in this methodology. In this framework, the motivation and engagement of both master and undergraduate students are increased. We take as references the cases of the University of Seville, Pinar-Domínguez and Murillo (2011) and the University of Washington, Wyglinski, Pu, et al. (2011), which already incorporate these elements to their teaching, but without the combination with active learning methodologies. We oriented our project to use HackRF One, a low-cost platform with enough feasible characteristics for different complex projects and standard implementations. At the same time, GNU Radio is an open-source solution with a good community support and offering a block-based graphical interface which greatly simplifies the learning curve.

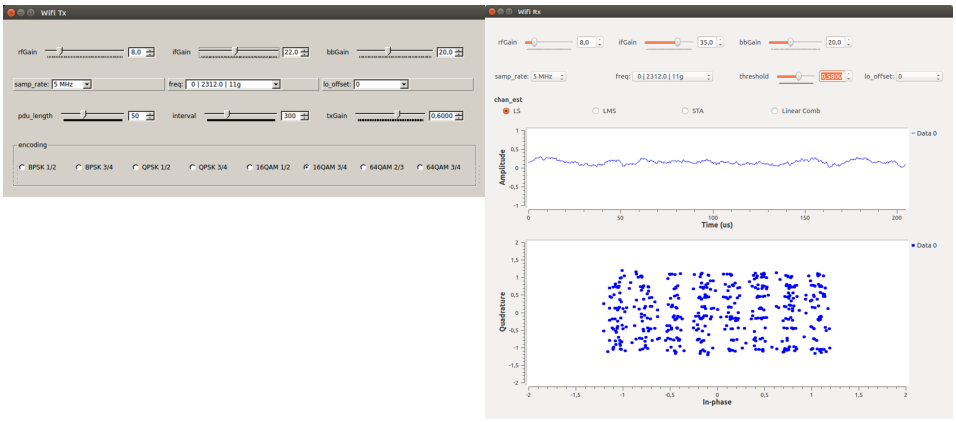
3. PBL in digital communications

PBL is a style of active learning that places the student in the center of the learning process. Active exploration of real-world challenges allows students to acquire a deeper knowledge. The learning process in PBL is led by students while the teacher's role is to guide student's research by introducing questions and tasks that help them to solve the proposed problem. The teacher is expected to introduce the problem and provide students with the materials and documentation required to start the project. Students are expected to assume the leading role of the project as the activity goes on.

3.1. Project preparation, instruction and initial tasks

PBL was implemented in a master's course because of the larger experience of students compared to undergraduate ones. Moreover, the number of master students per course (typically 8-10) is smaller than the 16-20 students per laboratory group in undergraduate courses. Students were organized in pairs, and all of them were asked to design a testbed to evaluate the performance of an 802.11 system. They were provided with two HackRF One per group, an Ubuntu 16.04 Virtual Machine (VM) with GNU Radio and the link to the github project implementing the 802.11p standard (*gr-ieee802-11*, https://github.com/bastibl/gr-ieee802-11), as detailed in ETSI (2009). During the project, students were given access to the communications laboratory where there was a workplace with a computer, which had the same software that was installed in the VM. The workplace was shared by all the groups, so they had to take turns to access the laboratory. The VM allowed students to conduct part of the activity at home, while the workplace at the communications laboratory permitted to test their advances with the SDR hardware.

Students were expected to conduct part of their research outside teaching hours, while the time in class was devoted to check the evolution of each group and to help them to continue with their work. The activity required three class sessions (3 hours each). The first session was used to introduce the project to the students. They were instructed with the VM, the *gr-ieee802-11* github project, and its documentation. The SDR project described in ETSI (2009) is based on USRP devices, while the project was expected to be done with HackRF One. In this first session, the teacher instructed students about the differences between the USRP and the HackRF One. The task proposed to the students in this first session was to adapt the *gr-ieee802-11* project to be used with the HackRF One. One of the drawbacks of the HackRF One is that it introduces a Direct Current (DC) spike in the received IQ signal. Students were advised to install the gr-correctiq (https://github.com/ghostop14/gr-correctiq) github project, and to use the *correctIQ* block in combination with the osmocom- source in order to remove the DC spike introduced by HackRF One.



a) *b)*

Figure 1. a) Image of the transmitter GUI, with the controls that allow to choose the characteristics of the transmission. b) Image of the receiver GUI. The receiver controls are placed in the upper part of the GUI, the middle part shows a time plot of the signal used to determine the arrival of a new packet. The lower part shows the symbols received in the last packet (from a 64-QAM modulation).

The resulting Graphical User Interfaces (GUI) developed by the students for the transmitter and receiver are shown in Figure 1. Figure 1.a shows the GUI that allows to adjust the transmission parameters, consisting of four rows of controls. The first one contains the three adjustable gains for the RF, intermediate frequency and baseband stages of the HackRF One. The second row of controls permits to set the sampling and channel frequencies. The controls in the third row are used to adjust the packet size and the time interval between consecutive packets. Finally, the desired modulation can be selected from the controls in the fourth row. Figure 1.b shows the GUI with the controls of the receptor. The upper part contains three rows of controls to adjust the performance of the receiver. The controls in the first and second rows of controls are similar to that shown in Figure 1.a for the transmitter. A threshold control was added in the second row, its function is to set the threshold that triggers the detection of an incoming packet. The third row of controls permits to choose the channel estimator among Least Squares (LS), Least Mean Squares (LMS), Spectral Temporal Averaging (STA) and COMB type. The central part of the receiver GUI (Figure 1.b) plots the time variation of the signal at the output of the short sequence detector, which is used to trigger the receiver on the arrival of a new packet. Finally, the lower part of the GUI shows the constellation of received symbols.

The controls in transmission and reception GUIs and the information shown in the reception GUI allowed the students to adjust the parameters for each modulation scheme. As a result, students were able to fix the gains of the transmitter and receiver HackRF One. The *gr-ieee802-11* project allows to set the sampling frequency either to 5 MHz or 10 MHz. But, considering that the maximum sampling frequency of the HackRF One is 20 MHz and in

order to reduce the computing requirements of the receiver, the students concluded that it was more appropriate to set the sampling frequency to 5 MHz. Students also evaluated which was the most suitable channel to conduct their experiments, since the presence of other WiFi Access Points (AP) interfered with the experiments. Better results were obtained in general when the lowest or the highest channels in the 2.4 GHz band were used. The number of AP in the 5 GHz band was smaller than in the 2.4 GHz band. However, a worse performance of the HackRF One was appreciated at 5 GHz. Considering the better performance of HackRF One at 2.4 GHz and in order to avoid interference from neighboring AP, the experiments were conducted at 2.3 GHz.

3.2. Student leadership

The teacher's role in PBL is to introduce the project and to suggest several tasks aimed at guiding students' research. Students are expected to progressively take the leadership of the work. This part of the PBL methodology lasted the second and third laboratory sessions, depending on the degree of autonomy of each group of students. The activity proposed to the students at this stage was reading a file and sending it through the wireless channel in order to evaluate the percentage of transmission errors. The chosen text was the cavalry book *El Quijote* from Miguel de Cervantes (1605). The comparison between sent and received texts showed that differences were due to packet losses. In order to automate the analysis, the wireshark connector block available in the *gr-ieee802-11* project was used to create two .pcap files, with sent and received packets, that were processed afterwards with a Python script in order to calculate the error rate (see Table 1). When using the 16 QAM and 64 QAM modulations, it was required to enable the RF amplifier of the HackRF One used for the transmission, while it was not required in the remaining modulations. Three different packet sizes were considered in order to evaluate their contribution to the error rate. In general, the error rate increased with the packet size. The high increase of error rate between 16 QAM and 64 QAM modulation suggests that the channel quality was not good enough to work with 64 QAM, since most packets were lost in these cases. Larger error rates were obtained with BPSK modulations than those observed with QPSK and 16 QAM, indicating that a deeper understanding of the implementation is required to determine the cause of such an unexpected observation.

Table 1. Error rate for the available modulations considering several packet sizes. Second, third and fourth columns stand for the packet size in bytes.

Modulation	Packet size (500)	Packet size (1000)	Packet size (1500)
BPSK 3/4	0.08	0.14	0.22
QPSK 3/4	0.04	0.08	0.12
16 QAM 3/4	0.07	0.10	0.08
64 QAM 3/4	0.85	0.97	0.99

4. Applying the benefits of the PBL experience to DTE laboratories

This section explains how to exploit the results achieved with the PBL experience at the master's level to enhance the laboratories in the DTE. Master students are the main actors of their learning process, while the experience provides the teacher with valuable information related with the system performance and with the problems they face. This information has been gathered in order to design a more guided experiment for the undergraduate DTE students. One of the comments raised by master students was the higher computing resources required by the receiver compared with the transmitter. In order to facilitate this task, a specific block (see Figure 2) containing the implementation of the physical layer of the receiver was constructed, while the block provided in the *gr-ieee802-11* project was still used for the transmitter. DTE students are provided with the block diagrams of the transmitter and receiver shown in Figure 3.a and Figure 3.b, respectively. Both diagrams include the wireshark connector block in order to create the .pcap files. The Python script used to analyze these .pcap files will also be provided to DTE students, so they can focus on performing the evaluation of the system rather than in designing the testbed. The implementation of the receiver shown in Figure 2 is also available, so students can identify the functionalities required in the detector.

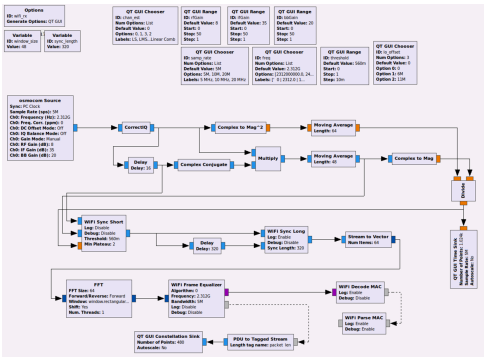
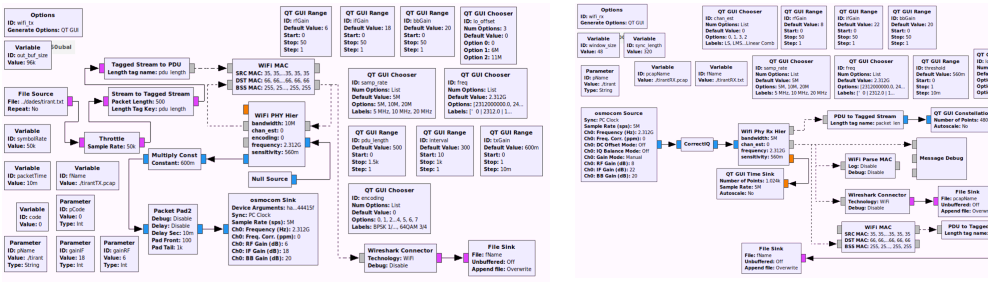


Figure 2. Block diagram of the physical layer of the WiFi receiver.



a) *b)*

Figure 3. a) Transmitter and b) receiver block diagrams.

5. Conclusion

Prior experience of the authors revealed the students' demand of more applications oriented Digital Communications and Signal Processing laboratory sessions. In this sense, software defined radio has proven to be an excellent tool to introduce real applications when teaching Digital Communications. This work presents the project-based learning experience conducted with students of the Master of Telecommunications at the School of Engineering from the University of Valencia, where they were proposed to design a testbed to evaluate the performance of a WiFi transmission system. This active learning activity contributed to position the students in the center of their learning process. In addition, the combined use of software defined radio and project-based learning has helped to increase the engagement of master students in the laboratory activities. From the results achieved by the master students, valuable information has been gathered in order to design similar and more guided activities for undergraduate students.

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Transition to virtual education at University of San Carlos of Guatemala 2020

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Abstract

The transition from traditional teaching to virtual teaching in public institutions of higher education (PIHE) is a process that began with the first computers in the 20th century, which has been accelerated by the Covid 19 pandemic, forcing the PIHE to adopt new virtual learning environments for which the traditional educational model was not designed at the University of San Carlos de Guatemala (USAC).

The global characteristics of the Covid 19 pandemic have affected USAC teachers, students, administrative and service workers, and authorities, who had to adapt various methodologies with the support of ICT to continue the educational process. The implementation and use of these technologies evidenced a digital divide both in cognitive processes and in the use and access of digital tools. The study addressed the trends of use and access to technology in three case studies at the campus of USAC in Guatemala City: Architecture, Humanities and Economic Sciences, with a sample of 2,128 students, who responded through a Google form survey instrument, interviews and a forum, from February to may 2020.

The results show that the different socioeconomic levels affect the access and use of technology for the educational process, which is why it is necessary for PIHE to adopt policies and strategies that guarantee education.

Keywords: *Educative model; digital breach; digital devices; social and academic networks.*

1. Introduction

The transition from face-to-face modality to virtual learning environments in public institutions of Higher Education (PIHE) has been accelerated throughout 2020 due to the policies of physical distancing derived from the Covid 19 pandemic, which caused both teachers and students to change abruptly the dynamics of the educational process, which came to depend almost exclusively on digital platforms, which promised to be an efficient and effective solution to overcome physical barriers and fulfill academic programs, supported by the notion that groups of *digital natives* and *immigrants*, were supposed to dominate ICT (Prensky, 2001). However, such assumption was supported by Prensky's experience in the United States context, (Koustropoulos, 2011), within a generational theory such as Millenials, developed by sociologists Neil Howe and Willian Strauss (2009) in *The Fourth Turning* (Strauss & Howe, 1997).

Nevertheless, reality showed that in Guatemala both teachers and students and the institutions themselves were not prepared to face a completely virtual modality, nor did they master ICT, showing, that instead of *digital natives*, as proposed by Van Dijk, there is a *digital divide* (van Dijk, 2006) this concept divides those who can possess technology and those who cannot, those who are skilled at taking advantage of it and those who are not as well as the development of new taxonomies applied to education (Bloom et al., 1956; Churches, 2009; Marzano & Kendall, 2006).

Moreover, the lack of interaction between students and teachers, and between the students themselves, leads to emotional and physical disorders (Kennedy et al., 2009), in addition teachers show stress and the "lack of social-emotial competencies to cope with the circumstances" (van der Spoel et al., 2020, p. 624), among other problems, related to the adoption of technology by teachers in such a short time.

Other studies (van der Spoel et al., 2020; Almazova et al., 2020) have addressed the perceptions and experiences of *teachers* regarding the impact that the use of ICT has had in public higher education institutions that enable the Equity in access to technology for all, however, this research addresses trends in the use of ICT in three groups of ***students*** in three different academic units of the USAC, who have greater limitations than teachers, in access to technology such as Internet access, equipment, software, overcrowding, electricity, among others (Toro González, 2020; Pedró, 2020), a situation evidenced and aggravated by the Covid-19 pandemic.

1.1. The traditional educational model

At USAC, throughout the 20th century, the traditional teaching model has been used. "The most used throughout history, part of the principle that teaching is to transmit knowledge, which is possessed by the educator. In this model, the student occupies a passive role, he is

a mere receiver of the knowledge that the educator must pour on him. In this sense, the educator occupies the leading role, since he must find a way for the students to learn, as if everything depended on him ". (Brockbank, 2017). This model, centered on the professor or teacher, in a traditional, face-to-face classroom environment, began to change with the process of self-evaluation of careers and programs of the USAC, in the nineties, with the appearance of digitization initiatives of the library catalog USAC headquarters, as well as the catalog of studies for remote online access. Later, in the second decade of the 21st century, some academic units established virtual platforms, among which we can mention Moodle, Adobe Connect, Chamilo, among others. However, its use was limited to academic administration, and, to a lesser extent, some academic units used it for teaching. This changed in the context of the Covid 19 pandemic, in which there was an increase in the use of accademic platforms, as well as specific applications such as Meet or Zoom, that were rarely used before.

The change in the trend of ICT use began much earlier, with the so-called knowledge society, whose implications go beyond the mere use of technology and encompass socio-economic aspects at a global and local level. This is reflected in the access to digital tools used by students, in a society where the consumption of both goods and services, and ideas prevails in a dematerialized world immersed in dataism (Han, 2019), in the 4th industrial revolution, where economic and cultural dimensions and contexts that affect the educational, among which the transition from a sequential process to a multitasking environment can be highlighted.

2. Method

The central categories proposed by Mark Prensky (2001) relative to the educational process and his later self-criticism were identified, as well as other authors such as Susana Lluna and her collaborators (Lluna Beltrán & Pedreira Garcia, 2017), Robert Darnton (2010), Marc Bloch (1993), among others, with which a Google Forms digital survey instrument was built. The survey included seven parameters: General Aspects; Technological aspect; Digital tools and traditional methods in data management; Multitask; Reading habits; Socio-economic aspects; and finally, Cognitive aspects. There were 37 questions, both open and on Likert scales. Prior to the development of the survey, the instrument was validated with a pilot study sample of 75 students from the Faculty of Architecture during 2019, after which, in 2020, information was adapted according to the specific disciplinary field of the three selected USAC academic units: Architecture, Economic Sciences and Humanities, with the participation of a sample of 2,189 students. The method included an on line survey, for the first six cathegories, and interviews, Atlas.ti, and a Zoom forum developed during may 2020, with the participation of 8 universities both from America and Europe for the Cognitive aspect.

3. Results

3.1. General aspects

The structure of the population (N) pyramids of the three academic units by five-year age groups, was analyzed, with data from the office of the registrar of USAC (Departamento de Registro y Estadística). This structure was then correlated with the sample, which shows similar composition, in terms of age groups and sex in the three academic units analyzed.

The survey reveals that most students (71 %) at the main campus of USAC, located in Guatemala City, come from the metropolitan area, even though, USAC has other campuses distributed in the country side of Guatemala.

3.2. Technological aspect.

Based on the hypotheses of Mark Prensky (2001), regarding the impact of technology, a series of questions were developed, with respect to the age at which students were born, the age when they had they first computer, their first cell phone, the first access to internet, among other aspects. It was found that about 80% of the students had access to a computer before the age of 14, as can be seen in figure 1.

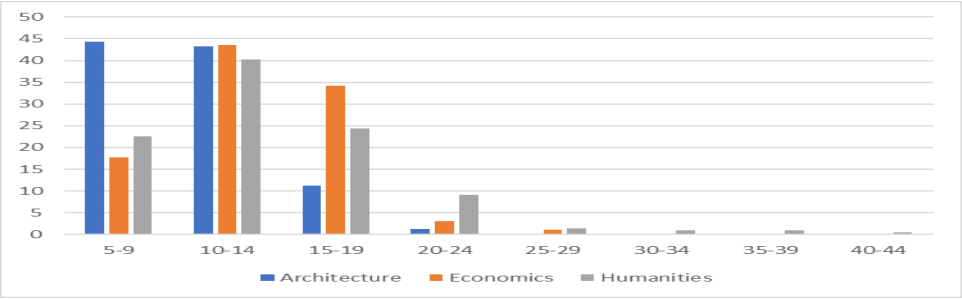

Figure 1. Relative frequency of the age at which the students who answered the surveys had access to their first computer, according to five-year groups in the three study units, indicated as a percentage. Source: Survey applied from February 25 to August 31, 2020, by the project team The myth of digital natives, trends in higher education. Using Google Forms, email and the dissemination platform of each academic unit.

3.3 Digital tools and traditional methods in data management

The questionnaire explored trends in the use of technology by asking students what do they do online? The specific questions regarding the trends in each academic unit fall outside the scope of this paper, however, the results indicate that in the three case studies, more than 60% of the time online is distributed between **music and video, searching for information, email, watching the news** (figure 2a, 2b, 2c). Followed by more than 30% dedicated to games, downloading books or applications, among others. Although the result confirms international trends in the use of social networks such as Facebook or WhatsApp, it also

reveals applications with upward trends such as Instagram, Pinterest, YouTube, among others.

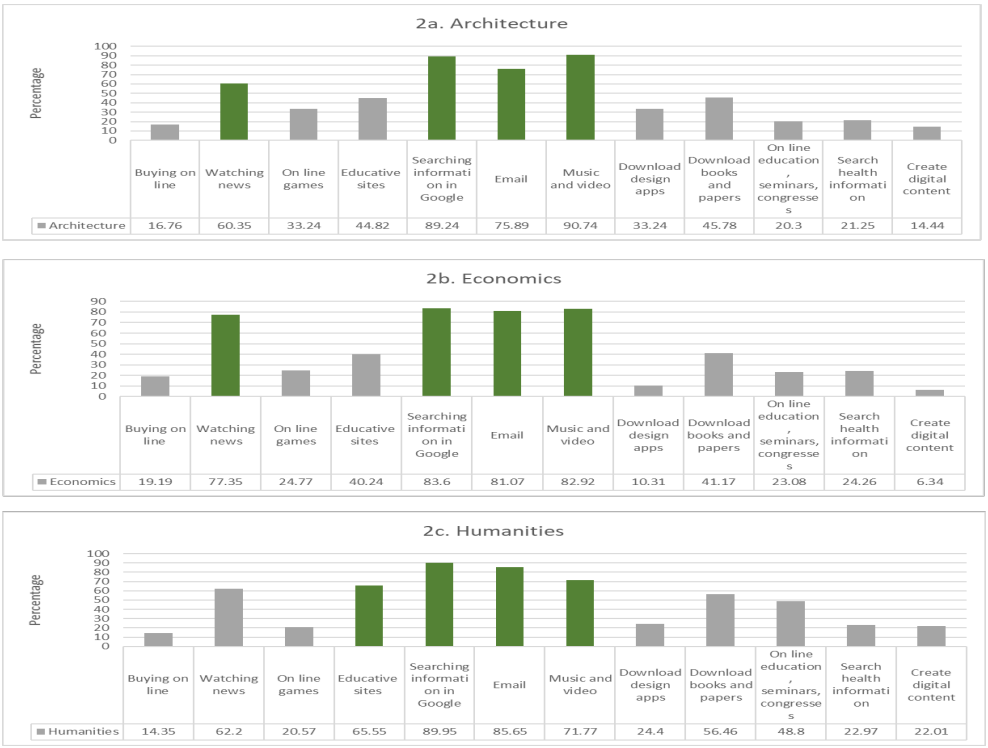

Figure 2a, 2b, 2c Relative frequency, of the activities that students do online, in the three study units. From top to bottom, 2a, Architecture; 2b Economics; 2c Humanities. Source: Survey applied from February 25 to August 31, 2020, by the project team The myth of digital natives, trends in higher education. Using Google Forms, email and the dissemination platform of each academic unit.

3.4. Multitask

This is a central and contradictory cathegory proposed by Prensky (2001). Even though students have the general idea that it is going to be required at work, and they feel capable of doing various things at the same time, with at least three applications on their computer, more than 44% indicate that they concentrate better when performing a single task at a time, and that they make more errors as a result of multitasking.

3.5. Reading habits

This group of questions explored first how students interact with the on line catalog of university libraries, and then, if they have access to academic contents available at other sources. Surprisingly, near 35% of students never consult the on line catalog.

3.6. Socio-economic aspects

The socioeconomic aspects reveal that there are differences between the academic units, while in architecture 68.12% of students sustain their studies with family support, and 31.38% work to sustain their studies; In economics, this trend is reversed, since 80.13% work to sustain their studies, with only 19.70% dependent on family support. The case of Humanities falls between these two extremes, with 76.07% of working students and 23.92% of students with family support (figure 3).

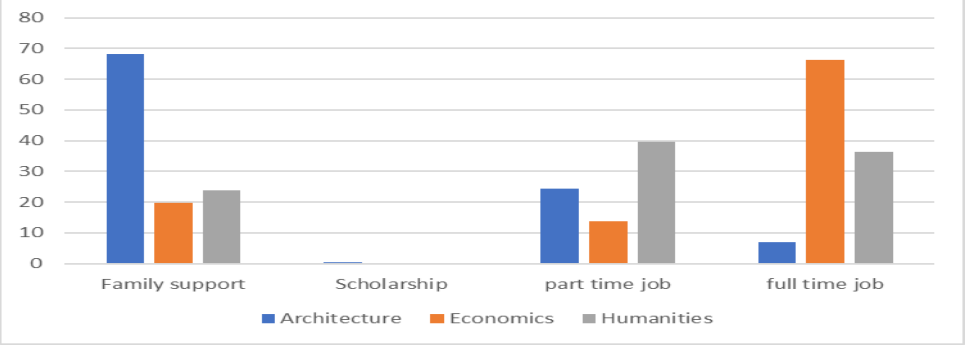

Figure 3 Relative frequency, indicated in percentage, of how students from the three academic units sustain their studies Source: Survey applied from February 25 to August 31, 2020, by the project team The myth of digital natives, trends in higher education. Using Google Forms, email and the dissemination platform of each academic unit.

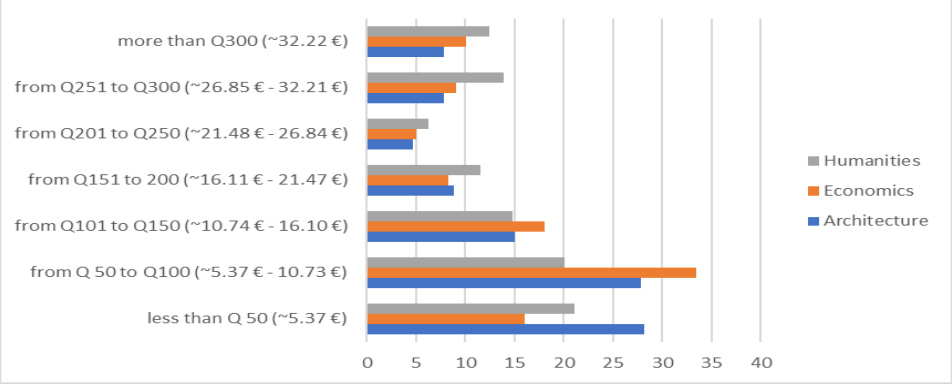

Figure 4 Relative frequency, indicated as a percentage, of how much the students of the three academic units invest in cell phone service each month trends in higher education. Using Google Forms, email and the dissemination platform of each academic unit. Source: Survey applied from February 25 to August 31, 2020, by the project team *The myth of digital natives,*

3.7. Cognitive aspect

The cognitive aspect were analyzed with Atlas.ti, interviews to students and teachers, and a zoom forum developed during may 2020, with the participation of 8 universities both from America and from Europe. Students think that there is a positive impact of ICT on their

academic formation, however, they don´t use ICT for academic purposes, and are devoted more to a superficial use of ICT through social networks, without an in depth critical thinking. Other aspects have been accelerated and made visible from the pandemic: first, educational and family activities are mixed together, there is a lack of eye contact among students and teachers, teachers lack interaction with their colleagues during evaluation, there is also according to Prof. Francesca Giofré, from Sapienza di Roma, a lack of technical vocabulary that has had to be constructed during the pandemic.

4. Discussion

The results show, first, the limits of the digital navites paradigm as proposed by Prensky, the supposed mastery of ICT by groups of students was only a myth. The idea of multitasking shows the pressure of the environment, that pushes students to declare on one hand that they are multitaskers, and on the other hand affirm that they concentrate better doing a single activity. Within the concept of Multitasking, the relationship of human beings with technology is hidden, in which human memory processes, with their limitations, can be increased with the use of digital devices where technology is used as a prosthesis. The immediate consequence is dependence on such devices and applications.

The transition from face-to-face classes to virtual learning environments already existed, and has been accelerated by the pandemic. This transition is reflected in the students' preferences in terms of using traditional media or digital tools to carry out their tasks, however, at the same time, as shown on table 6, their access to internet data is limited by their budget, increasing the digital divide, which is also discipline sensitive, as shown in the table 5, differences between Architecture and Economics regarding family support or if students have to work to finance their studies.

In the case of Architecture, Economics and Humanities, this transition shows two polarized groups, those who use and those who do not use digital tools. The transition process has revealed the great digital divide in the USAC, and its socioeconomic implications for students in the context of the covid-19 pandemic, and also, the fragile support to public higher education institutions in Guatemala.

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Reducing the Individual, Institutional and Societal Harms from Student Drug Use

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Abstract

Drug use among higher education students can cause harm to the individual, their institution, and the wider society. Academic performance, physical and mental health, institutional reputation, crime and unemployment can all be impacted by student drug use. Tackling this is a challenge, and is often compounded by limited student health and counselling capacity and the student's reluctance or unwillingness to seek support. Digital brief interventions have shown promise in reducing harm from substance use, and provide an opportunity to meet students where they are, delivering always-on, confidential support and intervention. However, limited interventions for drug use are available for students, and many struggle with engagement and retention. Our team have developed a novel brief intervention, using best practices in digital intervention development, and behavioural change to overcome some of these challenges. We describe the development of our intervention and discuss how implementation could result in tangible benefits to the individual, institution, and society.

Keywords: *Drug use; digital intervention; harm reduction; behaviour change.*

1. Introduction

Drug use among higher education (HE) students is an under-researched and under-resourced area. Anecdotal evidence from student health departments and student welfare offices speak to an increasing prevalence of drug-related issues among students, but empirical data to back this up is limited. A recent survey of 18-25 year-olds in Ireland suggests that 50% are at risk of problems from drug use (Dooley et al., 2019). Further, around a quarter of students report recent drug use (Schulenberg et al., 2018). Drug use has been linked to a myriad of personal, institutional and societal harms, as illustrated in Figure 1.

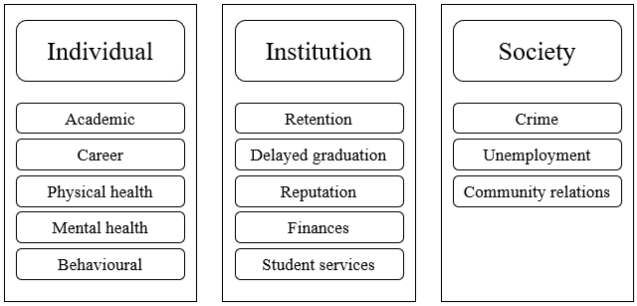

Figure 1. Individual, Institutional and Societal Drug-Related Harms

1.1. Individual

Harms from drug use are most concentrated to the individual and can include a range of academic challenges from missing classes (Kunst & Gebhardt, 2018) and receiving lower grades (Arria et al., 2015), to failure to attain a degree (Horwood et al., 2010) and expulsion or suspension (Palmer et al., 2012). In the longer term, harms can extend to post graduation and impact on career trajectories for graduates (A. M. Arria et al., 2013).

In terms of physical health, students have reported panic attacks, insomnia and sleep problems, nausea seizures, memory loss, unconsciousness, weight loss, loss of mobility, and teeth problems (T. H. Bennett & Holloway, 2014; Kunst & Gebhardt, 2018). Students have reported significant mental health problems (Skidmore et al., 2016), including a worsening of a pre-existing condition (NUS & Release, 2018), psychosis, increased depressive symptoms, deliberate self-harm, suicidal ideation and suicide attempts (Juan et al., 2015).

Students who use drugs have reported engaging in risky sexual behaviour (Skidmore et al., 2016), being aggressive or violent, getting involved in fights (Palmer et al., 2012; Skidmore et al., 2016). Additional harms can include legal (Palmer et al., 2012; Skidmore et al., 2016) and financial issues, failing to fulfil role function and losing interest in activities (T. H.

Bennett & Holloway, 2014). Further, students have reported minor harms such as embarrassment and guilt (Palmer et al., 2012).

1.2. Institutional

Drug use among students has been linked to increasing drop-out rates, delayed graduation and disruptions in college enrolment (A. M. Arria et al., 2013; Suerken et al., 2016). As many as 25% of students reporting minimal drug use may fail to complete college, increasing to 40% in chronic users (Amelia M. Arria et al., 2013). Further, interruptions to college enrolment have been reported in students who experience or seek treatment for depressive symptoms, for which drug use is a risk factor (Amelia M. Arria et al., 2013).

Issues with retention and progression can impact on institutional reputation and rankings. This may have a knock-on effect on the financial health of the institution as in some systems, external funding is dependent on student retentions rates (Yorke & Longden, 2004). Further, reputational damage could affect alumni donations (Downes, 2017). Parents often play a key role in deciding where their child attends college, and often provide significant financial support. Anti-social behaviour or crime committed on campus or attributed to students or staff can also damage the reputation, and impact on local perceptions of the institution. Direct financial costs from drug use can occur from the services required to support students, including student health costs, welfare officer time, and student counselling hours.

1.3. Societal

Students who use drugs have reported committing crimes such as driving while under the influence, violence and property damage, drug selling, anti-social behaviour and theft (T. Bennett & Holloway, 2018). A UK study found that 14% of drug users had come into contact with the criminal justice system as a result of their use. The majority had been searched for drugs by police or security, a quarter had received a police caution, and 10% had been arrested. A small percentage had been fined or charged with possession (NUS & Release, 2018). Further, drug involvement during college may also have significant adverse effects on post-college employment, possibly contributing to unemployment rates (A. M. Arria et al., 2013). HE Institutions (HEIs) often form a central landmark of towns and cities. As a result, anti-social behaviour and crime can also impact on those living locally and damage relationships within the community (Munro & Livingston, 2012).

2. Brief Intervention Therapy

Screening and brief interventions aim to identify current or potential problems with substance use, and motivate those at risk to change their behaviour. They are generally short, ranging from 5-30 minutes and are a valuable tool for addressing problematic or risky substance use behaviour. They can also be used to motivate those with more serious problems to seek and

accept more intensive intervention, or serve as a signpost to services (Henry-Edwards et al. 2003). The digital delivery of brief interventions allows for greater accessibility, flexibility and confidentiality. Participants can access digital interventions anywhere, at any time. They can circumvent the limited resources of face-to-face care, and research indicates that they are as effective as clinician-delivered interventions (Hoch et al. 2016).

Digital brief interventions have shown success in reducing harm from alcohol and tobacco among college students. The most widely-used digital brief intervention tool in HE is e-Check Up to Go (e-CHUG), a brief assessment and personalised normative feedback tool developed in the US. e-CHUG has proven efficacy in reducing harm from alcohol and has been implemented in 600 HEIs (San Diego State University Research Foundation, 2018). There are far fewer interventions for drug use, but evidence suggests a moderate reduction in measures of harm (Dick et al., 2019). However, many existing interventions report issues with retention and engagement, and lack a theory-driven behaviour change framework. Further, many of the interventions found in the literature do not appear to be publicly available. Of those available, the majority have been developed for US-based HEIs, which have traditionally different cultures from European HEIs.

3. Research and Development

My Understanding of Substance-use Experiences (MyUSE) is a research and development project being carried out in a large university in Ireland. This project is led by a multi-disciplinary team contributing expertise in student health, health information systems, public health and health psychology. The aim of the project is to develop and evaluate a digital behaviour change intervention for drug use among higher education students. We attempted to improve on the shortcomings of previous interventions by following a rigorous user-centred design methodology, in order to develop an engaging tool that students will want to use. Further, the content was developed using a well-established and robust methodology for intervention development following psychological theory. A Student Advisory Group were assembled at the outset of the project to guide the project from the perspective of the student, providing input and feedback on all aspects of the research, design, and development.

The first phase of the project was to research the area; establishing the efficacy of digital intervention for drug use, explore student motivations to change substance use behaviour, and establish best practices in intervention development. We conducted three systematic reviews to understand these key areas. Additionally, we conducted a survey of student drug use in the host institution, and conducted user-centred design workshops with students in order to better understand the issue of drug use, and how best to design our intervention to tackle it.

The second phase of the project was the development and design stage. A synthesis of our previous research was undertaken, following the Behaviour Change Wheel methodology in order to identify specific clusters of behaviours to target. From this, a large number of behaviour change techniques (BCTs) were identified for inclusion in the intervention. The second part of this phase was then to translate these theory-ground BCTs into a digital format. The research and development teams worked closely to develop scripts and to devise appropriate digital presentations of the content. This work was underpinned by development of the technical infrastructure to support these features. Figure 2 presents an overview of the content development from behaviour cluster identification to digital implementation. Throughout the development, several workshops were conducted with students to test and validate the digital content and platform.

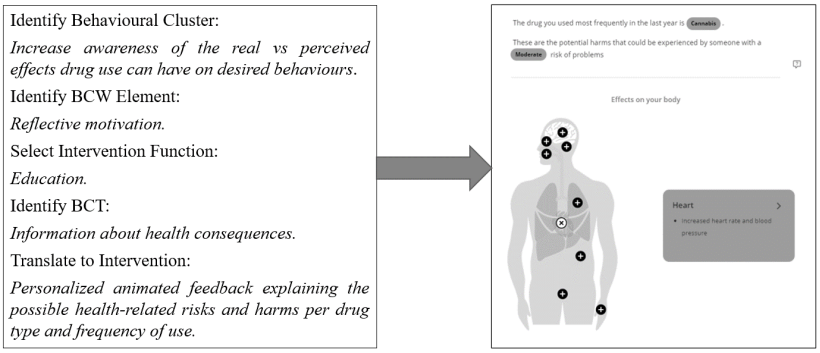

Figure 2. MyUSE Content Development.

MyUSE v1 was released in September 2020. This is a web and app-based intervention which allows students to self-assess their drug use and risk of problems using validated measures, receive personalised feedback on harms and education around drug use. Further, the intervention incorporates motivational interviewing, tailored behaviour change components and contextual skill-based activities, such as improving mindful decision making in relation to drug use behaviour.

The final phase is ongoing. Our aim is to evaluate the efficacy of the individual BCTs in order to optimise the intervention. We will achieve this using a fractional factorial evaluation, allowing us to assess a number of combinations of BCTs to determine the efficacy of each component. Following this, a final phase of development will take place to optimise the intervention, based on findings from the evaluation. We will retain the most efficacious components, and discard those which do not achieve the desired effects, resulting in a streamlined intervention. It is our aim to conduct a comprehensive technical, clinical and economic evaluation of the intervention in the future.

4. Potential Intervention Benefits

A US study of student health attendances (Turner & Keller, 2015) resulted in over 900,000 unique visits from 730,000 enrolled students per academic year, averaging 1.23 visits per student. Mental health accounted for 13% of these visits, and drug abuse accounted for 13% of mental health related visits. Mental health disorders had the highest number of visits per patient, at 4.93 on average. Extrapolating these figures to the Irish HEI context, based on a student population of 250,000 we can assume that there would be approximately 312,500 visits to student health services each academic year. Mental health would account for 60,625 and of these; 5,281 would be drug-abuse related.

This figure is likely to be conservative, given that the study above likely included only those with a clinically diagnosed drug abuse disorder. Further, most students declaring drug use will rarely visit traditional student health services, despite experiencing harms from their use (Schettino et al., 2015). The recent Irish study noted above reported that 50% of young people are at risk of problems from their drug use, suggesting that the need for support from college services could be higher. The precise impact and costs of drug use are difficult to quantify. However, the available research highlights potential for significant individual, institutional and societal harms, therefore measures should be taken to prevent them where possible.

In line with our research on other digital brief interventions, we would expect the implementation of the intervention to result in a correction of social norms and at least a small-medium reduction in harm from drug use (Dick et al., 2019). This could result in reduced harms to the individual, and at a population level, reduce the impact on the institution and society. MyUSE is built upon an intuitive reporting system based on user engagement. This data will also be used to inform the development of future intervention versions in conjunction with customer feedback. Meaningful inferences from the data are displayed within the administration area, which indicates user trends and engagement data. The administration area is a useful tool in identifying what issues may be a priority, as well as characterising local culture norms surrounding substance use. We expect that this data will contribute to a comprehensive national aggregate dataset of student drug use trends and behaviours and could be used to inform local and national policy.

5. Conclusion

MyUSE has been developed with the aim of implementing in HEIs across Ireland, the UK, Europe and beyond. The intervention provides an always-on, confidential service to students that they can access as and when they need, contributing to a reduction in the myriad of individual, institutional, and societal harms caused by drug use. Importantly, this intervention provides support to those students who may be experiencing harm from drug use, but are not motivated enough, or lack the awareness required to seek help and support. Further, it

incorporates administrative control and data collection for each institution. The intervention will collect institution and national-level data on student drug use trends, harms and consequences, providing institutions with a comprehensive dataset which can be used to support student services and policy development.

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Cross-border Previous Learning Recognition: Enhancing Lifelong Learning and Social Inclusion

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Abstract

Regarded as a social advancement tool, Previous Learning Recognition (RPL) processes' development in cross-border regions should enable the transferring of qualified and Higher Education graduated workforce across territories. Within the project LLL-Transversalis, French universities have been establishing RPL assessement events with international participants (Spanish and Andorran) in order to build a cross-border RPL system in the Pyrenees region. This paper exposes the characteristiques of these unique RPL processes and the results obtained. So far, eleven events have been developed, accrediting students in the domains of Engineering, Tourism and Management. Jurys were compounded on average of 7 members from both academic and professional worlds and observers from Spain and Andorra were present. Feedback from international participants is highly positive. Due to the economic and social crisis caused by Covid-19, cross-border and national RPL could turn out to be an effective way to galvanize human capital growth in the following years, hence the value of this project's actions. Taking advantage of mobility restrictions caused by the sanitary crisis, the first online cross-border RPL events will take place later this year, setting a starting point for further research and innovation on these practices in Spain and Andorra with the help of French institutions.

Keywords: *Lifelong learning; assessment; recognition; previous; learning; cross-border.*

1. Introduction

Recognition of Previous Learning (RPL) or Previous Learning Assessment (PLA) are terms referring to the process of awarding institutional credit to knowledge and skills acquired through informal education or work experience (Browning, 2020; Harris & Wihak, 2017; Kilgore, 2020; Morris & Rust, 2020). As the International Labour Organization [ILO] (Aggarwal, 2015) reports, a considerable amount of people struggle to get access to certain jobs or occupations due to a lack of recognized qualifications. In a recent study called "Recognition of Previous Learning in the 21st Century", Leibrandt, Klein-Collins and Lane (2020:2) stated that "effective policies and practices on the recognition of prior learning have the potential to create more efficient pathways for economic mobility and increase student success and credential completion—especially for adults." Facing an unprecedented economical and social crisis, RPL processes can help people widen their professional expectations and thereby contribute to improve their mobility, social inclusion and employability. At the EU level, the adoption of the Memorandum on Lifelong Learning (LLL) set the Commission's main policy instrument to foster employability and economic growth (Bousquet, 2019). Consequently, 15 years ago, the European Council adopted the principles to identify and validate informal and non-formal learning from which followed the guidelines - published by the European Center for the Development of Vocational Education and Training (Cedefop) - for validating these types of learning (Cedefop, 2015). Ultimately, the motivation for adopting RPL systems in member states is based on an increased development of lifelong learning, a better employability and mobility, and the enhancement of economic growth and competiveness (CEU, 2012). Following the EU priorities, different cooperative programs are developed in order to foster Lifelong learning practices accross member states. The authors would like to highlight the Interreg V-A Spain-France-Andorra (POCTEFA 2014-2020) European cooperation program which aims at addressing the cross-border challenges linked to the Europe 2020 strategy in the Pyrenees border region. One of POCTEFA's axis is "Social inclusion and labour mobility" within and accross the territories. In order to achieve the goals set in this axis, a project called Lifelong Learning Transversalis was created. Based on historical cooperation (TRANSVERSALIS 2009-2013) between Higher Education Institutions, this project aims at harmonizing and strengthening practices of life-long learning and vocational training, committing itself to achieve the following goals: a) to bind skills and training offers, b) to implement successful orienation tools and c) to create and develop common training models and RPL processes adapted to the labour market's needs (INTERACT, 2021). Focusing on the last goal, two research questions were put forward: a) Which is the RPL approach in Higher Education in the Pyrenees border region? and b) What are the proceedings in order to establish cross-border RPL processes? This paper presents the answers to these questions in the following sections by reviewing the legal countries' status in this regard and describing an innovative RPL approach in Higher

Education, in which either candidates or members of the jury come from different territories, members of the project LLL-Transversalis. Ultimately, deploying cross-border jurys should foster professional and student mobility as well as an improvement or changement in RPL processes in Spain and Andorra.

2. Recognition of Previous Learning in the Pyrenees border region

Regarded as a social advancement tool, RPL processes' development in cross-border regions should enable the transferring of qualified and HE graduated workforce across territories. Inequalities or differences between countries' RPL systems can hinder these exchanges (Croisille, 2012), hence the importance of knowing each territory's RPL approach in order to find a way of harmonizing the practices.

2.1. RPL in Andorra

Recognition of Previous Learning in Higher Education has not been developed yet in Andorra. The closest practice which exists in the University of Andorra is to validate an internship period thanks to professional experience if the latter is related to the training program (Bousquet, 2019). However, RPL processes in this country apply to Vocational Education and Training (VET) programs where students can validate some units and even obtain a diploma, by granting competences developed through professional experience the same value as those obtained through training (Govern d'Andorra, 2021).

2.2. RPL in Spain

Formalized in 2009, RPL in HE in Spain is still inexistant as it is conceived in other European countries such as France. Candidates can give credence to professional experience in order to enroll in a VET program or HE institutions (for candidates over 40 years old). Universities can also validate competency or learning units obtained through formal education but, in any case, this will let candidates obtain the whole diploma through recognition of previous learning (Gobierno de España, 2021). Additionally, RPL processes and HE institutions' requirements vary depending on the regions - given the Spanish decentralised governance approach - making RPL a complex and fragmented process withing the country (Bousquet, 2019).

2.3. RPL in France

Contrary to its southern neighbours, France has an extended tradition and experience in RPL in HE. First formalised in 1985, RPL was introduced in French decrees as a way to enable access or to resume previous HE studies through professional experience's validation. This step would lay the foundations for "The Social Modernization Law" (Loi de Modernisation Sociale in French), passed in 2002 which granted the individual right to experience

recognition in the Education and Labour Code (Bousquet, 2019). That same year, the RPL Decree was approved thus authorizing candidates to partially or totally obtain a HE diploma through recognition of professional experience and non-formal learning outcomes. Thanks to their long experience and a solid legal framework, French universities have been able to offer, develop and adapt RPL processes according to candidates' needs and HE institutions' possibilities. That being said, after some years of legal stability in this regard, the French government introduced, in 2018, a law which fundamentally changed the way HE programs are to be conceived. Instead of organizing them in units of study, HE degrees have to be issued in competency blocks. Although still gradually applied, this law affects the way RPL processes are developed and how candidates prepare their dossiers (Bousquet, 2019). Bearing in mind that content-based programs mainly rely and depend on each territory's reality and/or tradition, the authors deem this change positive as working with competency blocks may facilitate cross-border comprehension on learning outcomes thereby fostering mobility and recognition of competency acquisition through non-formal education and professional experience.

3. Cross-border RPL

In the European level, during the last 10 years, only two projects can be highlighted regarding cross-border RPL experiences. Both were developed between 2011 and 2013 and involved France and its northern neighbours (Héroult, 2015). Since then, European cross-border RPL development has been fostered within LLL-Transversalis. Such practices aim at introducing the Spanish and Andorran partners to HE RPL processes, fostering cross-border mobility in the Pyrenees region and, ultimately, enabling social inclusion through international recognition and validation of prior learning. In this section, the second research question is answered by explaining the experiences carried out by the University of Toulouse Jean Jaures (UT2J) and University of Perpignan Via Domitia (UPDV). Their outcomes are shown, as well as some quantitative data regarding the process.

3.1. RPL proceedings

In order to establish a RPL process, there are some requirements that both the candidate and the institution offering the validation have to meet. On the one hand, the candidate has to prepare a dossier containing: a) the candidate's experience, b) the functions assumed and competencies acquired, c) case studies and d) supporting documents. Through these sections, the candidate must be able to evidence the connection between the competencies and learning outcomes acquired through professional experience or non-formal education and those present in the HE program targeted. On the other hand, the institution needs to establish the assessment comittee and foresee the candidate's need of tutoring or support in case the dossier is accepted in the RPL process. At UT2J, the assessment comittee or jury is composed of

three professors-researchers and two active workers in the domain the candidate is applying. On the other hand, UPDV establishes larger juries, making no distinction between the participants. Also, both universities provide with an academic advisor who cannot be part of the jury and who advices and supports the candidate through the whole process. Finally, although it is not still a formalized participant, in some French universities - specially those members of the LLL-Transversalis project - there is a third party who assists in RPL processes; the observer. The observers can be people familiar with the validation process, interested in the field of study the candidate applies to and, or, stakeholders. However, they cannnot interefere in the jury's decision regarding the recognition (or not) of the candidate's prior learning. Figure 1 illustrates the participants in RPL events according to established guidelines within the project.

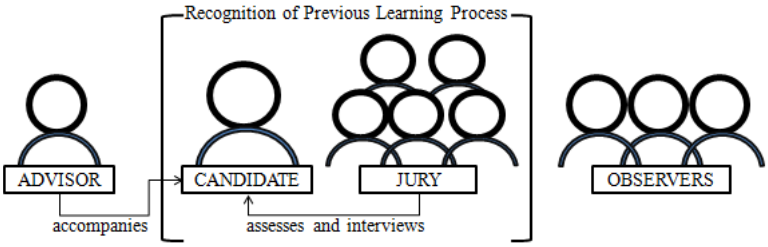

Figure 1. RPL assessment events' participants within LLL-Transversalis. Source: original.

3.2. Methodology

This was an action-based study in which quantitative and qualitative data was collected. The sole population requirement was that participants in the process were from different countries withing the Pyreenes border region. In order to limit the experience's scope, LLL-Transversalis partners decided to focus on four professional domains in which develop these cross-border experiences: digital technology, agri-food, turism and metallurgy. Once the candidate's dossier accepted, the host university contacted cross-border professors and/or professionals within the field concerned, thanks to LLL-Transversalis partners' network and invited them to participate as observers. Although they could not directly influence the jury's decision, a report and qualitative feedback on the process was asked to them, thus providing with a complete minutes. Up to now, these people had to travel to France in order to attend the RPL assessment event. However, the last RPL events were hybrid as international participants were not able to travel due to Covid-19.

3.3. Results

So far, and during the last two years, eleven cross-border RPL jurys have been established and developed. In the following table (1), a synthesis of these cross-border RPL assessment processes is presented, including the territories involved, the diplomas targeted - Master's

(M) or Bachelor (B) and the jury's decision, which could be a partial or total validation of the program chosen.

Table 1. Cross-border RPL assessment processes

Date	Diploma	Jury (n)	Observers (n)	Territories in France and Spain	Method	Decision
29/06/19	(M) Electronics and electrical energy	7	2	Perpignan-Gerona	On-site	Total
25/09/19	(B) - Tourist Guide	3	2	Toulouse-Gerona	On-site	Total
25/09/19	(B) - Tourist Guide	4	2	Toulouse-Gerona	On-site	Total
25/09/19	(B) - Tourist Guide	5	2	Toulouse-Gerona	On-site	Total
25/09/19	(B) - Tourist Guide	5	2	Toulouse-Gerona	On-site	Total
18/09/19	(M) Catering and hotel management	6	1	Toulouse-Gerona	On-site	Total
18/09/19	(M) Catering and hotel management	5	2	Toulouse-Gerona	On-site	Total
18/09/19	(M) Catering and hotel management	5	2	Toulouse-Gerona	On-site	Total
17/06/20	(B) Hotel management	10	2	Perpignan-Gerona	Hybrid	Total
17/06/20	(M) Touristic heritage management	10	2	Perpignan-Gerona	Hybrid	Total
17/06/20	(B) Communication and Tourism	10	2	Perpignan-Gerona	Hybrid	Total

Source: original

A total of 36 people were mobilized and thanks to a strict filter process of candidates' dossiers, a 100% of the participants obtained a total validation of their previous knowledge, which meant the acquisiton of the complete diploma targeted. Also, a changement in the method chosen can be observed during the sanitary crisis which started in March 2020. So far, only a specific Spanish territory (Gerona) has been attending and participating to these cross-border RPL events. Feedback from international observers was so positive that other Andorran and Spanish partners have gained interest in participating in forthcoming RPL events - which will be held online, hence facilitating the assistance -.

4. Conclusions

Innovative and unique, these cross-border RPL jurys and assessment events could pioneer an active approach in which HE institutions in the Pyrenees region could benefit from shared practices and easier ways to enable professional mobility. The inclusion of international observers in RPL assessment events had already been tried in a similar experience, carried out within an European cooperation project in which Lituanian observers were invited to

France, in order to get introduced to this practices (Bousquet, 2019). One of this project's asset and a key difference compared to previous experiences is that these cross-border RPL events are not a "one time" occurrence, which enables a constant improvement thanks to the feedback from the Spanish and Andorran observers. Additionally, given the advanced experience of French institutions in this field, such practices are a precious opportunity for Spanish and Andorran universities to become catalysts for change in their territories. Considering that neither of both [countries] have a formalized RPL system in HE yet, gaining experience through observation and gradually active participating in RPL jurys offer a chance to engage stakeholders and governmental agents, in addressing the need of established and clear RPL systems in Higher Education. Ultimately, these shared practices seek to create a RPL quality label valid in the Pyrenees region as to regulate and value social inclusion and mobility. Recognizing prior learning is acknowledged as a way to address issues related to lifelong learning, social inclusion and employment (Garnett & Cavaye, 2015) and has been highlighted as a strategic priority to value people's contribution to society (Golden & Gunn, 2020; Senséau & Ansart, 2013). Due to the economic and social crisis caused by Covid-19, cross-border and national RPL could turn out to be an effective way to galvanize human capital growth in the following years, hence the value of this project's actions. To end on a positive note, amid rather negative consequences of the pandemic, the authors deem mobility restrictions an opportunity to implement cross-border RPL assessment events as online sessions which enable a growing international assistance. Consequently, the first online cross-border RPL events will take place later this year, in May, hopefully setting a starting point for further research and innovation on these practices in Spain and Andorra.

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Developing a shared syllabus template as a living document of inclusive practices in a teaching and learning community

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Abstract

Inclusive teaching and learning is central to our educational mission. In this project, we used a whole-institution approach to make our institution's inclusive objectives concrete and specific. We aimed to develop ways to capture our own community's goals and objectives in a 'living document', a syllabus template in which insights from educational literature on diversity and inclusion are presented alongside the voices and practices of members of our own community of practice (CoP). We created the syllabus template by using the literature to list elements of inclusive design, inclusive delivery, inclusive assessment, and learning-focused syllabi, then identifying examples of those elements in syllabi of local experienced practitioners and deepening the good practices in interviews with the experienced practitioners. The final syllabus template presents authentic practices from local syllabi, with explanations of the relevance of those examples and reference to educational literature, links to teaching tools, and contact-information for individual colleagues. The shared syllabus template deliberately situates academic development within the practice of the local CoP. We found that even the most experienced practitioners find it challenging to work on inclusive practices, which is all the more reason to stimulate a collaborative approach.

Keywords: *Higher education; inclusive pedagogy; good practices; syllabi; interviews; liberal arts and sciences education.*

1. Introduction

Diversity scholars bring growing bodies of evidence showing that inclusive practices in institutions of higher education breed quality (Nature, 2014) and there is widespread agreement with the objective to strive for inclusive practices in teaching and learning (Lawrie et al., 2017). Yet, diversity scholars also observe that the objective "remains elusive, and opinions on how to achieve it proliferate" (Lawrie et al., 2017) and that the implementation of diversity policies is hampered by specific ideas or fears (Wekker, Slootman, Icaza, Jansen, & Vázquez, 2016). We see inclusive learning and teaching as central to our educational mission. Therefore, our aim was to make our institution's inclusive objectives concrete and specific, and to involve all members of our community in the discussion, specification, and implementation of these objectives.

We use Hockings' (2010) definition of inclusive learning and teaching: it "refers to the ways in which pedagogy, curricula and assessment are designed to engage students in learning that is meaningful, relevant, and accessible to all" (p. 1). She distinguishes four areas of focus: inclusive design, inclusive delivery, inclusive assessment, and institutional commitment to and management of inclusive teaching and learning. We underline the importance of a whole-institution approach (Lawrie et al., 2017): shared understanding and relationships between all stakeholders (faculty members, students, academic developers, and senior management) are central to the successful implementation of inclusive practices in teaching and learning.

Starting as a student-led project, we focused on the course syllabus: the artifact outlining the key structural elements of the course. The syllabus serves as a design tool, crafted and re-crafted by the instructor in collaboration with members of the teaching team, academic developers, topic experts and with students. Well-crafted syllabi invite students to connect course content and learning activities to important questions and societal challenges, and to focus on learning goals and objectives rather than on content and rules (Palmer, Wheeler, & Aneece, 2016). The institution's board of studies - the body formally responsible for curriculum design, delivery, and assessment - considers the most central parts of a course's syllabus before including it in the course offer.

We aimed to develop ways to capture our own community's goals and objectives in a 'living document', a syllabus template in which insights from educational literature on diversity and inclusion are presented alongside the voices and practices of members of our own teaching community. This syllabus template will not serve as an end-goal or manual, but rather as an intrinsically discursive document capturing the practice of the local teaching community, which we regard as a community of practice (CoP) - a group of people *mutually engaged* in a *joint enterprise*, with a *shared repertoire* (Wenger, 1998). Through its use, members of the CoP will continually engage with one another in a discussion of the ways in which inclusive education might be implemented.

2. The process of creating the shared syllabus template

We created the shared syllabus template in three steps. First, using the literature, we listed which elements of inclusive teaching practices could and should find a place in the syllabus template. Second, we identified examples of those elements in 21 syllabi of 11 local experienced practitioners. Third, we contextualized and deepened those good practices in interviews with 6 of the experienced practitioners. The experienced practitioners gave consent for including parts of their syllabi.

2.1. Criteria: which elements of inclusive practices should be included in the syllabus

We searched the higher education literature on inclusive practices for practices that are advisable and feasible in the local context (1-3) and regarding the syllabus specifically (4). We translated the practices into elements that should be addressed in the syllabus.

Table 1. Inclusive practices that can be represented in the syllabus. References describe the practices, not in all cases their representation in the syllabus.

1. Inclusive design (criteria based on Nelson Laird, 2011; Saunders & Kardia, 2004; Mallinger, Gabbard, & Starks, 2016; Boysen, 2012)

a. The syllabus presents a selection of materials that resembles the inclusion of multiple theoretical perspectives for each course topic;
b. The syllabus includes relevant contributions to the field made by researchers from varying cultural backgrounds;
c. The syllabus lists material that appropriately addresses the experiences of marginalized groups;
d. The syllabus presents activities that support the development of constructive dialog skills.

2. Inclusive delivery (criteria based on Boysen, 2012; Mallinger et al., 2016; Lee, Williams, Shaw, & Jie, 2014; Kumar & Wideman, 2014; Burgstahler, 2009; Nelson Laird; 2011; Lombardi, Murray, & Gerdes, 2011)

a. The syllabus discusses the type of environment the instructor expects to create and expectations about how students should approach the course;
b. The syllabus invites students to meet with the instructor to discuss diversity, inclusiveness and special learning accommodations;
c. The syllabus encourages regular and effective interactions between students and the instructor and describes practices which ensure that communication methods are accessible to all participants;
d. The syllabus describes how classroom discussions can be used to learn how to engage with others, and learn through interaction;
e. The syllabus presents content in multiple formats, e.g., video and text, inviting students to choose;
f. The syllabus describes varied formal and informal teaching activities which allow students to engage with content in various ways.

3. Inclusive assessment (criteria based on Butcher et al, 2010; Burgstahler, 2009; Lombardi et al., 2011; Nelson Laird, 2011; Kumar & Wideman, 2014; Lee et al., 2014)

a. The syllabus describes authentic and complex assessment components, not based on reproduction;
b. The syllabus describes feedback opportunities to foster learning prior to assessment;
c. The syllabus announces flexibility and accessibility of assessment practices;
d. The syllabus announces that students are assessed using multiple methods and tools;
e. The syllabus announces that students are supported to evaluate their own performance, e.g. through reflection assignments.

4. The learning-focused syllabus "(is) characterized by engaging, question-driven course descriptions (…); a focus on student success; and, an inviting, approachable, and motivating tone" (Palmer et al., 2016). See also Slattery & Carlson (2005).

a. The syllabus invites interaction by including information about instructors' availability outside of class, regarding office hours, office location, and e-mail address;
b. The syllabus includes the course description that captures the idiosyncrasy of the instructor's approach;
c. The syllabus clearly lists the course goals, preferably using action verbs (e.g. evaluate, analyze, create), rather than passive or vague verbs (e.g., learn, recognize, understand);
d. The syllabus links the course objectives to assessment forms;
e. The syllabus includes a description of how grades are determined (e.g., rubrics, performance assessment criteria) and which role students have in setting these criteria;
f. The syllabus guides students in organizing their work across the semester;
g. The syllabus includes a statement about what makes the instructor passionate about the topic;
h. The syllabus is itself a learning tool, inviting the reader to connect course content to topics and questions of relevance to (potential students);
i. The syllabus mentions University Support Services (e.g., tutorial services, counseling center, career services and writing centers).

2.2. Examples of good practices found in syllabi of local experienced practitioners

Using the criteria listed in 2.1, we identified examples of inclusive teaching practices in the syllabi used by experienced practitioners in our teaching community. These quotes serve to illustrate these criteria in the voices of colleagues familiar to the entire community.

Criterium 2a&d: "The success of this course is, to a very large extent, our shared responsibility; this entails the willingness to do collective work and engage in critical dialogues with others. (...) The conversation or disagreement can of course be passionate, but it has to stay respectful and responsible to the other person's ideas and sensitivities. Articulating ideas, listening and being attentive to difference is the goal."

Criterium 2c: "Also, asking questions in class can simply save a lot of time and effort trying to figure stuff out. You might find that you have been approaching the problem wrong all along or that there are more ways to find an answer to the problem."2e: "Dante Alighieri, Inferno (ca 1310), Cantos I-III; available at Princeton Dante Project as text and audio (English/Italian)."

Criterium 3e: "You write a piece of approx. 500 words in which you reflect on your writing and research skills, and what you have learnt in your first semester, drawing on the self-assessment form that you will fill out in class during the first week, and the goals that you will set yourself."

Criterium 4b: "(…) However, processes of decolonization, globalization and transnationalism, along with critical interrogation of dominant discourses, have led to greater visibility of 'peripheral' or 'marginalized' scholarship. The decolonization of the discipline has resulted in a critical and sometimes radical focus on cultures being studied, and to serious challenges posed to the politics of knowledge production in anthropology."

Criterium 4d: "The portfolio is related to the following learning objectives: 1, 2, 3, 4, 5, 6, 8. The individual research paper is related to the following learning objectives: 1, 2, 3, 4, 5, 6. The presentation is related to the following learning objectives: 9, 10."

Criterium 4g: "But above all, as a teacher and educational scientist, I am passionate about sharing this love for the beautiful Arabic language. I am always looking for new ways of teaching and like to experiment with digital tools and games in my teaching. I'm happy to hear your experience and feedback on the course."

2.3. Additional considerations from interviews with local experienced practitioners

Six experienced practitioners from our CoP were interviewed to contextualize and deepen the material collected in the previous two steps. Interview questions were inspired by literature on inclusive teaching and learning, educational sciences more broadly, and

professional development (Sciame-Giesecke *et al*., 2009; Neumann, 2009; Nelson Laird, 2011; Burgstahler; Mallinger et al, 2016; Opertti & Brady, 2011; Hockings, 2010).

1. Summarize your efforts in terms of diversity and inclusion. Respondents mentioned efforts on decolonizing the curriculum in terms of content; by focusing on class dynamics through acknowledging various perspectives and differences; and by focusing on equity over equality.

2. Is instruction adjusted based on student performance? Respondents mention adjustments made based on different forms of formal and informal assessment of learning: either mistakes that students make, which are discussed in the feedback, or (for example) expressions of homophobic attitudes through papers, which are also discussed individually.

3. In which ways are students offered the opportunity to 'customize' their learning? Respondents allow students to choose flexibility of assessment; contribute to the reading list; choose their own essay topics; practice exams; request extensions; be involved in course design. Respondents are lenient with students with learning difficulties.

4. How do you prepare for classroom interactions on difficult topics? Respondents ensure class discussions allow for multiple perspectives; use smaller groups; carefully select materials that will stimulate discussion; reflect on one's own perspective; teach students to present in front of a diverse audience.

5. How is a supportive climate in the classroom encouraged? Respondents mention striving for an equitable classroom; using safe, small groups; building a trust pact between instructor and students; using guidelines for constructive dialogue; guiding conversations; using a ritual at the beginning of the class that creates a sense of community.

6. How is active participation encouraged? All respondents found this difficult. Some mention translating their passion for instructional design and creating diverse teaching activities; using a random picker to avoid the same students vocalizing their opinions; breaking students up in small groups; doing a discussion round at the end of each meeting.

7. Do you perceive diversity in the classroom as challenging or enriching? All respondents found it both challenging (to create a safe environment; to be vulnerable as an instructor; to deal with difficult topics; to deal with assumptions and prejudice; to find common ground; to deal with tensions in society and in the classroom; to handle confrontations; to change students) and enriching (to have diversity of different kinds in the classroom; to encourage students to express different perspectives).

8. How do you explore your own cultural and intellectual background? Some respondents mainly moderate discussions, teach students how to argue well and do not share their own opinions. Others use personal examples, making their positioning explicit.

2.4. The syllabus template

The resulting syllabus template presents authentic practices from local syllabi (main text), with explanations of the relevance of those examples and reference to educational literature, links to teaching tools, and contact-information for individual colleagues (boxes on the right).

Figure 1. Pages of the syllabus template; details obscured because they are not relevant beyond our specific CoP.

3. Discussion

We explored whether the course syllabus can be used to specify, implement and discuss inclusive education objectives using a whole-institution approach. We discovered, first, that many inclusive teaching practices described in the literature can be meaningfully captured in a course syllabus. Next, a locally inhabited and interactive syllabus template was created by including examples of already existing practices in the words and voices of individual colleagues, alongside references to relevant educational literature and teaching tools.

We found that the collaboration on a shared syllabus template makes teaching practices explicit and visible, inviting all stakeholders to take part in their further development. It allows educational managers to promote an intrinsically discursive manner to work on inclusive education rather than bringing top-down initiatives. The shared syllabus template deliberately situates academic development within the practice of the local CoP. In this way changing needs and work demands (rather than, for example, policy initiatives) drive its learning (Boud & Brew, 2013). The collaborative syllabus template is likely to impact students' learning in particular, as bringing learners into the construction of a syllabus creates a participatory practice that more effectively meets their needs (Jones, 2018).

Finally: inclusive education goes beyond making education accessible to all and diversifying the body of knowledge. It is a central matter for the quality of teaching and learning (Hanafin, Shevlin, Kenny, & McNeela, 2007; Ladson-Billings, 1995). Through this project we learned that even the most experienced practitioners in our teaching community find it challenging to work on inclusive practices, which is all the more reason to support their work in more

than one way, i.e. by working with educational and diversity experts, as well as - as proposed here - in ways that stimulate shared development within the local CoP.

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Students from Portuguese Speaking African Countries in Portuguese Higher Education

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Abstract

Recently, African countries have been making efforts to expand their higher education systems. However, neither capacity nor quality have kept pace with demand, leading to a steady increase in students studying abroad. In this paper, we aim to analyse the development of enrolments in Portugal, one of the main destinations for students from Portuguese-speaking African countries (PALOP). Descriptive analyses were performed, disaggregating enrolments according to degree level, disciplinary area of study, and institution type. The results show that the choices of students from PALOP countries have followed different trajectories, in some cases with similarities. The public sector has the largest presence of these students, and polytechnic institutions have been the most frequent choice. Most of the students were enrolled in first degrees, except for those from Mozambique. Enrolments in Health, Services and "hard" sciences have increased, which may reflect the growing demand for highly qualified labour force in these countries. This paper highlights the continued importance of PALOP students for the internationalisation of Portuguese higher education and the need to avoid considering them as a homogeneous group of students.

Keywords: *International students; Portuguese speaking African countries; student mobility.*

1. Introduction

Africa is the world region that has the highest share of outbound student mobility for tertiary education. Many factors have driven the mobility of African students. First, there is a large university-age population, as 60% of Africans are under 25 years old and the levels of secondary education completion have been rising (Krtiz, 2015). Second, there is a shift from the agriculture-based system to a manufacturing and service-based system, which implies a demand for more qualified jobs (Langa, 2014). Even with the efforts to expand the higher education (HE) sector, both public and private, the current number of higher education institutions (HEIs) cannot support demand across the continent, leading to a steady increase in students studying abroad. According to UNESCO Institute of Statistics (UIS, 2021), in 2017 African students have become the most mobile tertiary students globally, representing an opportunity for countries and institutions which are keen to diversify their student body. This is China's case, which has made a concerted effort to attract African students, both for undergraduate programmes and for short-term technical programmes. In 2018, they represented 16% of all international students in China (Mulvey, 2020).

Since 1975, Portugal has received students from Portuguese speaking countries in Africa (PALOP), being the main destination of these countries due to strong historical and linguistic ties. Studies on PALOP students in Portugal have focused on their academic success (Wilks & Neto, 2019) or social adaptation (França e Cairns, 2020). Nevertheless, there is a lack of literature about the choices which students from different PALOP countries make within the Portuguese HE system. As they represent a large percentage of all degree mobile international students, the continued ability to attract these students is fundamental for Portuguese HEIs, not only from an economic rationale but also from an academic, politic and cultural one (Sin, Antonowicz, & Wiers-Jenssen, 2019). Knowledge of these students' choices regarding institution type, discipline and degree level can be important to sustain growth in enrolments. The current paper is an exploratory study on PALOP students' enrolments in the Portuguese HE system during the last decade, analysing the data according to each of the five countries, namely Angola, Cape Verde, Guinea Bissau, Mozambique and São Tomé and Principe.

It is only in the last decade that the Portuguese government has taken measures to promote internationalisation actively and to attract international students. Two pieces were paramount to achieve this: the internationalization strategy of Portuguese HE and the *Statute of the International Student*. With regard to Portugal and its former colonies, Veiga *et al*. (2006) pointed out that this relationship was based on political and cultural rationalities. Portuguese HEIs have clearly assumed the idea of a "Lusophone space", and cooperation with these countries represents a strategy that strongly reinforces the internationalization of Portuguese HEI. Indeed, the *Statute* maintains a special regime for students from the PALOP countries, offering scholarships in order to preserve the privileged relationship with these countries (Sin, Tavares & Cardoso, 2019). Recently, Angola and Cape Verde have represented key

players for the Portuguese HE system, being respectively the second and third most frequent countries of origin of students in full-degree mobility (DGEEC, 2021).

During the colonial era, Portugal failed to establish HEIs in its former colonies, unlike other European colonial powers, such as the United Kingdom and France. It is important to note that, before the 1960s, when the pressure for independence became increasingly strong, there was no HEI in Portugal's overseas territories (Langa, 2018). In 1962, the first HEIs were established in PALOP countries, namely in Angola and Mozambique. Although the Portuguese government addressed the integration of the African colonized population into the Portuguese way of life, the places were offered primarily to the sons of Portuguese colonialists, while very few Africans managed to reach university level (Langa 2014; 2018).

Except for Angola and Mozambique, HE is a very recent phenomenon in the PALOP countries. Most of its characteristics are similar to the Portuguese system, with some variations developed after independence in the mid-1970s. Besides a historical connection, these students' enrolment in HE in Portugal results from other specific reasons. Having a network of friends and family who live (or have lived) in Portugal can be very important in determining where to study, which can attract more students to Portugal than to other European countries with which they do not share a common past (Ploner & Nada, 2020).

Also, common language plays a key role in choosing the country destination. As demonstrated in the previous literature, students with proficiency in the host country's language have a better experience (Sin & Tavares, 2019; Wilks & Neto, 2016). However, the issue of language deserves more attention. Some researchers have reported language as critical to PALOP students' integration in the host country (França & Cairns, 2020; Vilela, 2002). On the one hand, HEIs expect that students have fluency in Portuguese, both written and spoken. On the other hand, Portuguese is not their first language, although it is the official one. This may negatively impact their self-efficacy, affecting their academic success and even their social integration into the host society (Sin & Tavares, 2019; Wilks & Neto, 2016).

2. Method and Results

Data was retrieved from the General Directorate for Education and Science Statistics website, specifically information from the academic year of 2011/12 to 2019/20 on students of all nationalities enrolled in Portuguese HEIs. The dataset is available online in the public domain. For this study, we only considered as countries of origin the five PALOP, namely Angola, Cape Verde, São Tomé and Príncipe (STP), Mozambique and Guinea-Bissau. Descriptive analyses were carried out for each country, disaggregating enrolments according to degree level, disciplinary area of study, and type of HEI. Table 1 shows the evolution of the number of enrolments in Portuguese HEIs by country over the years.

Table 1. Number of international students from PALOP countries enrolled in Portuguese higher education.

Year	Angola	Cape Verde	Guinea-Bissau	Mozambique	São Tomé and Principe
2011/12	3500	3318	461	674	823
2012/13	3314	3009	420	642	826
2013/14	3737	2740	429	673	811
2014/15	3719	2561	420	731	751
2015/16	3741	2653	543	767	877
2016/17	3707	2781	602	838	1049
2017/18	3969	2942	838	952	1267
2018/19	4028	3598	1722	1013	1215
2019/20	4299	4929	3705	1257	1220

Source: DGEEC (2021).

2.1. Angola

Throughout the analysed times series, enrolments of Angolan students grew by 22.82%, as shown in Table 1. There is a preference for the public sector (54.77%). Nevertheless, a year-by-year analysis reveals that it has not always been so. At the beginning of the period, the distribution of enrolments between public and private was quite balanced (50.14% and 49.86%, respectively). In the year 2014/15, the number of enrolments in the public sector overtook private enrolments, reaching 55.42% in 2019/20.

University education is most prominent (77.79%). However, interest for polytechnic education, mainly public, has been growing, from 9.91% (344) to 17.79% (757). More than half of the students (55.39%) were enrolled in 1st cycle degree courses. Regarding the disciplinary area, just over half (51.93%) of students were enrolled in courses belonging to the Social Sciences, Business and Law. Although this is still the most important area, there has been a slight reduction in recent years. Conversely, enrolments in Engineering have increased, from 13.09% (458) students to 23.68% (1018) in the analysed period.

2.2. Cabo Verde

Comparing the beginning and end of the time series, there is a growth of 48.55 in the enrolments of Cape Verdean students (see Table 1). There is a preference for public education (82.83%), and a year-by-year analysis shows that this preference has intensified over the

period. In 2011/12, 75.91% of students were enrolled in public institutions, increasing to 83,47% in 2019/20.

The division between university (50.04%) and polytechnic enrolments is quite balanced. Nevertheless, while university education was predominant (66.15%) at the beginning of the period, over time this difference decreased. From 2016/17, polytechnic institutions started to have more enrolments. In 2019/20, 64.5% of students were in polytechnic education. Such growth is mainly due to the rapid growth in enrolments in the public polytechnic subsector, which went from 31.83% (1053) to 55.01% (2699).

The majority (64.24%) of students are enrolled in the 1st cycle. The growth in CTeSP (short technical courses) enrolments is noteworthy, from 3.23% (107) to 13.02% (639). Concerning the disciplinary area, the most chosen courses are those belonging to the Social Sciences, Business and Law (36.47%) and Engineering (26.03%). Although Health is in third place, its growth is worth highlighting, from 6.39% (230) to 14.40% (710).

2.3. Guinea Bissau

Among the PALOP countries, Guinea-Bissau is the one that shows the highest proportional growth of enrolments in Portuguese HEI, registering eight times more students in 2019/20 than in 2011/12, as shown in Table 1.

Enrolments in public institutions are by far dominant (82.94%). Regarding the type of education, the preference for polytechnic education grew from 26.52% (122) to 64.15% (2376), making the division between university and polytechnics sectors balanced over the entire time series. The growth in polytechnic education occurred proportionally, both in the public and private sectors. However, in absolute numbers, the public polytechnic is much more prominent, having grown almost 20 times more, from 106 to 2116.

The majority (66.07%) of students are in 1st cycle degree courses. The growth in CTeSP courses is noteworthy, from zero to 1389 (15.26%). Regarding the disciplinary area, just over half (54.68%) are in Social Sciences, Business and Law. Concerning the other disciplinary areas, it is observed that the ones with the highest growth were Services (from 3.38% to 9.13%) and Natural Science, Mathematics and Informatics (from 2.60% to 7.46%)

2.4. Mozambique

An increase of 86.49% was observed in the enrolments of Mozambican students. There is a clear preference for the public sector (87.05%), which has intensified over the period, in parallel with a reduction in the private sector, from 19.94% to 7.92%. University education predominates (83.75%), making Mozambique the only analysed country in which the public polytechnic sub-sector is not the one experiencing the highest growth.

Although, as in all PALOP countries, 1st cycle degrees register the highest number of enrolments, there is a greater distribution among the other degrees. Namely, 36.26% of students are in master degrees (21.98% in 2nd cycle master degrees and 14.28% in integrated masters) and 25.29% in doctorates. In this case, it is the public university sub-sector that registers the greatest growth, having in 2019/20 doubled the number of students compared to 2011/12. Most students are in Social Sciences (41.62%) and Engineering (16%). The growth in the areas of Health is noteworthy, from 6.97% to 12.65%.

2.5. São Tomé and Principe (STP)

Enrolments of students from STP went from 823 to 1220, representing an increase of 48.23%. As in the other PALOP countries, there is a preference for public education (82.83%). The growth of the public polytechnic subsector was more accentuated, while the remaining subsectors experienced a reduction. This happened mainly more recently and, in the last year, about 69% of students were enrolled in polytechnic education. Analysing the entire historical series, it is observed that 55.37% of the students from STP are in polytechnic education.

Most students are enrolled in 1st cycles (65.24%). It is important to note that the number of enrolments in CTeSP throughout the historical series has almost quintupled, from 26 to 123, with most of these students in public polytechnic schools.

Almost half of the students from the entire period study Social Sciences, Business and Law (51.27%). The growth in Natural Sciences, Mathematics and Informatics stands out (1.46% to 8.45%).

3. Discussion and Conclusion

The current study has analysed the last decade of enrolments of PALOP students, contributing to a more nuanced overview of how the internationalisation of the Portuguese HE system has been marked by the choices and distribution patterns of these students.

Angolan students are the most represented ones in this group of countries, followed by Cape Verdean students. The latter have grown very rapidly in recent years, mainly enrolling in polytechnic education. Considering proportional growth, however, Guinea-Bissau is the country that presents the biggest increase in the number of enrolments.

The results show changes over the past few years, allowing a better understanding of which segments are most preferred by students, according to their nationality. Some aspects are shared among the five countries, for example, the predominance of public rather than private institutions, which can probably be explained by the special regime for granting scholarships to students from PALOP. However, for some countries, the choice of the public sector is more marked, as is the case of Mozambique. In fact, this country distinguishes itself from the

rest of the PALOP countries in an additional way: most Mozambican students are enrolled in more advanced degrees (i.e. master and 3rd cycle), contrasting with the 1st cycle and CTeSP, which is dominant for the other African students.

With regard to the type of education, Angolan and Mozambican students are strongly present in university education, while students from STP are in polytechnic education. However, there has been a change in recent years: enrolments of Cape Verdean and Guinean students have grown rapidly in polytechnics institutions, especially in the public sector. In fact, public polytechnics is the fastest growing subsector, except for students from Mozambique.

Health, Services, Engineering and Natural Sciences, Mathematics and Informatics stand out among the disciplinary areas with the highest growth, although Social Sciences, Business and Law continue to dominate. Considering that polytechnic education is more oriented towards practical training and the labour market, the greater demand in these courses and in this type of institution may be related to the transition that PALOP countries have experienced in terms of economic sectors. With the transition to a manufacturing economy, high-skilled jobs in areas such as agricultural engineering, telecommunications and civil engineering are on the rise, as are jobs related to health and tourism. This suggests that HEIs with educational offerings in these areas could look at Africa as a promising source of potential candidates.

Finally, some limitations must be noted. As international students, we considered those who are not born in the country where they study, given the data limitations. Although they are counted in national data as degree-mobile students, they can be long-term residents or may have even acquired dual nationality.

HE is a rather recent development in PALOP countries and demand for HE is growing fast. The African continent is the second-largest in the world, and it is unwise to consider the entire continent as a homogeneous group, without attention to the specificities of each country or group of countries. In fact, an imaginary form of an African student is actually a stereotype that reverberates neo-racism, by disregarding the social, ethnic or national origin of the students (França & Cairns, 2020). This work is expected to open new avenues for understanding the PALOP students' distinctive preferences within Portuguese HE. As Portugal is not a major recruiter of international students, but is the main destination for those coming from PALOP countries, maintaining attractiveness for these students is essential for the successful internationalisation of Portuguese HEI's student body.

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DIADEMMA: A tool to promote peer-mentoring in Colombian higher education

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Abstract

Mentoring programs in higher education have gained importance in recent years for their contribution to the development of professional and personal skills, as well as improving student retention and completion. Considering this, the program Generation E, –created by the Colombian Ministry of Education to provide socioeconomic support to underprivileged youth for their access to higher education–, started to include mentoring strategies in 2019 as a key element to foster completion. In 2020, a development model was designed to assess the situation of these programs in higher education institutions across the country. This article describes an analytic tool –called DIADEMMA (Diagnosis of Mentoring Moments Development)– which articulates five development moments with six factors key to any mentoring program, drawing on a structure proposed by an existing model for the assessment of higher education programs for student retention in Colombia. The first implementation of DIADEMMA allowed to identify the status of peer-mentoring initiatives in an initial group of institutions, providing input to define actions to support their consolidation, considering the nature and possibilities of each one of them.

Keywords: *Mentoring; higher education; development Model; DIADEMMA.*

1. Introduction

Student attrition in Latin America is a worrying phenomenon for international, regional and local governments and agencies. The Observatory of Higher Education of Medellin, Colombia –ODES– (2017), reports that Latin America attrition rates range from 40% to 75%, while the Colombian Association of Universities –ASCUN–, cited in Suárez-Castrillón et al (2020), notes that 45% of young people who start post-secondary studies in Colombia don't finish them.

In 2018, the Colombian government, by means of the Ministry of Education (MoE), launched the *Generation E* Program, with the aim of promoting access to higher education as well as completion by youth in condition of economic vulnerability. By the end of 2020, there were 113 Higher Education Institutions (HEI) participating in the program (out of a total of 300 registered HEI), benefiting around 160,000 students. *Generation E* contributes with: a grant that covers tuition and partial support; the development of welfare strategies; and the generation of networks that connect students with local entrepreneurship ecosystems. However, previous experiencies with similar programs suggested that providing support for student integration to higher education is as important as supporting access (Andrade-Fernandez et al, 2017; Alvarez-Rivadulla, 2019; Diaz-Velasquez, 2019). Thus, in 2019 the MoE convened EAFIT University and the Cooperative University of Colombia to collaborate in the design of a Mentoring Program which was first deployed in the second half of 2020.

Given that student retention[1] represents a shared concern between MoE and HEI, in recent years several alternatives have been explored to seek the development of the personal and academic skills needed for students to succeed, such as *peer support* (which in many cases involves *peer learning*). This strategy is characterized by the participation of students of advanced semesters in activities or programs where they support their peers outside the classroom, either for their integration into higher education, support in understanding curriculum subjects, or adaptation to city life –in the cases where they arrive from other regions or countries. Broadly, *peer support* involves an interaction between peers that encourages the exchange of knowledge or experiences. In Colombian HEI there is a high heterogeneity in the objectives, scopes and characteristics of these type of strategies, which is reflected in the great diversity of denominations found in the sector –tutoring, monitoring, mentoring, among others–. It should be noted that, for the specific case of mentoring

[1]Recently, the word *retention* has started to be replaced in local discourse by the word *permanence (Spanish permanencia, meaning to stay, to remain)*, as a way to put emphasis in the outcome expected from the student (to remain in the education system), instead of the action carried on by the HEI. However, *retention* will be used in this text, given its pervasive use in English-based higher education.

initiatives, not all of those called this way correspond to what is described in the literature, while others fulfill their characteristics even if they are called otherwise.

Considering this situation, the first step for the implementation of the *Generation E* Mentoring Program was an assessment of the type of strategies developed by HEI, their degree of development and the feasibility of articulating the proposed Mentoring Program to existing initiatives.

2. A development model for mentoring programs in higher education

A maturity model shows how an initiative evolves, "allowing to identify on which step it is, so it can make the required improvements to advance to the next step" (De Freitas, 2018, p. 7); according to this author it is not that common to find such models in higher education institutions. Maturity models indicate the levels of qualitative developments, the parameters that describe them and the conditions for advancement or maturation from an initial condition to a condition reached (p. 11). Maturity models can be built according to the needs and objectives of each organization, and, thanks to them, it is possible to have a benchmark reference to identify at what stage a process, program or strategy is located, and what actions are needed to foster its development.

In this sense, the formulation of a development model for mentoring programs became the initial step to identify the status of such initiatives in Colombian HEI, using as reference the literature review on the definition of mentoring, its history, contexts, types, modes of delivery and, in particular, its role in Ibero-American higher education. The work of Casado-Muñoz, Lezcano-Barbero and Colomer-Felui (2015) in their article "Ten key steps to developing a programme of university mentoring for newly enrolled students" was especially relevant, describing both structural components related to the institutional commitment to the program –such as availability of resources, assessment & evaluation– and substantial elements related to its nature –such as assessment of needs, recruitment and training of mentors. Additional recommendations about the creation of successful mentoring programs in other areas (Chronus, 2017; National Mentoring Partnership, 2019; Mentors4U, 2021) were included in the literature review.

In the design of the national-level *Generation E* Mentoring Program, seven elements for action were defined to be addressed in iterative stages, according to the conditions of each HEI:

- **Attracting,** focused on the processes of stakeholder communication and recruitment of mentors and mentees.
- **Knowing,** aimed to identify the entry conditions and the needs for guidance and learning of the different actors of the process.

- **Connecting,** dedicated to pairing mentors and mentees according to criteria defined in the characterization, in order to foster the creation of connections between them.
- **Guidance**, focused on the development or mentoring skills in mentors as well as skills for life and career plan in mentees.
- **Evaluating**, which includes the processes of monitoring, assessment and evaluation of the actions, outcomes, results and impact of the program, according to its theory of change.
- **Articulating**, which refers to the coordination between MoE and HEI on the subject of mentoring, to give consistency to the program and weave networks that promote the sustainability of the strategy.
- **Technological platform**, which supports the structural dimension –data management systems, information and analytics– as well as the substantial dimension of the program – training, guidance and interaction of the participants.

On the other hand, the development model identifies a set of key factors for a formal mentoring program at the HEI level, which can be articulated with the elements for action mentioned above:

- **Positioning,** which refers to the articulation of mentoring programs with existing programs, processes and policies of well-being or student retention.
- **Monitoring,** related to the identification of results and impact of the program, as input to its continuous improvement.
- **Management,** referring to the involvement of mentors and mentees in the program in order to achieve its objectives.
- **Training,** which includes the activities established for the onboarding, guidance and development of competencies of participants in the program.
- **ICT,** which refers to the promotion and use of digital technologies for learning, interaction and management of information during the development, monitoring and evaluation of mentoring.
- **Sustainability**, which involves resource and knowledge management, so the program can consolidate and evolve over time.

These factors are articulated with five stages or moments of development:

- **Initiation,** stage where the components for the creation of a program are still disjointed, with informal mentoring activities that do not yet have institutional visibility.
- **Installation,** stage where the components are starting to be articulated. Pilot experiences may have been undertaken or initial implementation of a mentoring program in the HEI is expected.

- **Formalization,** stage where the articulation of the components is consistent, so it is possible to find reviews of lessons learned, as well as clear relationships with well-being or retention processes or programs. Also, guidelines for monitoring, evaluation and ICT use in the development of the program have been established.
- **Appropriation,** stage that refers to a mentoring program in full operation.
- **Consolidation,** stage where the program has financial, human, institutional and interinstitutional supports, as well as a system of continuous improvement in operation.

The combination of factors and moments of development produced an analytical tool called DIADEMMA (Diagnosis of Mentoring Moments Development), which helps to assess the status of a mentoring initiative in a HEI, as well as to determine actions needed to move to the next stage, according to its own situation. From a national perspective, this tool allows to compare the situation of different institutions, helping to determine the focus of the technical assistance actions carried out by MoE.

3. DIADEMMA: Diagnosis of Mentoring Moments Development[2]

The conceptual elements of DIADEMMA are based on the development model mentioned, while its structure was inspired by the *Guide to the implementation of the model of student management and permanence in HE institutions* (2015), a tool developed by MoE to assess student retention and graduation in Colombian HEI. In DIADEMMA, each factor groups together key aspects that in turn articulate specific variables, as shown in Table 1.

[2]The development of the initial factors of DIADEMMA involved the participation of a team from Cooperative University of Colombia, Medellin headquarters: Reina Cecilia Duque (Head of University Welfare and Alumni), Javier Mauricio Zuluaga (Head of Planning) and Juan David Quiceno.

Table 1. DIADEMMA contents.

Factor	Key aspects	Variables
Positioning	Articulation with well-being or permanence	Degree of articulation
		Documentation
	Responsible authority	Place of coordination
	Broadcasting	Consistency and outreach
Tracking	Diagnosis and characterization	Baseline assessments
		Mentor profiles
		Characterization of students
	Monitoring	Early warnings
		Analytics and reports
	Impact evaluation	Cost-benefit analysis
		Impact analysis
Training	Coordinators	Training and guidance
	Guidance to students receiving mentoring	Training processes
		Articulation with other support services
	Mentoring	Training and guidance
		Feedback
Management	Selection	Mentor selection process
	Pairing	Matchmaking criteria
	Incentives	Incentive management
ICT	Using ICT	ICT for training
		ICT for interaction
	Digital systems for monitoring	Data collection
		Data processing
Sustainability	Resource management	Internal resources
		External resources
	Knowledge management	Articulation with secondary education
		Interinstitutional work

Each variable becomes a question with five possible answers, presented in progressive order. The respondent chooses the one that better describes the program situation at the time the assessment is made. Table 2 presents an example referring to the variable "Mentor selection process", articulated to the key aspect "Selection" that is part of the Management factor.

Table 2. DIADEMMA presentation mode.

	Initiation	Installation	Formalization	Appropriation	Consolidation
How are mentors chosen?	No requirements are established for the entry of mentors.	General requirements have been established for the entry of mentors.	Beyond general requirements, the Institution has established a formal, staged process for mentor selection.	The mentor selection process is carried out periodically, according to the requirements of the mentoring program.	In addition to implementing it periodically, the mentor selection process is evaluated and adjusted as neccesary.

Each response corresponds to development moment, valued from 1 –initiation stage– to 5 –consolidation stage–. The average of each factor indicates the stage of that factor; with total average indicating the overall stage of program development, according to the ranges shown in Table 3.

Table 3. DIADEMMA valuation averages.

Initiation	Installation	Formalization	Appropriation	Consolidation
1.0 to 1.8	1.9 to 2.6	2.7 to 3.4	3.5 to 4.2	4.3 to 5.0

DIADEMMA was implemented in 41 Colombian HEI in the second half of 2020 and was enriched with further conversations, in order to clarify the conditions and characteristics of existing initiatives and to identify opportunities for improvement. According to the results of these HEI, 16% have programs in the *Initiation* stage, 33% in the *Installation* stage*,* 28% *in Formalization* –including some in the pilot phase or in the process of reviewing lessons learned and articulating with other institutional areas–, 16% in the *Appropriation* stage and 7% in the *Consolidation* stage*.* This shows an interest among participating HEI in such programs, as well as an opportunity to put the experience of the leading institutions at the service of those in earlier stages. As for the factors, the prevalence of development was found in the *Positioning* factor in contrast to a low level in *Sustainability,* which indicates the importance of creating networks that can build solutions in this line.

DIADEMMA proposes not only a way to assess the current situation but also actions for the improvement of mentoring programs, given that each possible answer to the question-variables refers to an action. By identifying which factors and variables require attention, the institution can be guided to take relevant actions to improve its initiative. In this way, each institution can design its own paths of action for the development of its mentoring programs after applying the tool. This takes into account the possibilities of each HEI and a gradual and sustainable process that guarantees the advancement and duration over time of such strategies.

During 2020, the implementation of DIADEMMA was followed by the deployment of support mechanisms between HEI, as well as support in the implementation of programs at the institutional level, all part of the *Generation E Mentoring Program*. In total, 89 HEI participated, involving more than 2600 volunteer mentors and more than 6500 mentors in the first stage. A new implementation of DIADEMMA is expected at the end of 2021, to account for the development achieved by HEI in their initiatives.

Even though DIADEMMA was developed in the context of Colombina higher education, it could be used by any higher education institution to support the process of assessment and definition of strategies related to institutional-level mentoring initiatives. EAFIT University

keeps working in the refinement of the tool, as well as fostering exchanges between institutions.

4. Conclusion

By facilitating both diagnostic assessment and the identification of development paths, DIADEMMA contributes to the construction of a culture of formative assessment in a higher education institution. In addition, it opens the discussion and planning around the processes of welcoming and supporting students in their integration to higher education. These processes are particularly relevant today, not only because of changes in the skills and needs of new generations –which require improved support mechanisms–, but also because of the circumstances that the COVID-19 pandemic has created in the last year. The massive use of digital technologies to support learning processes brings opportunities as well as challenges for retention with equity.

The development of mentoring initiatives can contribute in the solution of these problems, developing key personal and professional skills and helping in the cohesion of university communities, building bonds and a sense of solidarity. This makes relevant the availability of analytical tools to help HEI to understand their particular situation and development paths. DIADEMMA will have to improve over time, as mentoring programs evolve and the earlier stages become less relevant. At the time, it is a useful tool to foster new discussions and understandings for student retention.

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Short Videos to Communicate Effectively to Engineering Students

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Abstract

The use of multimedia in education has become a basic tool for educators. As Millennials and Generation Z use technology in their everyday life, the educational model has been shifting towards the use of multimedia and technology to enhance the active learning process.

The objective of this project was to design, produce and implement short educational or instructional videos to present content with a more active approach and measure the impact on their understanding and preference. A video with the content of graduation requirements was produced, shared with 240 seniors of Engineering Academic Programs.

The results show that 97% of the students liked the video and the way the content was shared and 91.6% of the students find the video format useful. The results show that the learning process was active and effective. The exit poll also shows that 97% of the students think that there should be more educational videos on some other processes.

This project included the design, production and implementation of 18 videos. This research describes the approach and impact of using short videos in engineering and transition from a traditional method of sharing content to students to a more active learning environment.

Keywords: *Educational videos; active and collaborative learning; student engagement; educational innovation; higher education.*

1. Introduction

Educational models all around the world are facing the challenges of implementing technology and multimedia in their courses in an effective way. Traditional learning is no longer efficient to new generations. The new educational model at our university will develop competencies and skills through flexible programs, learning experiences that are both interactive and challenging, educational spaces that promote learning, collaboration, and innovation and the use of innovative technology in the teaching/learning process (ITESM, 2020). Professors are transitioning to the new model and it includes the use of technology in the classroom along with all type of communication with students.

Research on educational videos shows the benefits of implementing technology in the teaching/learning process. The use of video may provide a significant means to enhance student engagement and improve student learning (Allen and Smith, 2021). Mitra´s study (2010) suggests that the use of video can provide useful material for students to engage with. Video viewing is an activity that promotes learning in an ongoing and highly interconnected process of comprehension (Marshall, 2002). Successful and productive use of multimedia in the classroom has increased dramatically over the last decades due to the growth of technology and more user-friendly tools (Cruse, 2007).

Brame (2016) considers the use of the video as an effective tool in the learning process, highlighting three elements: Cognitive load, student engagement and active learning. Some recommendations are to keep the videos brief and targeted on learning goals, use audio and visual elements to highlight important ideas and use a conversational and enthusiastic style to enhance engagement. Shephard (2003) also suggests that the video clips should be kept short to be more engaging. Studies suggest that a video should be kept at 3 to 6 minutes for it to be effective.

There have been studies that suggest that the use of videos improve effectiveness in communication with students. Li et al. (2016) used online videos for international students at UCB and UO to stimulate students´ interest for exploration of library services and resources. On the other hand, Nikolic´s study (2015) on the use of online resources in the teaching laboratory shows that such videos were used by a great amount of students to aid their learning process, increase productivity and at the same time, the level of engagement in the lab practice increased. The use of online resources can have a large positive impact on student learning and experience.

The use of videos to share information and engage with students can have notorious advantages. Having access to multimedia gives students control to watch the videos on their own time, pace and even the choice to repeat the segment if needed for comprehension (Shephard, 2003). Online videos are useful tools for students that are visual learners and the

ones that prefer to watch short clips to engage in a certain topic instead of reading or a traditional lecture (Diwanji et al., 2015).

This study focused on designing, producing and implementing short educational and instructional videos to be shown in the classroom and be shared in multiple platforms and social media. By sharing the contents in a different way than the traditional methods (orally in the classroom or by email), the aim of the study is to measure the impact of the videos as a communication tool and its usefulness from engineering student´s perspective.

2. Methods

The first step was to define the list of contents that program directors frequently use either in the classroom or with students. During the semester, students can schedule an appointment with the program directors to answer questions about a certain processes. The goal of the project is to produce videos with those contents that are most requested by students so that this information can be shared in a more friendly way, and at the same time, efficiently. Through a strategic planning session with the program directors of Mechanical Engineering, Mechatronics Engineering and Industrial Engineering, the following focus groups were defined: Current students enrolled in the Mechanical Engineering, Mechatronics Engineering and Industrial Engineering programs. 2. Freshmen students enrolled in the Introduction to Engineering course (2011 study plan) or F1001B (2019 study plan). 3. Senior students enrolled in the Introduction to the professional life course (2011 study plan).

Once the focus groups were defined, a brainstorming session with program directors was held. During this session, a list of topics were chosen based on the importance of its content, the frequency of student's appointments in regards to this issue and the order of importance from a program director´s perspective. The topics that were selected as priority are: Course registration process, Social Service, International Programs procedure, Final exams, Alumni short videos, Graduation requisites, Available labs at the campus, Academic improvement program, and Student conduct.

The first approach was to design and produce a video on student graduation requisites. All students at our university have a list of requisites that have to be accomplished by the time they finish their last semester. Instead of sharing the information in class (orally) or by email, the approach was to share it with a video. All the requisites were included as part of the script and a program director explained this while being filmed. Figure 1 shows a screenshot of the video with the format that was used. The content was shared with a casual tone of conversation and an enthusiastic style to enhance engagement.

Once the video was edited, it was shown to 240 students in the Introduction to the Professional Life course from the Mechanical Engineering, Mechatronics Engineering and

Industrial Engineering academic programs in the January-May 2019 semester. All students have to enroll to this course during their last semester. The video was shown during the class and also shared in the academic program portal (Blackboard) as well as in closed groups on Facebook. The intention of sharing the information online is to offer students the option of watching the video whenever they want throughout the semester. In addition to the institutional email, these two plataforms are the tools that are mostly used to share information with our students. Figure 2 shows evidence of the implementation of the video.

Figure 1. Graduation Requisites Video

Figure 2. Implementation of the video in the classroom and closed groups on Facebook.

A Google Forms opinion exit poll was created and used to get information from students in regards of the video approach, the way it was shared and the interface that was used. This information will be helpful to verify with the students if they approve the approach and also to determine if they prefer the video format rather than a traditional method.

3. Results and Discussion

As mentioned before, an opinion exit poll was applied to 240 students in order to measure the impact of the video. It was our interest to know if the short video was helpful and if students would prefer this format or a traditional method, such as explanation in the classroom with a PowerPoint presentation or an email. Out of the 240 students, 178 completed the survey. This represents 74% of the graduation candidates for the five academic programs (IMA- Mechanical Engineering with minor in Industrial Engineering, IME- Mechanical Engineering with minor in Electrical Engineering, IDA- Automotive Engineering, IMT- Mechatronics Engineering, IIS- Industrial and Systems Engineering). From the exit polls, 77% of the responses were from male students while 23% were from female students. Figure 3 shows the sample distribution taking into account engineering discipline. The representation of the student population in the survey makes sense as Industrial Engineering is the biggest program out of the 5 academic programs.

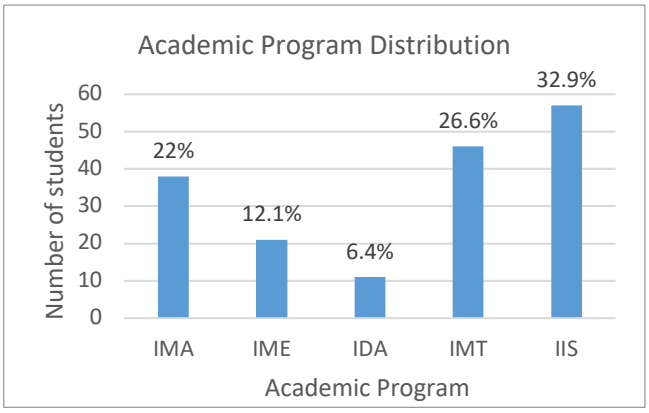

Figure 3. Sample Distribution

According to the opinion polls, 97.2% of the students liked the information that was presented on the video. As it can be observed in Figure 4, 91.6% of the students find the video format useful. Students were asked to evaluate on a scale from 1 to 10, where 10 is the highest and 1 the lowest, how much they learned about graduation requisites with the video format. It was interesting to see that 87.3% of the students selected a scale of 8 or above. 39.3% of the students chose the highest score. Figure 5 shows the results for this question and the distribution of the results. Apart from the video, it was our interest to see if students would prefer to have more educational videos made for other univeristy processes. Figure 6 shows that 97.1% of the students think that there should be more videos for other topics and processes. Results confirm that students prefer the use of multimedia for this type of information.

As a discussion, it was interesting to see on the exit poll that there is a 2 to 1 ratio on the student´s preference in regards of the video approach versus the traditional explanation by a professor in the classroom. Future work in this study includes investigating the preference and efficiency of the different platforms where these educational videos can be shared. The poll´s results reaffirm the main goal of the project: create and implement short videos in order to communicate effectively and at the same time, enhance comprehension, and engage with students.

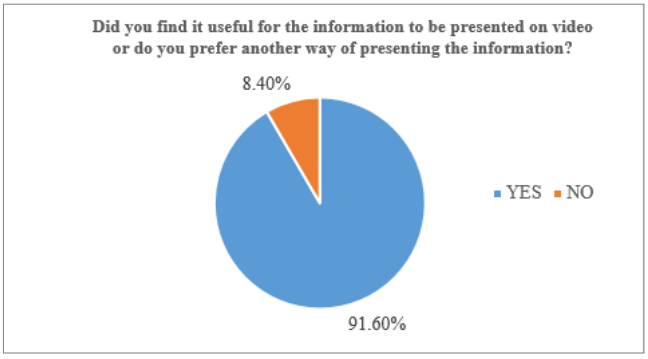

Figure 4. Results on the video format

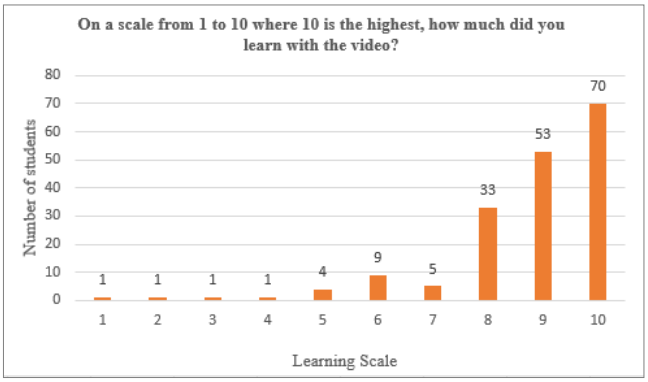

Figure 5. Learning outcome with video format

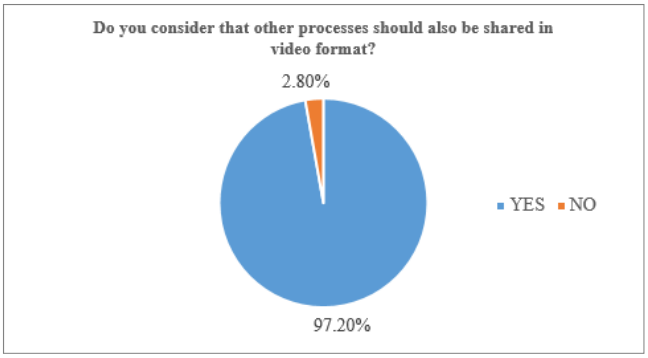

Figure 6. Results of student preference for more videos of other processes

Once the results were obtained and the team confirmed that our students prefer to receive information in a video format and find that approach useful and effcient, the following videos were produced and implemented: Virtual Lab Tours, Lab Safety Rules, Lab Practices, Graduation requisites, International Programs, Course registration process, Final Exams, Course drop out process, Alumni testimonials, Students testimonials, Block F1001B (Academic Regulations, Services and Processes).

The impact of sharing these videos in the academic program portals is shown in Table 1. Around 2,662 students have the videos available at the portal and have access at any time. This will benefit students as the information will be available online, and if there are further questions about a certain topic, students can request an appointment with the program director. The number of student appointments in regards of the content that was covered with videos, is expected to be reduce. This would be also interesting to measure for future work.

This project also produced videos that were implemented nationwide as part of the new educational model in the F1001B block. Around 390 professors in all of Mexico´s campuses were able to use the educational videos with the 5,571 engineering freshmen students.

Table 1. Impact of Educational Videos

Academic Program	Number of Students
IMT- Mechatronics Engineering	652
IMA- Mechanical Engineering with minor in Industrial & Systems Engineering	550
IME- Mechanical Engineering with minor in Electrical Engineering	300
IDA- Automotive Engineering	180
IIS- Industrial & Systems Engineering	1150
Modeling of Engineering and Science- Module Zero (Nationwide)	5,571 students

This project included the design, production and implementation of 18 videos. This study analyzed the impact of one of them focused on last-semester students. A limitation of this study is that the survey was conducted on groups where the professor was the researcher asking and might have a positive bias. Future work considers contemplating freshmen students, applying the survey to different groups where the professor is not the researcher.

4. Conclusions

Educational models are shifting from the traditional teaching format to an active learning environment. One approach to achieve active learning and student engagement is with the use of short videos that will connect with our new generations. The use of short educational or instructional videos with a casual conversational approach connect with new generations. Millenials and Generation Z students are used to technology and this approach engages them with the content and their learning style.

This study shows that students connected with the video, they liked the video format and they learned in a more active way. Students were engaged with the videos and suggested that more contents should be available in this format. Also, it was interesting to see that students prefer multimedia rather than a traditional method (email or oral method). Educators have the challenge to transition from a traditional way of teaching to an active learning approach and the use of technology will improve student´s interest and engagement.

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Insights into academic feasibility at the KIT: a mixed-methods exploration of the department of mechanical engineering

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Abstract

As part of their accreditation procedure, universities have to ensure academic feasibility of their study courses. Against that backdrop, student's workload and study conditions are focused as indicators of quality. However, this prioritization of formal criteria is defined by the module handbooks rather than by the students themselves. Therefore, a mixed-methods-analysis at the Karlsruhe Institute of Technology (KIT) was conducted to shed light on these issues: How can individual expectations and requirements of students towards the academic learning settings be incorporated into quality assessment? Which opportunities of individual development for students exist in the academic setting and do they differ with regard to different departments at the KIT? The data of surveys completed by 324 students of the department of mechanical engineering and 242 students of the department of economics and management at the KIT are the basis of our analysis. The empirical analysis via chi-square-test and Mann-Whitney-U-Test indicates significant distinctions between students of both departments at the KIT concerning their experiences with research and inquiry and their motives for enrolling to university courses. Further analyses via interviews are planned to reveal the complex chains of reasons for this research results such as considerations of course characteristics and cultural condition.

Keywords: *Higher education; academic feasibility; mechanical engineering.*

1. Introduction

When universities are to ensure academic feasibility of their study programs as part of their accreditation procedure, as a rule only a balanced students' workload and the assessment of study conditions are focused as indicators of quality (Langemeyer & Schlindwein, 2021). Emphasizing the "practical relevance" of a degree course as well as occupational qualifications is widely argued as important for so-called knowledge society (Tremp, 2018). However, this prioritization of formal criteria is defined by the module handbooks rather than by the students themselves. If higher education teachers invest enough time to develop the curriculum according to learning achievements and aims is an open question. Following similar questions of interest within the field of higher education, Trigwell and Prosser (2004) revealed the importance of student's perceptions of their learning settings and environments. Therefore, a mixed-methods-analysis at the Karlsruhe Institute of Technology (KIT) was conducted to shed light on these issues: How can individual expectations and requirements of students towards the academic learning settings be incorporated into quality assessment? Which opportunities of individual development for students exist in the academic setting and do they differ with regard to different departments at the KIT? What can be detected from assessing research-driven teaching and learning from students' perspective?

2. Design and methods

Surveys completed by 1482 students of all departments at the KIT in 2016 are the basis of our analyses. The questionnaire includes items about students' experience with various didactic elements of research and inquiry in their learning setting in higher education. Furthermore, students' motives for enrolling to university courses and their expectations about their individual development were assessed. In previous empirical work, different methodological approaches have shown significant distinctions concerning the experiences with and judgements about various didactic elements of research and inquiry, learning strategies and study requirements of students (Langemeyer & Schlindwein, 2021).
In the present study, the subsample of 324 students of the department of mechanical engineering and the subsample of 242 students of the department of economics and management at the KIT were used for a comparison. The following questions were scrutinized via mixed-methods-approach at the Karlsruhe Institute of Technology (KIT): How can individual expectations and requirements of students towards the academic learning settings be met? Which opportunities of individual development do students have in their particular academic setting and how do they differ with regard to the chosen departments at the KIT? The analysis then focused on the use of particular experience with didactic elements such as informing students about currently published research results or challenges to plan and conduct independently a research project. Students' motives for enrolling to university

courses were also assessed, such as high-income opportunities, preferring a career in science or engaging with scientific problems and issues.

2.1. Experience with didactic elements of research and inquiry

Via chi-square-test, significant distinctions between students of the department of mechanical engineering and students of the department of economics and management at the KIT concerning their experiences with various didactic elements of research and inquiry were confirmed. Table 1 shows the selected experiences with didactic elements the survey contained and the results of the analysis.

Table 1. Results of chi-square test concerning experiences of research and inquiry between students of the department of mechanical engineering and students of the department of economics and management at the KIT.

Variable	χ2	FG	p	ω2
researching independently a certain theme (- research content)	3.38	1	.06	-.07
familiarising with current research results	6.89	1	.00	-.11
using examples of research for illustration	.58	1	.44	.03
participating in the work of research projects at the institute/chair	6.83	1	.00	.11
developing research questions	4.10	1	.04	-.08
running experiments/small projects	6.81	1	.00	.11
developing and planning a research project	.078	1	.78	.01
conducting independently a research project	.95	1	.32	.04
exploring interrelations in a particular field	1.23	1	.26	-.04
participating in excursions	9.17	1	.00	.12
acquiring basic knowledge	.72	1	.39	.03

Source: own elaboration based on data from 2016.

The analysis shows that significant distinctions can be found with regard to the experiences of familiarising students with current research results, participating in the work of research projects at the institute/chair, developing research questions, running experiments/small projects and participating in excursions. The result that students of mechanical engineering learn significantly less about current research results than their peers in the department of economics and management at the KIT indicates that basic knowledge as it is taught and acquired during the first year(s) of their study program is considered as approved more than the equivalent knowledge in economics. However, the subsample of students of the

department of mechanical engineering has a higher level with regard to participating in research projects at the institute/chair, running experiments/small projects and participating in excursions than students of the department of economics and management. In the next section, it is analyzed how these differences correspond with significantly different expectations towards academic education by the respective groups of students.

2.2. Motives for enrolling to university courses

To analyze differences between both groups of students of the two departments at the KIT items concerning their motives for enrolling to university courses are considered. The Mann-Whitney-U-Test as non-parametric procedure was conducted (see table 2). The results show that students of the department of mechanical engineering have significantly higher mean ranks with regard to the interest in scientific work, striving for an academic career and engagements to improve society. They also show a significantly higher interest in their disciplinary subject as a motive for enrolling to university courses. However, students of the department of economics and management point out earning opportunities as motive for entering higher education and have significantly higher values here than the students of mechanical engineering. Furthermore, the results also indicate that students of the department of economics and management are influenced more strongly by expectations of their parents, family, peers etc. than students of the department of mechanical engineering. This indicates that there are more students in economics who want to please family or peers by enrolling into higher education than in the subsample of mechanical engineering. However, this information must not be overestimated since the overall number of students' who agreed with this item is small.

Table 2. Results of Mann-Whitney-U-Test analysing motives for enrolling to university courses of students of the department of mechanical engineering and students of the department of economics and management at the KIT.

	Students of the department of mechanical engineering		Students of the department of economics and management				
Variable	**N**	**Mean rank**	**N**	**Mean rank**	**U**	**z**	**p**
Preferring higher education than vocational training	320	286.58	239	271.19	33135.5	-1.1	.24
Higher education as future-oriented investment	319	278.38	239	280.99	37764.5	-.21	.83
Earning opportunities	319	267.03	239	296.14	34142.5	-2.1	.02
Improvement of society	317	291.24	238	260.37	33526.0	-2.2	.02
Engaging with social issues	316	268.69	238	289.20	34820.0	-1.5	.13
Social commitment	317	266.91	237	291.66	34208.5	-1.8	.07
Scientific working	318	311.57	237	232.96	27009.0	-5.7	.00
Aspiring a career in science	316	303.52	238	242.95	29381.0	-4.4	.00
Engaging with scientific issues	319	308.94	238	238.87	28410.5	-5.1	.00
Social environment	317	265.62	236	292.28	33799.5	-1.9	.05
Advice of family or friends	317	275.83	236	278.57	37036.0	-.21	.84
Interest in the subject	319	289.61	235	261.06	33618.0	-2.1	.03
Individual talent	318	270.35	236	287.14	35249.5	-1.2	.21
Acquiring knowledge	319	271.83	236	286.34	35673.0	-1.1	.26
Life-realization	318	273.68	237	283.80	36309.5	-.74	.45
Avoiding routine work	316	276.64	237	277.48	37331.5	-.06	.95
broadening mental horizon	320	270.61	237	290.32	35236.0	-1.4	.13

Source: own elaboration based on data from 2016.

Since there are a correlations between motives for enrolling to university courses and the department affiliation of students further analyses are conducted.

For further investigations with regard to the sample of students of the department of mechanical engineering, we used a multiple linear regression model. The aim was to explore which variables predict certain enrolling motives, starting with the item that students are motivated to attend higher education because they enjoy engaging with scientific issues. Therefore, the dependent variable examined was the preference of dealing with scientific issues. Table 3 shows that via multiple regression analysis we determined the following predictors for scientific aspiration: Students preferring to deal with scientific issues tend to perceive added value in research-driven teaching. They also have an aspiration to making a scientific career and prefer scientific working in general. The clear interest in their subject is also positively correlated with preferring to deal with scientific issues. The explained variance of this model is 58.9 percent.

Table 3. Results of multiple linear regression analysis of students of the department of mechanical engineering (N = 306) at the KIT.

Variable	B	SE	β	t	p
constant	1.109	.526	-	2.11	.03
I perceive added value in research-driven teaching.	.125	.039	.136	3.32	.00
Scientific working	.501	.046	.536	11.0	.00
Aspiring a career in science	.131	.032	.184	4.07	.00
Interest in the subject	.180	.051	.137	3.56	.00

Dependent variable: Engaging with scientific issues.
Source: own elaboration based on data from 2016.

Table 4. Results of multiple linear regression analysis of students of the department of economics and management (N = 232) at the KIT.

Variable	B	SE	β	t	p
constant	1.883	.625	-	3.01	.00
I perceive added value in research-driven teaching.	.041	.056	.042	.73	.46
Scientific working	.466	.060	.521	7.75	.00
Aspiring a career in science	.148	.045	.189	3.32	.00
Interest in the subject	.178	.065	.135	2.75	.00

Dependent variable: Engaging with scientific issues.
Source: own elaboration based on data from 2016.

To compare the subsamples of students of both departments, we also conducted a multiple linear regression analysis of students of the department of economics and management with the same items (see table 4). The dependent variable of preference of engaging with scientific issues is positively correlated with an aspiration to making a career in science and a preference of scientific working in general. Via multiple regression analysis also a clear interest in their subject is salient. Up to this point, the predictors of the multiple regression analysis encompass no explicit distinction to their peers of the department of mechanical engineering. However, concerning the item "I perceive added value in research-driven teaching" a significant contrast to the sample of students affiliating to the department of mechanical engineering can be found. Preferring to deal with scientific issues is not correlated with perceiving an added value in research-driven teaching for students of the departments of economics and management. With an explained variance of 50.7 percent of this model, it fits to the half of the sample of students of the departments of of economics and management. As a preliminary conclusion, the outlined significant distinctions concerning their experiences with research and inquiry of students of the department of mechanical engineering and of the department of economics and management at the KIT, does not affect their subjective value of research-driven teaching.

3. Conclusions

Via chi-square-test, Mann-Whitney-U-Test and multiple regression analysis distinctions between students of the department of mechanical engineering and students of the department of economics and management concerning their experiences with various experiences of

research and inquiry and also their motives of enrolling to university courses, specifying the the main results obtained.

This study suggests that universities should develop strategies for incorporating students' motives for enrolling to university courses and their experiences into strategies of assessing study programs. For answering the questions which directive strategies exist and if there is any imperative seen to review previous strategies at the department of mechanical engineering, interviews are planned. The interviews will address teachers affiliated to the the department of mechanical engineering to combine our research results with their valuable and relevant insights, such as course characteristics and cultural condition. Vice versa, with the current research results we are able to initiate a different perspective on decision-making patterns concerning the implementation and design of module handbooks in the selected departments.

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Making the Abstract Straightforward: A Pilot of Immersive VR in an Allied Health Program of Study

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Abstract

Emerging technologies in education are offering new tools for teaching and learner engagement. Today's study and practice can include use of digital technologies far beyond looking at a flat screen: virtual reality, augmented reality, interactive 3D objects and 360 video can provide immersive and impactful teaching and learning. There are a variety of definitions for these "realities" but the overarching impact is one of powerful, immersive, visual learning. Immersive virtual reality in a learner-centric environment can provide more presence and engagement for students, enabling the possibility of enhanced learning experiences relative to conventional classroom practices. This paper presents formative early results of a pilot study leveraging the possibilities of VR technology in service to an existing program of study in allied health services:graduates surveyed report high degrees of confidence in course materials learned by means of the custom VR components developed, reporting the adjunct course materials substantially helped learners in understanding otherwise difficult to grasp concepts of the course.

Keywords: *Virtual reality; educational technology; active learning; experiential learning; qualitative evaluation.*

1. Introduction

Emerging technologies in education are offering new tools for teaching and learner engagement. Today's study and practice can include use of digital technologies far beyond looking at a flat screen: virtual reality (VR), augmented reality (AR), interactive 3D objects and 360 video can provide immersive and impactful teaching and learning tools, (Martín-Gutiérrez, J., Mora, C. E., *et al*. (2017). There are a variety of definitions for these "realities" but the overarching impact is one of powerful, immersive, visual learning.

Libraries' use of virtual, augmented realities and 3D objects and video, like all technological advancements, has been growing and in flux for several years. However, in 2021, it is no longer seen as a technology whose time is yet to come - its rapid adoption in multiple areas of learning and workforce development is officially emergent in the area. Libraries of all types across the country are actively using VR/AR/3D technologies to drive accelerated learning, especially in STEM. According to a 2020 study in the British Journal of Educational Technology, students who use virtual reality in their science lessons across six weeks significantly outperformed the control group in terms of academic improvement (Bower, M., & Jong, M., 2020).

Immersive virtual reality in a learner-centric environment can provide more presence and engagement for students, enabling the possibility of enhanced learning experiences as adjunct to conventional classroom practices (Kim, K., Oertel, C., *et al*. 2020). Leveraging the emergent classroom technology can create student engagement and enthusiasm (Chen, 2010); immersive virtual reality, compared to the conventional monitor-based low-immersion can enhance learning through situated experience with greater immersion, learning through multiple perspectives, and knowledge transfer through simulations of the real world (Dede, 2009). VR offers possibilities of creating immersive learning situations for the learners in a safe, exploratory practice space (Le, Q.T., Pedro, A., et al, 2015), encouraging students to be active learners and promoting decision-taking by enabling autonomous exploration and learning by doing, (Martin, Gutierrez, Mora, Anorbe-Diaz, *et al*, 2017)

This paper presents formative early results of a pilot study leveraging the possibilities of VR technology in service to an existing program of study in allied health services.

2. Materials and Methods

From 2019 – 2020 the Nevada State Library leveraged its partnership with the College of Southern Nevada and established subject matter experts in STEM skill development and career navigation to increase interest in Diagnostic Services Career Pathways and accelerate engagement with the Dialysis Laboratory Technician occupation. Purposeful, defined virtual reality tools and content workforce recovery training programs are advancing to support and

influence workforce recovery in STEM fields that lead to living wage employment (Nevada Governor's Office of Economic Development, 2020); with immersive 360° video, prospective students can literally see and experience if the Diagnostic Services Career Pathway is a good fit for their interest. Followed with a unique introduction to this pathway's occupations by means of VR content, and curated for diagnostic healthcare, the 3D content has the potential to cognitively anchor difficult science concepts while enabling the student to acquire a more meaningful understanding of "the job" (Dede, 2009).

In short, career exploration by means of a software-as-a-service database combining 360 video, STEM virtual reality, and data analysis modules, could create a "job coach on steroids". The authors piloted the development of the proof of concept program with the College of Southern Nevada dialysis technician program, and developed program assets that became homework help to students once enrolled in the program of study.

2.1. State health need and occupation demand informed selection of the program of study

Medicare, the federal health program in the United States for people 65 or older, in addition to certain individuals with disabilities, requires a national certification for any dialysis care technician employed within 18 months of hire date. This program is vital to the state's dialysis providers, as 21.1% of its population is dealing with kidney disease at various stages. The ability to meet growing regional demand for a highly skilled technical workforce is possible through this uniquely focused partnership. Constraints, or bottlenecks, to requisite in-person clinical hours were restricting the number of certified dialysis technicians in the talent pipeline. To manage the constraint, the proof of concept identified a clinical simulation option to drive unnecessary in person work study.

Dialysis patient care technicians work under the direction of nurses and physicians and perform dialysis on patients with acute or chronic kidney failure. These technicians operate dialysis machines that remove waste, salt, and extra water from the patient's blood while keeping safe levels of certain chemicals. Patient Care Technicians prepare patients for dialysis, monitor them, adjust settings on the machine, and perform required procedures upon completion.

2.2. Demand for graduates greatly exceeded capacity of the program

Medical and Laboratory Technician, identified by Nevada's Office of Science, Innovation, and Technology as a priority occupation in the Las Vegas Valley region, serves businesses that provide healthcare and social assistance to individuals. Employer identified skill gaps for qualified technicians include: processing information; interacting with computers to set up functions and enter data, and skill in observing, receiving and otherwise obtaining information from all relevant sources to make decisions; monitoring processes, materials or surroundings to detect or assess problems and evaluating information to determine

compliance with standards. The Health Sciences Career Cluster prepares individuals for employment in the industry in general, and the Diagnostic Services Career Pathway specifically for the Medical and Laboratory Technician (aka Patient Career Technician) occupation (there are 16 total occupations in the Diagnostic Services Pathway). Total current employment in the Health Sciences Career Cluster is 53,928 and total projected employment by 2024 of 66,934, with a total annual demand for 2,465 (turnover + growth). Within the Diagnostic Services Career Pathway, including the Medical and Laboratory Technician occupation, total current employment is 4,640 and total projected employment in Nevada by 2024 of 5,869, with a total annual demand of 207 (turnover + growth).

The existing College of Southern Nevada's (CSN) Dialysis Patient Care Technician (PCT) certificate of completion, as well as the nationally recognized Certified Clinical Hemodialysis Technician (CCHT) credential, is recognized and valued by companies employing Patient Career Technicians in Southern Nevada; however, employers needed to see it expanded to grow the pipeline of skilled workers available to dialysis providers and other advanced technology healthcare sectors.

2.3. Developing the VR course adjunct materials need and occupation demand

Once the program of study had been selected for the pilot, the implementation group met with the instructor of record in the context of the classroom for an in-depth discussion and exploration of which point or topics of the course of study students could most benefit from access to customized VR learning content. In particular, the core question posed was to ask the instructor to think back to their most recent cohort of students in the program: was there one concept, topic, or lecture that was most central or key in the long-term success of students in the program? That is, a concept or skill that once mastered, the instructors' confidence that the student would successfully complete the training and be gainfully employed.

The lead instructor of the program walked to the classroom whiteboard, and began sketching the outlines and describing the fundamental nature of the dialysis procedure. Illustrated with a photograph in Figure 1, the "extra-corporeal circuit" mapped out how the patient's blood flows through the tubing – taped to the whiteboard for effect – through the various pieces of the equipment, to the "dialyzer" that effectively filters the blood, ultimately returning to the patient's arm. The instructor explained that without a core understanding of each of the aspects illustrated, in conjunction with basic STEM skills and mathematical ability, students would ultimately prove incabable of completing the course and acquiring the certification needed to practice. It was a complicated lesson, and one the instructor explained typically took an entire class period, and clearing up misunderstandings throughout the remainder of the course.

Virtual reality STEM publisher, Lifeliqe, LLC, Lifeliqe was contracted to create an immersive VR learning module to address the learning need and enable students to self-teach

by means of the immersive adjunct VR content. Titled simply "Dialysis," the application provided an option to explore 12 interactive 3D models, wherein the user can explore different parts of the 3D models, with each part having additional information about itself, in depth. Made available as a “channel” unlocked with a license key made available to all libraries within the proof of concept area and the College of Southern Nevada (CSN), students enrolled in the program could leverage the simulation at their local public library branch.

The course instructor further identified specific topics from the curriculum used in the Dialysis Patient Care Technician core curriculum that benefit from practice. Each practice module was designed to be self-paced and provide instant feedback on learner responses. Students could visualize reactions and processes while solving problems in real-time. Importantly, the modules combine real world context in a virtual dialysis center, requiring learners to think critically and perform mathematics in their development of specific quantitative reasoning. In a virtual environment designed to enable students to learn “hands on,” students can return to the modules at any time for practice. Learning supplements have indefinite shelf lives, as the science behind the curriculum is longstanding.

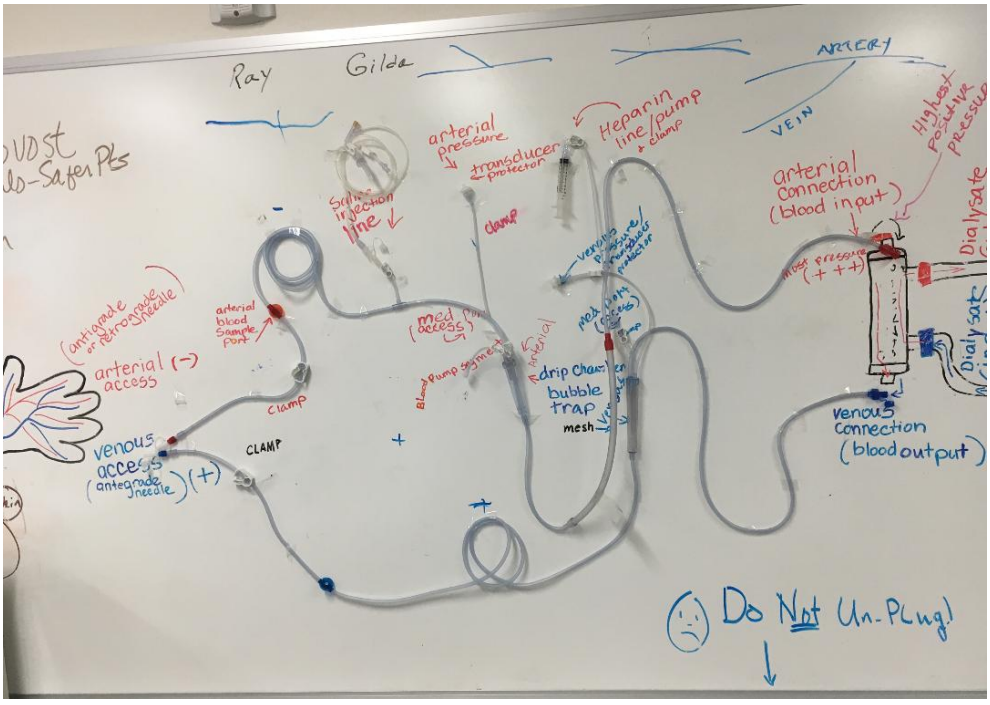

Figure 1. The extra-corporeal circuit, as taught to the traditional classroom by means of a whiteboard, annotations, and discussion.

Figure 2. Rather than a theoretical discussion in front of a whiteboard, the VR simulation places the learner directly in the context of the dialysis workplace. Note the embedded learning cues such as "touch the dialyzer" offering immediate feedback.

3. Results

Although insights are formative and not validated externally, early results from a pilot study interrupted by the onset of the novel COVID-19 pandemic, based on the impact the of the immersive VR content and its utility the decision was made to transition the program to an online format supplemented by the VR content made available through the public library. Rather than cancelling courses currently underway, despite the pandemic and associated restrictions, of the 12 students enrolled in the program 11 were able to successfully complete the program. The ultimate indicator of success, each of the graduates gained immediate employment in the discipline at competitive rates of pay – in spite of an economic environment brought on by pandemic closures resulting in unemployment for well over 30% of the regional population.

Although the conditions of the pilot had shifted, with the VR component shifting from homehork help to becoming actual laboratory and coursework, feedback was gathered from students in the cohort upon completion is useful for others that may be contemplating similar work. Responses to the anonymized in-depth survey offer insight into the degree to which the VR component improved learning outcomes, including on respondent stating the primary benefit of “being able to visualize the concepts”. That statement was echoed by another stating the VR component “helped me much in understanding the concepts.” Yet another compared the immersive three-dimensional VR content to a two-dimensional video on a flat

screen, pointing out that the "new and different environment and was very helpfully [sic] and much better than traditional learning materials to exhibit the practical ablity of the process".

When asked whether the addition of 3D interactive and virtual reality content to the program increased their confidence going into the midterm exam, all respondents seemed to echo the statement one student made, simply "I am confident about using what I have learned." The majority responded at the highest affirmative level, with the remainder indicating only one step down from the highest level of confidence. Indeed, the impact on confidence had one student reporting "I opened the models when we were waiting to enter the classroom to take our midterms and I passed on first try."

Notably, some students reported experiencing dizziness, or a sense of claustrophobia when wearing the VR headset and chose instead to use simulation on their cellphone or tablet computer. Access to the content overall seemed transformative to the students' learning experience, with one student summing the experience up simply: "…my first day was like whoa this is an actual water room. It gives you an idea on what you can expect."

4. Discussion and Directions of Future Work

Although this paper reports promising findings from the initial pilot study of implementing customized VR experiences as adjunct training facilities in an allied healthcare program of study, they are formative at best and should be validated by other study. There is a need for a more structured longitudinal study to document potential impact and begin steps toward eliciting best practices. Nevertheless, from a practical standpoint this pilot has already demonstrated that coursework formerly restricted to the classroom and clinical workplace can be expanded with judicious selection, development, and implementation of VR adjunct course material. A case in point, the program at the College of Southern Nevada has not only been able to maintain a pipeline of course graduates to serve the growing need, but to expand the number – even as the quality of the learning may be increased by the access to the immersive learning environment. Further, the development and access to the VR content enabled a successful transition to a fully online program, lifting former geographical limitations on enrollment and potentially expanding the program well beyond the local area.

There is a need for additional build out of supporting modules in the existing course of study, even as it is underway with additional cohorts. Even among the first cohort there was a call from the students to include additional content, such as a variety of emergency situations that might arise. As one of the respondents noted, "It seems to only be a smidgen of what is actually done in the clinic and even in the classroom. I don't know how costly or how much work it would take… but it would be awesome to see more." It would be good to include actual fiscal impact in future work, speaking both to the costs of development and

implementation, as well as the potentially increased impact and cost-benefit of both learners and the educational institutions involved.

Based on the strength of these initial results, in addition to building out additional models in support of the current certification program of dialysis technicians, there is a clear opportunity to leverage such customized VR content to increase efficacy of instruction in similarly difficult to learn topics. The framework and methods described in this paper could be relatively easily applied to meet needs in similar programs of study across higher education. In particular, the potential to open up and expand access for individuals unable to learn effectively by means of traditional classroom methods, particularly in STEM disciplines, promises to not only transform individuals' lives, but to impact local economies in a positive way.

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Students' self-perceptions of mindfulness after learning mindfulness techniques in a professional skills course

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Abstract

In this paper, we describe the effect of incorporating two mindfulness techniques (keeping a diary and motivational interviewing) in a professional skills course, and the impact these had on students' self-perceptions of mindfulness. Over a fourteen-week semester, students were asked to keep a diary at four different time points and were also taught motivational interviewing skills, which they had to apply to a four-part counseling project. Using a pre-post study design and the validated tool, the Mindful Attention Awareness Scale (MAAS), we measured students' perceptions of mindfulness pre-course and post-course. Results from the study indicated that students' perceptions of mindfulness significantly increased from pre-course to post-course. Further, most students agreed that both the diary assignments and practicing motivational interviewing increased mindfulness from pre-course to post-course. Additionally, a majority of students reported that practicing motivational interviewing enhanced their counseling skills on the four-part counseling project and that the four diary assignments improved their writing skills. This study underscores the importance of incorporating mindfulness techniques into a professional skills course to increase students' mindfulness, which can further benefit the student by increasing students' professional skills to become more competent counselors and writers.

Keywords*: Mindfulness; anxiety; diary; motivational interviewing; counseling; writing skills.*

1. Introduction

1.1. Background on Mindfulness

Over 40 million adults in the United States suffer from an anxiety disorder ("Understanding the facts," 2020). College students have substantially higher rates of anxiety and depression than the general population (Ibrahim *et al*., 2013). Stress and anxiety are within the top five health concerns for college students, which can lead to academic, mental, and emotional struggles (Griffin *et al*., 2020). College is a stressful time in the life of a young adult, yet there is evidence that practicing mindfulness can decrease symptoms of anxiety and depression (Martin, 2018). Kabat-Zinn (1994) defined mindfulness as, "paying attention in a particular way, on purpose, non-judgementally, to the present moment" (p. 4). Martin (2018) found that practicing mindfulness can increase well-being and decrease emotional reactivity among college students. Mindfulness is considered to be a disposition that can be enhanced by practicing mindful techniques (Sohl *et al*., 2016). Learning and practicing mindfulness techniques can further benefit college students because these practices can increase resilience to academic stressors and can enable students to more easily accept the ebb and flow of academic life (Ramasubramanian, 2017).

A meta-analytic evaluation of stress reduction interventions for university students indicate that cognitive-behavioral therapy, coping skills, and social support interventions were effective in reducing perceived stress, whereas relaxation training, mindfulness-based stress reduction, and psychoeducation were more effective in reducing anxiety (Yusufov, *et al*. (2019). Pogrebtsova *et al*. (2017) found that brief and cost-effective interventions focused on mindfulness techniques can quell stress and foster positive functioning. Creating brief, occasional diary entries is one such cost-effective mindfulness intervention that can be used among college students. This technique can incorporate a focus on social support from the reviewer. Interventions that employ social support provide environments where individuals are encouraged to communicate their experiences, thoughts, and feelings to one another (Kim *et al*., 2016) and this can be done through diary writing. Social support can buffer the impact of stress on numerous outcomes (Uchino & Birmingham, 2011; Yusufov *et al*., 2019). Electronic diary entries can be especially beneficial to increase mindfulness in college students and to decrease anxiety, (Doorley *et al*., 2020). Expressive writing is a key component of journaling in a diary and is a commonly used tool for self-reflection (Frattaroli, 2006). This informal type of writing can give students a safe context to recognize their feelings on events in their lives so that they can gradually understand, validate, and accept them (Greenberg & Lepore, 2004).

Another technique that can increase mindfulness is motivational interviewing (MI). MI is a counseling technique that embraces a spirit of supporting autonomy, eliciting one's reasons for change, and aligns with an assessment of readiness to change a behavior (Sohl *et al*.,

2016). MI leads to self-discovery, which is a component of mindfulness. Mindfulness influences client-centeredness, which is the main driver of MI (Sohl *et al*., 2016). Clinicians and counselors are also susceptible to job stress and burnout due to the high levels of empathetic demand that can create compassion fatigue or emotional exhaustion. Modified mindfulness training may help support clinician health, reduce burnout, improve job satisfaction and emotional well-being, which may have implications for patient care (Fortney *et al*., 2012). In addition, training clinicians to use MI has been shown to also reduce burnout scores (Pollak *et al*., 2016).

1.2. Course assignments to increase mindfulness

To assess students' perceptions of mindfulness from pre-course to post-course, two assignments focused on increasing mindfulness were created as required submissions in the professional skills course. A 4-part diary assignment was devised based on a twofold approach: first, as an emotional regulation technique to increase mindfulness, and second to improve students' writing skills. Bryant (1997) said that "you can't read and write well unless you can think straight, and you can't think straight unless you get in touch with your real thoughts" (p. 20). High levels of social anxiety correlate with increased difficulty in emotional regulation (Hayes-Skelton & Graham, 2013). A study by Kivity and Huppert (2016) found that the practice of keeping a diary decreased social anxiety and increased emotional regulation. Based on this, the 4-part diary assignment was low stakes grading and provided points just for completion. Additionally, the style of writing was informal and encouraged free expression, so students would not feel judged but provided them with social support from the instructors. A 4-part nutrition counseling project was the second assignment with the twofold intent for students to practice MI skills, acting as the nutrition counselor to a client, and thereby increase their mindfulness. The counseling project required students to establish rapport with the client and to create goals and an interventional plan of action with the client in the spirit of MI. After three counseling sessions with their clients, students reflected on their MI skills, and changes in their self-efficacy, and mindfulness.

1.3. Hypothesis and research questions

We hypothesized that mindfulness would increase among the students from pre-course to post-course after students had learned about mindfulness techniques and given ample opportunity to practice some of the mindfulness techniques (i.e, diary entries and MI) throughout the semester. In addition, we expected that students' writing skills would improve as a result of practicing these mindfulness techniques in the professional skills course. Five research questions were formulated to guide our study; see Figure 1.

Research Questions

1. Is there a significant increase in mindfulness from pre- to post-course among students who complete the course?
2. Do students believe submitting diary entries at four points throughout the semester increased their mindfulness?
3. Do students believe learning and practicing motivational interviewing techniques increased their mindfulness?
4. Do students believe practicing motivational interviewing techniques made them better nutrition counselors?
5. Do students believe submitting diary entries at four points throughout the semester made them stronger writers?

Figure 1. Research questions.

2. Methods

This pre-and post-test study was approved by the Institutional Review Board (IRB) of a public university located in the western suburbs of Philadephia and was introduced in a Professional Skills in Dietetics course. Throughout the semester, the instructors employed the use of a variety of mindfulness techniques (i.e diary entries and motivational interviewing skills) in the form of two, four-part assignments: a diary assignment, and a nutrition counseling project. The instructors provided lectures on the rationale behind diary entries making students stronger writers, and on MI skills to use in counseling clients. Instructor feedback was provided to the students on all assignment submissions.

2.1. Participants

A total of 102 third- and fourth-year students across three-course sections taught by two instructors for the course consented to participate in the study. All study participants were in the Nutrition and Dietetics major at the university and enrolled in the Professional Skills in Dietetics course. The study employed a convenience sample and participation in the study was voluntary. IRB approval was received before the start date of the study. There were no benefits to participating in the study, aside from furthering the existing body of literature on the topic of mindfulness.

2.2. Data collection and analysis

The students completed a 17-question survey as a pre-test on the first day of class, and they completed a 21-question post-test on the last day of class. Both the pre-test and the post-test employed the validated tool called the Mindful Attention Awareness Scale (MAAS). The MAAS is a 15-item scale used to study dispositional mindfulness. Items in the MAAS are consistent with the mindfulness theories on self-awareness (Bishop *et al*., 2004) and evaluate

behaviors related to internal and external present-moment experiences. Additionally, questions on the post-test asked about students' perceptions of the correlations between the diary assignments and mindfulness, practicing motivational interviewing techniques and mindfulness, practicing MI techniques and being a better nutrition counselor to a client, and the diary entries effect on being a stronger writer.

Paired t-tests were used to compare students' perceptions from pre-test to post-test and frequencies were calculated using the Statistical Package for the Social Sciences (SPSS) version 22 to analyze students' perceptions of assignments throughout the course. The MAAS allows the researcher to calculate a dispositional mindfulness score based on how each participant assessed the fifteen survey items. A mean score can be calculated and higher scores reflect higher levels of dispositional mindfulness. As such, we calculated mean scores pre-course and post-course for the entire group of study participants.

3. Results

One hundred two students completed the pre-and post-tests and thereby completed the professional skills course that incorporated mindful activities. After computing mean frequencies on the MAAS for participants from pre-test to post-test, it was found that the mean mindful score significantly increased from pre-course to post-course. These results can be seen in Table 1.

Table 1. Mean Mindful Scores from Pre- to Post-Course.

Mindful Score	Mean	Standard Deviation
Pre-Course	53.9	11.5
Post-Course	56.1	11.5

N = 102, p = .043

Frequencies were calculated to determine students' perceptions of mindfulness correlated to assignments throughout the course. When analyzing students' perceptions that the four-part diary assignments increased their mindfulness, it was found that the majority of students (91.2%) slightly agreed to strongly agree that the diary assignments increased their mindfulness; see Table 2.

Table 2. Diary Assignment and Mindfulness Correlations.

Response	Frequency	Percent
1. Strongly Disagree	2	2.0
2. Disagree	3	2.9
3. Slightly Disagree	4	3.9
4. Slightly Agree	18	17.6
5. Agree	47	46.1
6. Strongly Agree	28	27.5

Frequencies were calculated to determine students' perceptions of mindfulness, as correlated to learning about and having had the opportunity to practice motivational interviewing. Results indicated that almost all the students (99%) slightly to strongly agreed that practicing motivational interviewing increased mindfulness; see Table 3.

Table 3. Practicing Motivational Interviewing and Mindfulness Correlations.

Response	Frequency	Percent
1. Strongly Disagree	0	0.0
2. Disagree	0	0.0
3. Slightly Disagree	1	1.0
4. Slightly Agree	25	24.5
5. Agree	39	38.2
6. Strongly Agree	37	36.3

Frequencies were calculated to determine students' perceptions of the correlation between practicing motivational interviewing and their counseling skills. Results indicated that all the students slightly to strongly agreed that practicing motivational interviewing improved their counseling skills; see Table 4.

Table 4. Practicing Motivational Interviewing and Counseling Skills Correlations.

Response	Frequency	Percent
1. Strongly Disagree	0	0.0
2. Disagree	0	0.0
3. Slightly Disagree	0	0.0
4. Slightly Agree	3	2.9
5. Agree	32	31.4
6. Strongly Agree	65	65.7

Frequencies were calculated to determine students' perceptions of the correlation between the completion of the diary assignment and their writing skills. The majority of students (89.2%) slightly to strongly agreed that completing the diary assignments improved their writing skills; see Table 5.

Table 5. Diary Assignment and Writing Skills Correlations.

Response	Frequency	Percent
1. Strongly Disagree	1	1.0
2. Disagree	3	2.9
3. Slightly Disagree	7	6.9
4. Slightly Agree	15	14.7
5. Agree	37	36.3
6. Strongly Agree	39	38.2

4. Discussion

Most of the research on mindfulness in college students has focused on meditation-based interventions. These studies have demonstrated an increase in mindfulness as measured by

the MAAS when college students were taught mindful techniques such as meditation (Crowley *et al*., 2020; Shapiro *et al*., 2008). Our study was unique in adding mindful practices that were relative to writing and counseling skills along with increasing mindfulness. Students shared many stressful situations in their diary entries, and the instructors' non-judgmental feedback on this low stakes grading assignment provided social support which has been shown to help reduce perceived stress (Yusufov *et al*., 2019; Kim *et al*., 2016; Uchino & Birmingham, 2011) Overall, adding mindful techniques (i.e., diary assignments and MI) within the course semester increased students' overall mindful attention awareness.

Most of the students found that diary entry assignments and practicing MI increased their mindfulness. The MAAS is consistent with the mindfulness theories that focus on self-awareness behaviors in the present moment (Bishop *et al*., 2004). The diaries provided a form of expressive writing that aids in self-reflection and emotional regulation (Frattaroli, 2006; Kivity & Huppert, 2016). Further, the majority of students found that being more mindful helped them to be better nutrition counselors and strengthened their writing skills. When training students to be future counselors it is imperative to provide strategies that will enable them to balance their empathy for their clients with their self-preservation. The study by Fortney (2013) used the Mindfulness-Based Stress Reduction (MBSR) program that includes discussions, yoga, stretching, along with other evidence-based strategies to help improve clinicians' well-being to reduce burnout. A study that involved a coaching intervention to teach MI to all clinic staff found that the clinicians in the intervention group reported improvements in burnout scores, self-rated MI skills, and perceived team cohesion (Pollak *et al*., 2016). Our students found that practicing MI increased mindfulness and improved their counseling skills. A strength of the study was using the validated MAAS that is commonly used in the literature to measure mindfulness. Limitations of the study include not having a control group and not using evidence-based strategies such as meditation to increase mindfulness.

5. Conclusion

This pre-and post-test study demonstrated that incorporating mindful activities and assignments into a professional skills course can increase students' perceptions of mindfulness, which can further improve students' counseling skills and writing skills. The mindful techniques used in this study related to skills necessary for students to practice in the nutrition and dietetics field. Using more evidence-based strategies can be considered for training students for their future careers.

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Group Formation - Finding-Your-Matching-Card in a Collaborative Learning Classroom

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Abstract

This paper presents a non-traditional strategy of group formation that engages students in utilizing prior learned knowledge to solve problems at a collaborative learning classroom. Through the grouping process students communicate mathematical thinking with their peers and physically moving around to find their matching cards and group partners. The grouping process warms up students to launch an active learning mode. Although the grouping method was implemented in the mathematics content course for preservice elementary teachers and the capstone course for preservice secondary mathematics teachers, it could perfectly fit different types of classrooms including grades K-12 or college level.

Keywords: *Group formation; finding-your-matching-card; collaborative learning.*

1. Introduction

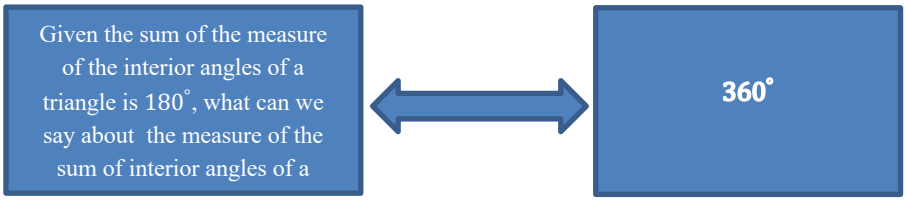
Collaborative learning is an effective teaching/learning approach. Collaborative activities have positive impact on student learning with respect to effectively communicating ideas, developing critical reasoning, and cooperating with others (Schlichter, 1997; Barros & Verdejo, 1998; Dillenbourg, 1999; Alfonseca *et al*, 2006, Kaddoura, 2013). Students are provided opportunities to actively engage in learning through working together in groups at a collaborative learning classroom. Existing Research have documented how collaborative learning benefited students' learning outcomes and helped equip students with the skills needed in the 21-century workplace by a joint intellectual effort of students and teacher (e.g., Johnson & Johnson, 1989; Artzt & Newman, 1990; Andrini, 1991; Johnson, Johnson, & Holubec, 2008; Johnson, Johnson & Smith, 2014; Gillies, 2016). It has been becoming a common educational practice that students are divided into small groups to engage in deep discussions or solving problems collaboratively. Naturally a question is raised: How to divide groups can ultimately promote collaborative learning? There have been different strategies being proposed to form student groups. For example, student groups could be formed heterogeneously, randomly, or could pair-up with neighbors (think-pair-share) due to different considerations (Kaddoura, 2013; Zhang *et al*, 2016). In this paper, I would like to propose a non-traditional way of group formation that provides an opportunity for students to revisit the previously learned content knowledge and get prepared for class discussions while grouping activity is taking place. In this sense, grouping itself is an integral part of the collaborative learning process.

2. The Innovative Group Formation Method

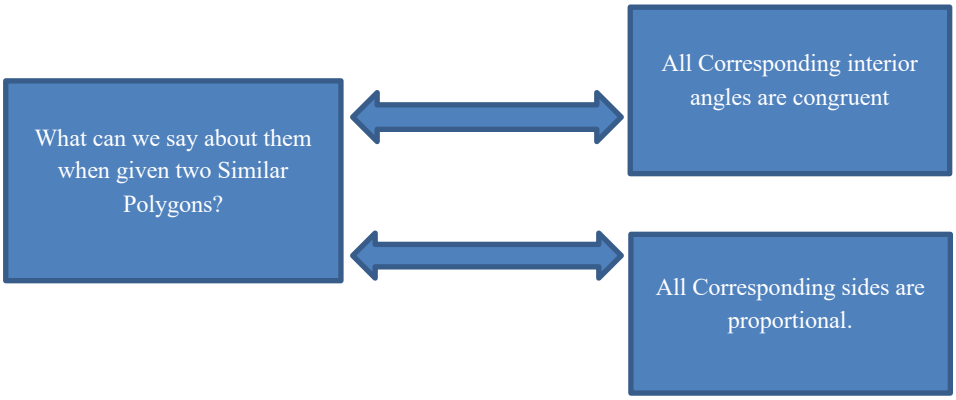
Educational research has reached a consensus that actively engaging in doing mathematics has more effective impacts on student learning than passively listening to a lecture. Documented positive impacts of active learning include deeper understanding, communicating mathematical ideas effectively both orally or in writing, persistence, and sense of belonging (Kogan & Laursen, 2014; Freeman *et al*, 2016; Braun *et al*, 2017). I implemented active learning approach in both the mathematics content course for preservice elementary teachers and the capstone course for preservice secondary mathematics teachers. Students were doing mathematics in groups during each class period. Students' engagement in group discussions is a vital part of the learning process in the structured course of active learning. Usually in the beginning of semester, I randomly divided students into groups for discussions, and then after several weeks when I became familiar with students, I grouped students heterogeneously based on their level of achievement. However, I observed that each class took some time to form groups only. I wanted to change the way of group formation in order to make a grouping activity itself an integral part of learning. Starting spring semester 2020, I implemented a new way to group the students in class. Students started solving

mathematics problems in the beginning of each class while finding their group partners. Before each class, I created the question cards and the corresponding answer cards accordingly. In the beginning of a class, the created cards were randomly issued to students, then they had to find his or her group member(s) by matching the question card and the corresponding answer card at their hands. Each question-card had one question and could be matched by another card with the answer for the question. Since I had odd number of enrollments for both of the classes, I must have one group formed with three students. In this case, I created two answer-cards which match the same question-card. On the one hand, the questions on question-cards were selected to engage students in recalling some previously learned content knowledge in order to find their matching cards and group partners; on the other hand, the questions on question-cards were designed to provide the scaffolding knowledge for the current class discussion and warm up students to make connections between the prior learned knowledge and the new knowledge. There are two examples given below.

The one-on-one card matching for a group of two members:



The one-on-two card matching for a group of three members:



Similarly, if one group of four students are preferred, then one question/description on one card can be designed to correspond to the content on three other cards. In next section, designing appropriate groping cards will be discussed.

3. Designing the questions on the question-cards

Relating new knowledge to prior knowledge helps meaning-making and connecting mathematical ideas/concepts in a complete picture for a better understanding. Constructivism recognizes that learning takes place when a learner integrates new knowledge and understanding with prior learned knowledge and experience (Piaget, 1972). Activating a relevant prior knowledge is crucial to an effective instruction (Sidney & Alibali, 2015). Guided by learning theory of constructivism, when designing a question on a groping card, an instructor should consider what content will be studied and discussed in class. Answering the question on a groping card should help students recall a previous knowledge that connects to the new knowledge being learned. In this sense we can consider the groping activity as a warm-up activity for students to make learning connections. For example, when learning the similar polygons, students need to know congruent angles and proportional lines in order to understand that there are the congruent corresponding interior angles and the proportional corresponding sides in the similar polygons. Samples of question-cards are provided in the following:

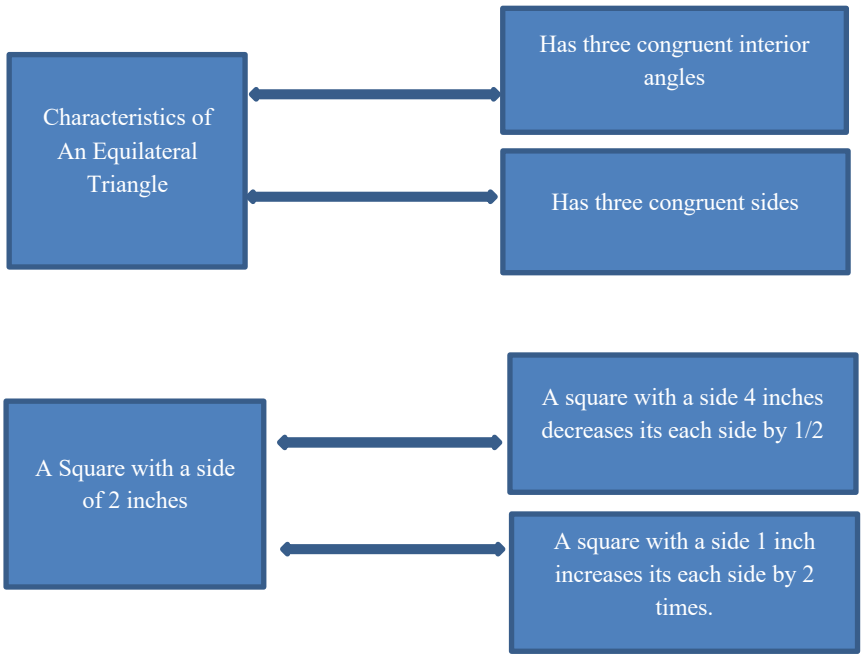


Figure 1. Samples of question-cards.

This way of group formation forces students to interact to each other, communicate mathematical ideas, and helps create active learning atmosphere. In the process of group formation, students recall what they have already learned and process their understanding

again for "old" knowledge application. In order to serve the purpose of this way of group formation, when creating questions on grouping cards, I would like to recommend the rules of thumb as follows:

- The questions on cards should be closely related to previous learned knowledge.
- The questions on cards should help scaffold students' thinking for the new mathematical content being discussed in class.
- The questions should be concept/main idea oriented.
- The question should not be too complicated to solve.

You may add more to this list when you gain new insight after implementation in your active learning classroom.

4. The innovative way of group formation applies the learning theory into teaching practice

In the past decades, constructivism has guided teaching/learning research and practice in the field of mathematics education. Research have indicated that human beings learn by active engaging and knowledge cannot be delivered or transferred from an expert to students by simply telling and listening (e.g., Vygotsky, 1978; Lorsbach & Tobin,1992; Freeman *et al*, 2014). Constructivists believe that instructors should help students develop the bridge connecting previously learned knowledge and new knowledge. Knowing what students have already known and then teaching accordingly is the most important factor influencing learning (Ausubel, 1968). Starting a class by having students recall prior knowledge and figure out the matching cards, each student is provided an opportunity to communicate with other students and verify their understanding of certain concept/idea. Many times, students have the opportunity to help or to be helped addressing some misconception. For example, four students get four different cards respectively as follows:

Card 1 Card 2 Card 3 Card 4

Figure 2. Samples of question-cards.

Based on our teaching experience, we know that there is often a common mistake made by some students, they may think that $(x-3)^2 = x^2 - 9$, but some student would realize that $(x+3)(x-3) \neq x^2 - 6x + 9$. The four students would have to work together to figure out the appropriate match. If the four students are not able to match successfully, they can ask

other students to help them and explain which pair are a correct match. In this case, students are forced to learn from their peers when needed during the process of grouping.

Finding-your-matching-card group formation works as a bridge connecting prior learned knowledge to new knowledge. It offers good opportunities for students to collaborate and engage in correcting misconception when necessary. Through working together to find the match of a question and an answer on their cards, students experience applying what they have learned to solve problems; it is one important stage in learning hierarchy (Anderson *et al*, 2001; Stanny, 2016). In addition, after practicing the application of the prior knowledge, students will bring their understanding into the process of acquisition of new knowledge.

5. Observed Effects of the innovative method of group formation

Once the finding-your-matching-card (FYMC) grouping becomes a routine practice and is implemented in the beginning of each class, the students would regard finding the group member(s) as a regular class activity. In my classes, students were pushed to recall knowledge they had learned before; and they were helped by peers in case they didn't sustain the prior knowledge. Words often heard were: "what is on your card?", "No, the answer on my card doesn't match the answer on yours.", "Yeah, my card question seems to match yours", "I think she has the card answering your card question"…… I observed some quiet students had to step out and talked to other students in order to find their matching partners. Some interesting conversations took place, for example, "our cards are not matched because not all rectangles are similar, remember the example we discussed last class……"; "is an isosceles triangle a regular polygon?"; "no, $(a+b)^2$ is not equivalent to a^2+b^2"……. Based on what observed during the process of group formation and reflecting on the implementation, I recognized that the FYMC grouping has the positive impact on learning and teaching. On the one hand, from the perspective of student learning, the grouping activity

- stimulates students' learning interest;
- engages every student in revisiting previous learned knowledge;
- promotes collaborative learning environment;
- increases interactions among students;
- pushes students to make connection between mathematical ideas/concepts;
- provides scaffolding knowledge for students to learn new knowledge;
- help students sustain knowledge they learned previously.

On the other hand, from the perspective of instructor teaching, the grouping activity

- informs an instructor of students' learning status;
- provides evidence for an instructor to make a wise decision during the process of classroom teaching (e.g., when students have trouble to match their cards due to

mistakes or lack of understanding, the instructor could decide to spend some time to address any problems right targeting on the involved concept/idea);

- helps an instructor systematically design in-class tasks coherently related to students' previous learning.

The FYMC grouping method is a promising teaching strategy for an active learning classroom. Its benefits on learning will be revealed as more practices are carried on over times.

6. Concluding Remarks

The FYMC group-formation method engages students in thinking about prior learned knowledge, communicating with their peers, and physically moving around to find the matching card in the beginning of a class. The grouping process itself bridges "old" knowledge with new knowledge and becomes an integral part of learning; it warms up students to engage in learning new content in an active and interesting way as well as takes students to launch an active learning mode . This paper brings up an innovative group formation strategy that provides a promising impact on active learning. More experimental study report on this grouping method will be beneficial on mathematical teaching and learning in the future. Mathematics educators can create more effective grouping cards applicable for different mathematics content ready to use in active learning classrooms. Although the group formation method was implemented in the mathematics content course for preservice elementary teachers and the capstone course for preservice secondary mathematics teachers, it could perfectly fit different types of classrooms including Grades K-12 or college level.

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Linking teachers' facial microexpressions with student-based evaluation of teaching effectiveness: A pilot study using FaceReader™

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Abstract

This study seeks to investigate the potential influence of facial microexpressions on student-based evaluations and to explore the future possibilities of using automated technologies in higher education. We applied a non-experimental correlational design to investigate if the number of videotaped university lecturers' facial microexpressions recognized by FaceReader™ serves as a predictor for positive results on student evaluation of teaching effectiveness. Therefore, we analyzed five videotaped lectures with the automatic facial recognition software. Additionally, each video was rated by between 8 and 16 students, using a rating instrument based on the results of Murray's (1983) factor analysis. The FaceReader™ software could detect more than 5.000 facial microexpressions. Although positive emotions bear positive influence on the "overall performance rating", "emotions" is not predicting "overall performance rating", $\beta = .05$, $t(37) = .35$, $p > .05$. The study demonstrates that student ratings are affected by more variables than just facial microexpressions. The study showed that sympathy as well as the estimated age of the lecturer predicted higher student ratings.

Keywords: *Teaching effectiveness; facial expression recognition software; student evaluation; higher education.*

1. Introduction and facial expression recognition software

In order to move teaching evaluations beyond content-based questionnaires, researchers and lecturers in higher education can look towards other design-based fields that traditionally seek to observe or influence human behavior. In both advertising (Lewinski, Fransen & Tan, 2014) and food sciences (Danner, Sidorkina, Joechl & Duerrschmid, 2014), among others, facial expressions have been incorporated into experimental research for years as an indicator of subjects' emotional states. In these studies, the face itself is treated as a dependent variable (Ekman & Rosenberg, 1997). Of particular interest are what Haggard and Isaacs call "micromomentary facial expressions" (1966) which last only fractions of a second and are therefore difficult to recognize for untrained individuals (Yan, Wu, Chen, Liang & Fu, 2013). As a result, automated facial recognition technologies may help in analyzing these involuntary, spontaneous expressions.

This study seeks to investigate the potential influence of facial microexpressions on student-based evaluations and to explore future possibilities of using automated technologies for experimental studies in higher education. The study was conducted using the commercial, automatic facial recognition software FaceReader™ 6 (Noldus, 2014), which utilizes the Active Appearance Model (Cootes, Edwards & Taylor, 2001) to describe the face's texture and the key points on it. A trained neural network then continually examines and classifies the recognized face into various categories. These take form as the six universal emotions which exhibit pan-cultural qualitites—happy, angry, sad, surprised, scared, disgust (Ekman, 1970)—as well as "neutral". The accuracy of this tool has been validated early in various studies (den Uyl & van Kuilenburg, 2005; Lewinski & Butler, 2014), as has as an agreement between facial data and self-reporting when similar emotions were grouped together appropriately.

There are numerous potential applications of FaceReader™ technology in higher education, including the possibility of creating additional, custom expressions within the respective software (Sarkol-Teulings, 2021) to allow further specialization and adaptation of research. In online learning environments especially, facial recognition has been thought of as a possibility concerning student engagement detection (Dewan, Murshed & Lin, 2019; Liu, Wang, Yang & Wang, 2021).

2. Background

2.1. Emotion in the (virtual) classroom

In recent decades, increased attention has been given to the role that emotions play in cognitive processes in a (virtual) classroom (Titsworth, Quinlan & Mazer, 2010; Zembylas & Schutz, 2016). There is still a lack of tangible results through classroom research on

emotion in learning environments (King, Ritchie, Sandhu & Henderson, 2015); this applies even moreso to emotional expressions of teachers/lecturers. There have, however, been descriptions of reciprocal multilevel interactions between the emotions of students and their teachers/lecturers (Frenzel, Becker-Kurz, Pekrun, Goetz & Lüdtke, 2018). Additionally, most research on the topic has focussed the school level, as opposed to higher education (Mendzheritskaya & Hansen, 2019).

2.2. Evaluation of Teaching Effectiveness

In Europe especially, efforts toward achieving greater degrees of standardization and comparability of educational outcomes in higher education have increased following the Bologna process (Seyfried & Pohlenz, 2018). One assessment method frequently used by institutions of higher education is a student evaluation of both the courses offered and the teachers/lecturers involved. Many of the categories used therein—enthusiasm, rapport, and clarity, among others—were established in a factorial analysis by Murray (1983). While the approach of applying findings from personality psychology onto research about teachers and their (perceived) effectiveness has been perpetuated throughout the decades, it has never become dominant in the field of education (Göncz, 2017).

3. Research Questions

The following research questions (RQs) were developed in order to explore the potential uses of facial recognition software in higher education:

RQ1. What kind of emotional patterns does FaceReader™ software detect when analyzing non-calibrated facial microexpressions of different videotaped university lecturers?

RQ2. Is there a connection between video-taped lecturers' facial microexpressions recognized by FaceReader™ and the results of student evaluation of teaching effectiveness?

Hypothesis 1 (H1). The number of video-taped university lecturers' facial microexpressions recognized by FaceReader™ serves as a predictor for positive results on student evaluation of teaching effectiveness.

4. Methods

We applied an non-experimental correlational design to investigate the research questions, analyzing five video-taped international guest lectures, originally held at a Bavarian university. The lecturers seen in the video were all male and well known in the scientific community. The topics of their guest lectures ranged from finance to health and were located in the field of social sciences. Each video was between 80-100 minutes in length and the lecturers consented to the recordings being used for academic purposes. Non-calibrated

FaceReader™ software was used to analyze the microfacial expressions shown by the lecturers in the video at a framerate of 25fps. A general face recognization model was used for the analysis.

$N = 43$ learning science students voluntarily participated in the study to evaluate the video-taped lectures. Each video was rated by between 8 and 16 students, using a rating instrument based on the results of Murray´s (1983) factor analysis. We developed a 10-item rapport scale with items chosen for example from the students' perception of teaching effectiveness (SPTE) rapport, such as "communicates with students in a respectful way" (Jackson et al., 1999). The enthusiasm scale consisted of a total of 11 items, mostly drawn from the Enthusiasm Awareness Index (EAI; Rosenshine, 1970). The clarity scale likewise consisted of 11 items, such as "gives various examples to agreed with those actually taught" and was developed based on the results of several studies, mainly on Murray's (1983) factor analysis of the Teacher Behaviors Inventory. All values of the three scales were added up and divided by the number of items in order to calculate the average mean of the overall performance rating. Additionally, the rating instrument measured the stduent's level of sympathy towards their lecturer, as well as the lecturer's professional appearance, English language skills, estimated age, and the complexity of their lecture. Rapport, clarity and enthusiasm were measured on a 10-point Likert scale. The additional variables were measured categorically: Cronbach's α for Rapport is $\alpha = .93$; Cronbach's α for Enthusiasm is $\alpha = .96$; and Cronbach's α for Clarity is $\alpha = .86$. We used SPSS 26 for the analysis of the RQs. To answer RQ2, we used a linear regression model.

5. Results

Table 1 shows the descriptive results of the analysis via FaceReader™. The software could detect a total of 5,133 different facial microexpressions from the analysis of five guest lecturers. Expectedly, the categories "unknown" and "neutral" were detected most often. This can be explained by the fact that real-life lectures include movement on the part of the lecturer. Lecturers do not always look straight into the camera. They turn to the board, move their heads, nod, and do many other things. Therefore, the software was not able to analyze every frame of the recorded session. All emotions besides "scared" and "disgusted" were detected in the videos; "Happy" was recognized most frequently, 351 times. Facial microexpressions of single emotions lasted slightly more than 2 seconds on average.

Table 1. Frequency of facial microexpressions detected by FaceReader™.

Emotion	Frequency	Frequency in %	Average duration of emotion in seconds	Detected in how many videos
Unknown	2,262	44.07%	13.00	5
Neutral	2,086	40.64%	4.47	5
Sad	184	3.58%	1.95	5
Surprised	133	2.59%	2.06	5
Angry	41	.80%	2.20	5
Happy	351	6.84%	2.17	5
Scared	23	.45%	2.06	3
Disgusted	53	1.03%	2.16	3
Total	***5,133***			

Regarding the connection between teachers' facial microexpressions and the student-based evaluation of teaching effectiveness, the variables "overall performance rating" and "emotions" were found to be moderately negatively correlated, $r(38) = -.34$, $p = .019$. Since the categories "unknown" and "neutral" were predominant but did not provide additional information to the RQ, we decided to exclude those categories from further calculations. As Table 2 shows, we labeled the remaining emotions in two categories: positive and negative. Lecturer 5 received the best overall performance rating ($M = 7.57$); still, the recognized emotions were mostly negative. For the linear regression model, "overall performance rating" served as the dependent variable and "appropriate professional appearance," "level of sympathy for the lecturer," "estimated age of the lecturer," and "emotions (without neutral and unknown)" were included as independent variables. Although positive emotions have a positive influence on the "overall performance rating", "emotions" does not predict "overall performance rating" ($\beta = .05$, $t(37) = .35$, $p > .05$). "Appropriate professional appearance" also does not predict the "overall performance rating" ($\beta = -.142$, $t(37) = -1.19$, $p > .05$). "Level of sympathy for the lecturer" significantly predicts the dependent variable ($\beta = .651$, $t(37) = 5.34$, $p < .001$). The regression model also showed that students tend to rate younger lecturers (estimated age) more positively ($\beta = -.320$, $t(37) = -2.11$; $p < .05$). The independent variables also explained a significant proportion of variance in the overall rating ($R^2 = .57$, $F(4, 37) = 10.73$, $p < .001$).

Table 2. Connection between facial microexpressions and overall performance rating.

Lecturer	No. of observations	Frequency of emotions detected in %	Emotion (without neutral and unknown)	Overall performance rating (Average)
1	9	▪ Unknown (92.09%) ▪ Neutral (39.01%) ▪ Positive (.41%) ▪ Negative (1.08%)	Mostly negative	4.59
2	9	▪ Unknown (77.33%) ▪ Neutral (6.42%) ▪ Positive (9.29%) ▪ Negative (1.76%)	Mostly positive	6.97
3	9	▪ Unknown (60.64%) ▪ Neutral (35.94%) ▪ Positive (1.39%) ▪ Negative (2.03%)	Mostly negative	6.93
4	16	▪ Unknown (59.21%) ▪ Neutral (39.01%) ▪ Positive (1.53%) ▪ Negative (.26%)	Mostly positive	4.64
5	8	▪ Unknown (43.43%) ▪ Neutral (49.53%) ▪ Positive (3.34%) ▪ Negative (3.76%)	Mostly negative	7.57

6. Discussion

This study sought to investigate the potential of facial recognition software for higher education, particularly the connection of facial microexpressions detected by FaceReader™ with student-based evaluations of teaching effectiveness. The results showed a moderate negative correlation between lecturers' emotions and their overall performance ratings. Lecturers who show emotions in lectures do not necessarily receive more favorable effectiveness ratings from students. The expression of mostly negative emotions does not exclude the possibility of favorable student ratings. This might be explained by the lack of consideration of the content presented in the videos. Students' ratings are affected by more variables than just facial microexpressions. The study showed that sympathy and lower estimated age of the lecturer predicted higher student ratings. FaceReader™ software could

detect more than 5,000 facial microexpressions, but the leading category was "unknown," which is a limitation to the study. Further research should focus on the multidimensional connections between content, emotions, and student evaluation in higher education.

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graphed: A Web-Based Concept Mapping Application for Instruction and Research

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Abstract

The ongoing worldwide pandemic has forced educational establishments to accelerate full-scale adoption of online learning at an accelerated pace, while the development of tools appropriate for remote instruction assessment is yet to catch up. Most of the time traditional assessment methods are still employed, but they are not always optimal for use in online environments; better tools are needed to help gain deeper insights into how students think and learn. graphed is a web application developed to support the assessment of learners' understanding and knowledge acquisition and, simultaneously, provide researchers with data that can help in the development of dedicated processes for the automatic evaluation and comparison of concept maps. Our goal is to take a more practical approach by studying the capabilities offered by existing software, libraries, and computational avenues to advance the use of concept maps as assessment tools. Preliminary findings suggest that the concept mapping activity has achieved its purpose of promoting deep thinking, that the application is relatively usable, and clarified the path for future development and enhancement. Examples on the use of graphed in the classroom are provided.

Keywords: *Concept map; knowledge; assessment; instruction; web: graphed.*

1. Introduction

Research and development of new approaches and tools for education and performance support is rarely, if at all, amenable to sudden changes in pace and demand. Nevertheless, the ongoing worldwide pandemic has forced full-scale adoption of online learning at an accelerated pace. The uptake in the development of technologies supporting remote activities and work has somewhat facilitated the sudden move to online learning. However, this transition has proven to be much more challenging than expected and in dire need of tools and approaches to help assess information delivery, as well as knowledge building and retention. Although most of the traditional assessment methods, such as essays, quizzes, or tests, are still effective, they generate an incomplete picture and are seldom able to offer insights into the learner's mental schema underlying a specific cognitive process. Therefore, educators are always searching for better tools to help them gain deeper insights into how their students think and learn.

One such tool is the concept map, which can be used both stand alone or in conjunction with the more traditional assessment methods. Because of its ability to succinctly and efficiently represent the connected nature of one's domain knowledge, the use of concept maps has the potential to significantly enrich educators' understanding of their students' learning. When implemented properly, the use of concept maps has the power to increase instructional efficiency and efficacy.

Unfortunately, concept maps have a significant drawback. Their evaluation and assessment are notoriously difficult to automate. Traditionally, concept maps are evaluated qualitatively, using scoring rubrics or other structured means, which is a laborious qualitative process (Jonassen, 2006; McLinden, 2017). Notably, attempts have been made to use mathematical and computational tools to evaluate concept maps (e.g., Taricani & Clariana, 2006), but the difficulties posed by the high variability of expression in building the concept maps has prevented the use of these methods in real applications to become reality. Advances in programming languages, computational tools, and mobile technologies may now help address some of the previous barriers inherent to the use of concept maps in education.

For this purpose, we have designed and developed a web-based application, ***graphed (https://graphed.igiresearch.com)***, mostly to aid instructors in implementing concept maps as part of instruction. In this paper we introduce the first version of this application which, in addition to its use in the classroom, it was also designed to be a platform for data collection, for both usability testing and to support the evaluation of existing software, libraries, and computational avenues as tools for automated concept map assessment.

2. Background

Concept maps, also known as semantic networks, are well-established knowledge elicitation tools, utilized to express the connected nature of one's knowledge within a domain (Jonassen, 2006). Their origins can be traced back to Ausubel's (Ausubel *et al*., 1968) hierarchical memory theory and Deese's (Deese, 1965) associationist memory theory, which eventually converged towards the concept of concept maps as representations of one's knowledge. The term concept map was coined by Novak & Govin (Novak & Gowin, 1984). The idea that underlies the use of concept maps assumes that understanding any topic or subject requires people to form relationships between the various concepts and constructs relevant to the domain. Structural knowledge (why), which is what concept maps help elicit, is what connects the declarative (what) and procedural (how) knowledge together (Jonassen, 2006; Lee & Murcia, 2013). Therefore, the elicitation of people's understanding of these relationships can be useful in assessing their comprehension of the domain with less subjectivity than other methods, such as written statements.

There is a wealth of research conducted on the implementation of concept maps for individual instruction. Studies have highlighted their value when used as a tool for consolidation of knowledge, aid to writing assignments, support for critical thinking, mediator of interaction between students, or assessment of structural knowledge (Cañas *et al*., 2003, McLinden, 2017). Unfortunately, the use of concept maps in large groups' instruction is hindered by their known difficulty of assessment. So far, the best way to evaluate concept maps is still primarily a qualitative process; the analysis and presentation of concept maps has not changed significantly since their inception (McLinden, 2017). Over the years, efforts have been made to deal with the wide variability in defining a concept map for the same knowledge domain, such as using similarity flooding algorithms (Marshall *et al*., 2006) or genetic algorithms (Rocha *et al*., 2004). Attempts to apply numerical and computational approaches to the evaluation and comparison of concept maps have also been made (Rocha *et al*., 2004), but the process has limitations (Limongelli *et al*., 2017; Siew, 2018; Siew *et al*., 2019). McLinden (2017) offers a summary of promising numerical and computational methods covering multidimensional scaling analysis and clustering algorithms using the R language and social network analysis. Cañas *et al*. (2018) have extended CMap to work over the web. Pathfinder networks and latent semantic analysis was also proposed for concept map analysis (Clariana *et al*., 2006; Koul *et al*., 2005; Taricani & Clariana, 2006).

3. Rationale & Purpose

The published literature suggests that most, if not all these attempts have merit, but it also notes that more research is needed to make them useful in practice. Searching for concept mapping tools available today returns many choices; for example a Google Scholar search of

"concept map" yielded almost 60,000 results. Unfortunately, the concept mapping applications we could find across the web are either too generic, proprietary, or too complicated to use at scale in the classroom. Furthermore, most of them are designed to support the free-form development of concept maps and do not seem to offer usable computer-based concept map analysis and assessment, beyond basic metrics.

Based on the current state of knowledge our intentions follow a more practical path: use existing software, libraries, and computational approaches to support the use of concept mapping techniques in the classroom, for both instruction and assessment, while gathering usability data that can further advance our understanding of the tool, and to generate ideas for further development of the software.

4. Design & Development

On the one hand, ***graphed*** does not place, by default, too many constraints on how the maps are represented, therefore allowing for significant flexibility and adaptability in use. On the other hand, its design offers ways for imposing constraints, to support a wider range of applications as both an educational tool and data collection platform.

At this stage, the application was built to support the basic representation of a concept map. Within ***graphed***, *concepts* are represented as nodes, understood as "perceived regularity in events or objects, or a record of events or objects, designated with a label" (Cañas *et al*., 2003). *Connectors* are represented as labeled (usually written as verbs) directed arrows, linking the concepts together, expressing the relationships between these concepts. Together, two concepts and a labeled arrow form a *proposition* that represents a meaningful statement about the relationship they describe. In the end, the map should be able to tell a story.

While intuitive to use, there is a learning curve associated with successfully deploying this app in an online learning environment. Due to its many benefits, we opted for an audio-visual approach in guiding first-time users (either instructors or students), in the form of short explanatory videos and step-by-step demonstrations. A pilot testing of the training modules in a real classroom showed that students (graduate level course) overwhelmingly preferred videos to written instructions. Nevertheless, a comprehensive user guide in PDF format is currently under development, as it is easier updating as the development of the application continues.

To date, two of the primary user-related areas of ***graphed*** development have been focused on fine-tuning the graphical interface, and in deploying the collaboration tools which allow teams of students to work together to construct concept maps. As we have stated previously, feasible technologies and algorithms for automatically interpreting concept maps are in need of development. ***graphed*** can offer researchers in this field access to comprehensive data

about the students' journey in developing concept maps, thus positioning itself as a research tool, in addition to being an instructional tool. The development of ***graphed*** as a web application gives us the ability to add functionality as we gain understanding, without disrupting the instances where the app has been already implemented as an instructional tool.

The design and development of the application is based on just a few foundational considerations:

- Mapping process should be made as simple as possible, without hurting the richness of expression.
- The application should be available everywhere the web can reach and on any device of any size. So far, the application is working, but the user experience on small-screen mobile devices still needs improvement.
- Offer flexibility in defining the task. To do this, the application (so far) offers the following options:
    - Constrained Concept Maps, for which the set of concepts has been predefined. The task would only require connecting these concepts with named connectors, selected from a predefined set, to form propositions.
    - Open Concept Maps, for which there is no predefined set of concepts. The task requires the definition and naming of concepts and the construction of the connections between them.
- Availability of collaboration options. Currently, the application offers only two ways of working with concept maps:
    - An individual mode, in which the users develop the maps by themselves, without seeing other users' maps.
    - A collaborative mode, in which the user can both explore and work on each other's maps.

One of the guiding principles for the development of this first version of the application was to explore ways to limit variability to allow us to test as many evaluation algorithms as possible. Therefore, we decided to allow instructors to predefine the concepts to be used in a map (Constrained Concept Maps), which removes the variability generated by using different names to define the same concept or construct. We also decided to use a standardized list of connector names (Jonassen, 2006, p. 109), which allows us to limit the variability introduced by open-ended connector naming. The use of a specific list of connector names offers the added benefit of enabling the ability to build a connector weight and equivalence map that can help refine the analysis further. Should the need arise, this list can be extended.

From a technical perspective, we chose to use Python for the server-side programming language with CherryPy for the web framework, visjs for the concept map visualization in the browser, and PostgreSQL for the database back-end. We chose Python because it arguably offers the most comprehensive set of libraries for data analysis as well as great interoperability with other server-side languages, such as R, that may be used in the future. Visjs was chosen because of its visualization and editing capabilities, its compatibility with browser engines, and data representation. PostgreSQL was chosen for its ability to use document storage (JSONB) inside a relational database, which offers us the ability to store map data in a compact, searchable format.

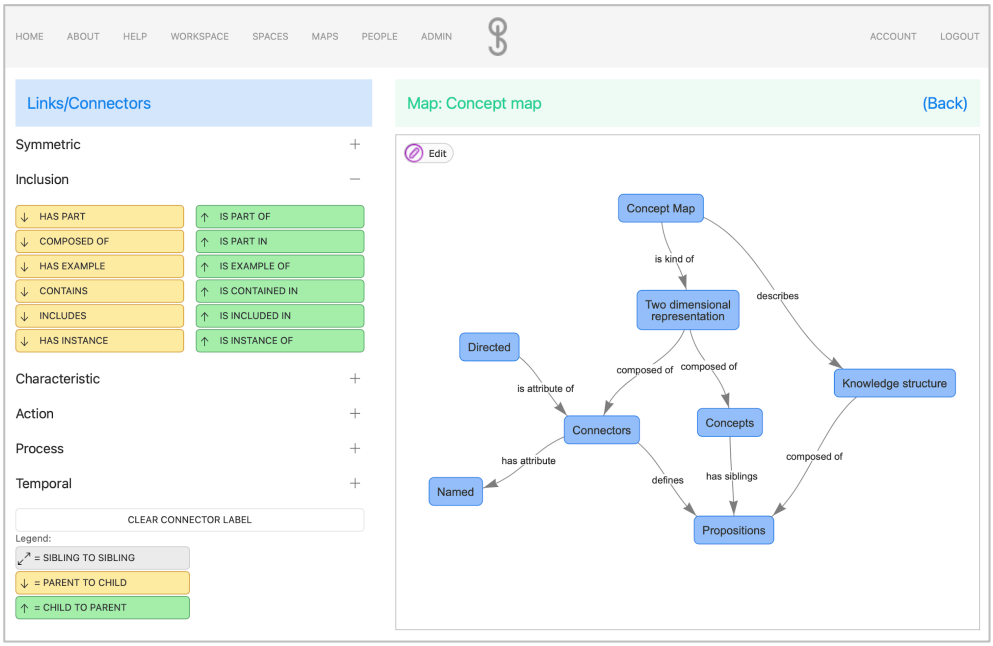

Figure 1. graphed. Concept map builder interface

In the Spring 2021 semester, the graphed web application has been used to support a graduate level course in social sciences. We used this opportunity to collect the first round of student-generated concept maps and application usability data. Simultaneously, we are evaluating existing tools that we could implement to assist instructors with using concept maps for the assessment of students' academic achievement. We purposefully chose a small class (nine students) to allow for richer feedback from the users and close interaction with the instructor.

The use of graphed has been closely integrated with the course syllabus, as a supporting tool for instruction and assessment. The didactic approach has also been slightly altered to focus more on relevant concepts and constructs for the domain, the relationships between them,

and how they all can be tailored to contribute to the development and justification of a comprehensive research project.

So far, we can only report on implementation and preliminary results. The first step was to train the students on the principles and practice of concept mapping and use of the website. Video tutorials and personal guidance were both available. They were also encouraged to explore the website and build concept maps on their own. Next, the students were asked to build a constrained concept map using a predefined set of 23 concepts covered in class. For this activity the instructor chose to disable collaboration between students within the shared space. The final step was to conduct an informal virtual focus group where the students were asked to offer feedback about the software and the task. The students recognized that the concept mapping activity required them to think deeper about the relationships between the concepts and their organization within the field, with one suggesting that it would be helpful o build a map at the beginning of the class, and one at the end so that they can see the progress. One comment stood out: a student who is also a teacher noted that she would see herself using this website in her classroom. The students also made suggestions for the improvement of the application. They ranged from improvements to the interface to added functionality. The difficulty of use on small screen mobile devices was also brought up.

5. Future Directions

This first version of ***graphed*** is an early foray into the quest to find an intuitive and scalable solution to facilitate the inclusion of concept maps as an educational tool, one that can be seamlessly used in both online as well as in-person instruction environments. The future development of the software solution will be data driven. Qualitative research will gather both instructors' and student's feedback on implementing concept maps as part of a course, and will be used to further tweak both the user interface and the usability of the web app. It will also be used in assessing the concept maps to offer a base of comparison between humans and machines. Quantitative research will focus on the development of specific metrics to analyze concept maps and evaluate similarities and differences between them, as well as modalities in which these metrics can be standardized and deployed as part of an automated assessment and evaluation algorithm within ***graphed***. Planned experimental research will also study knowledge acquisition and retention associated with the use of concept maps in the classroom, as it relates to the new assessment approaches.

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Developing a technology enabled workflow to aid space layout communication for students with Autism Spectrum Disorder – A project case study

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Abstract

Within the higher education sector there has been a shift towards flexible teaching and learning spaces that can be re-imagined and re-organised depending on the teaching approach to be employed. While this has undoubted benefits in terms of student engagement, innovative delivery, and exciting learning approaches, it potentially presents a challenge for a student group, those with a diagnosis of Autism Spectrum Disorder (ASD), that has not been fully considered to this point. This study draws upon advances in the Architectural Technology discipline to develop a methodology which can assist in designing and communicating proposed teaching environments, with a particular focus on the potential to benefit students with ASD. The methodology is presented in the form of a case study. The aim is to assist designers and end users in analysing and defining the necessary links to evaluate solutions for the layout planning of spaces, determining functionality and whether proposals are feasible. The output obtained from this workflow elevates its potential in aiding space layout planning, helping those who need assistance in understanding newly formed layouts.

Keywords: *Learning environment; technology; space layout planning; ASD.*

1. Introduction

From an architectural perspective, space-layout planning is a critical part of successful design development. Guo & Li (2017) define layout design as determining "the shapes, dimensions, and positions of internal building spaces to satisfy architectural criteria." One of the most critical building typologies in respect of space-layout planning is educational, as learning spaces have been said to reflect an institution's teaching and learning "philosophy" and potentially impact on learning and teaching styles (Oblinger, 2005). Within the higher education sector there has been a shift towards flexible teaching and learning spaces, purposely designed for swift layout change depending on the teaching method employed. Some excellent literature on both learning space design and classroom layout planning exists, but the extent to which this guidance is implemented in practice by academics prior to teaching sessions remains unclear. For example, many will meticulously plan the pedagogical approach to be employed for a particular teaching session, but, based on experience, it is questionable as to whether the layout of the space will have been given equal consideration. Yes, academics may have a general idea of how they may want to arrange the space, in terms of desk and seating positions, to align with their pedagogical approach. However, the approach to layout planning is often quite limited, and for good reason, due to unfamiliarity with the environment, time pressures and the physical exertion required.

With it being suggested that space planning requires the enhancement of current methodologies, including involvement of the end user during the process of design (Ciolfi, 2004; Scott, 2009), there is the potential to develop a novel approach to facilitate such a workflow for educational spaces. This could involve end users, in this instance academics and students, as co-creators in the planning of teaching spaces. Such an approach would allow for consideration of the specific needs of students in a particular cohort, for example, those presenting with diagnosed intellectual disabilities. Whilst flexible teaching and learning environments have many benefits, such as encouraging collaboration and personalised learning, they also have the potential to prove challenging for students diagnosed with Autism Spectrum Disorder (ASD).

In Northern Ireland in 2019/20, children with an autism diagnosis made up approximately 4.2% of the school aged population (Rodgers & McCluney, 2020). Such data is of importance to education providers in terms of helping inform space layout planning and pedagogical approaches to teaching delivery as these children progress to the next stage of their educational journey. Individuals with ASD tend to prefer routine, and continuous layout changes can negatively impact their learning experience and mental state. This assertion is supported by the content of a 2018 report by Stackhouse (2018) entitled The Impact of 'Place' on Autistic Children. As such, there needs to be a balance between the needs of the individual, the teaching approach employed, and the layout of spaces. So how can this be achieved? It has been suggested that individuals with ASD have a natural allure for technology (Valencia

et al. 2019), this is where the link with the Architectural Technology (AT) discipline emerges. Due to the use of technology within the built environment sector increasing over recent years, many of those designing learning environments already posess the skillset to harness new design and communication methods and apply them in novel areas. With this work we aim to develop a methodology which can assist in designing and communicating proposed teaching environments, with a particular focus on the potential to benefit individuals diagnosed with ASD. It has been acknowledged that there is a lack of research relating to the broad area of place and ASD (Stackhouse, 2018 citing Vazquez & Torres, 2013), with this work we hope to contribute to closing the knowledge gap. It should be noted that the focus of this paper is on the layout of the physical environment once constructed and how this is communicated to end users.

2. Autism Spectrum Disorder, Flexible Learning Spaces & Technology

ASD is a developmental disorder that affects how a person can communicate, interact and behave in certain situations. According to the NHS (2019), individuals on the autism spectrum may "get anxious or upset about unfamiliar situations and social events". As such, it is reasonable to assume that flexible learning and teaching environments with constantly changing layouts could have a negative impact on the student experience. This view is strengthened by Vazquez & Torres (2013), cited by Stackhouse (2018), who suggest that moving spaces and changing activity can be sufficient to trigger a panic attack in an individual with ASD due to "the inability to 'imagine' and create a mental image of what might be on the other side of the door…". McAllister & Hadjri (2013), cited by Stackhouse (2018), use the term 'frightening' when describing some pupils perception of educational environments. Stackhouse (2018), citing the work of others, provides some perspective by cautioning that there needs to be a balance between catering for the needs of pupils or students and preparing them for the wider world environment.

2.1. Learning and Teaching Environments

It is broadly accepted that teachers should accommodate their students' diverse needs by employing teaching methods which resonate with students of all ability levels (Zeppetella, 2009). However this does not always occur, perhaps due to a lack of understanding of what constitutes good practice. Zeppetella (2009) identified ten practices to help students with Asperger's Syndrome (which falls under ASD) in the classroom. The findings suggested that teachers mostly employ a 'visual' strategy. This approach, combined with strategic positioning within the classroom (carefully considering location, lighting, noise, and ventilation) is important in creating a comfortable learning environment. Such an approach is more achievable nowadays as learning spaces no longer solely consist of fixed layout lecture theatres (Comiskey *et al*. 2016). It is also important to acknowledge the impact that

the COVID-19 pandemic may have in respect of this wider discussion. The prolonged period of near exclusive remote delivery brought about by the pandemic has most likely fast tracked the move towards increased adoption of blended learning approaches. It has also seen the emergence of the hybrid classroom concept, that being a combination of students physically present in the learning environment with others joining virtually. Both flexible learning environments and hybrid classrooms in which layouts constantly change, whilst having notable benefits, have the potential to inadvertently increase anxiety levels with ASD students as changes to 'the normal' can cause setbacks in how they function through everyday life. As such, research into methods to reduce stress and anxiety must be advanced.

2.2. Use of Technology

As has already been alluded to, an area with potential for reducing stress and anxiety for ASD students is the use of technology, both for partaking in layout design exercises and communicating space layouts in advance of teaching sessions. A report by Lui *et al*. (2017) concluded that Augmented Reality (AR), via smartglass use, "may have an important future role in helping address the therapeutic needs of children with ASD". Individuals on the autism spectrum appear to respond well to AR technologies as they react powerfully to imagery and graphical content. This is where the link between approaches used within the AT discipline and communication with ASD students becomes apparent. By their very nature, architectural design approaches and outputs are visual due to the need to communicate design concepts to a wide audience. Recently, increased use of technology within the discipline, a combination of government mandate and increased focus on building performance, has exposed more practices to the benefits of technology. This has instigated further exploration, such as the use of laser scanning for data capture, and augmented and virtual reality applications for communication. Augmented reality "adds context by overlaying data and other information on the real world for the end user" (Sargent, 2019). Meanwhile, Virtual Reality (VR) simulates "real world situations and scenarios" in a computer-generated three-dimensional environment, immersing the user in their surroundings (Sargent, 2019). Such advances have provided an opportunity to harness the power of these technologies and use them in novel ways such as outlined in the case study which follows.

3. Research Methodology

This study could be described as real world research (Robson & McCartan, 2016), utilising a qualitative research methodology in the form of a case study to generate an in-depth, multi-faceted understanding of the potential for technology to aid the design and communication of flexible teaching space layouts. A case study approach was selected as it allows for in-depth exploration of a 'case' and retains a holistic and real-world perspective (Yin, 2018).

The definition of the methodology follows the steps depicted in Figure 1. It is based on the potential to use technology related advances in design disciplines and adapt them to the aim of this study. After selecting a suitable teaching space, the first stage involved identifying a way of capturing the existing layout (Step 1) and bringing this into an environment where it could be modelled in three-dimensions to create a virtual representation of the space (Step 2). This facilitated space layout exploration (Step 3) before integration with virtual and augmented reality communications platforms was investigated (Step 4). The following case study explains the workflow process in greater detail.

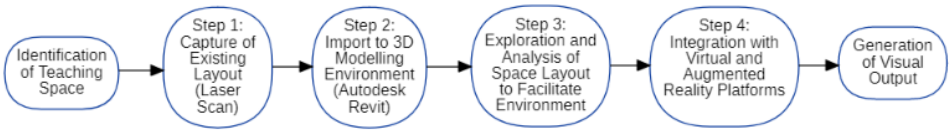

Figure 1. Technology Enabled Workflow.

4. Case Study

The flexible learning space identified for the case study was a design studio located on the Jordanstown Campus of Ulster University (Figure 2). Step 1 involved capturing the environment for the purpose of creating a virtual three dimensional model of the space. The use of laser scanning technology was deemed most appropriate for data capture due to its accuracy, image generation, and ability to be processed and imported into architectural design software, in this case Autodesk Revit, to construct an accurate model of the space. It should be noted that the data capture for Step 1 and a basic model for Step 2 had been captured and created by Leica Geosystems prior to this study and was made available for use in this paper.

Figure 2. Flexible learning space used in the study.

Autodesk Revit allows for the use of bespoke furtiture elements, meaning an exact replica of the real world environment could be created from which layouts were optimised. Whilst advances in technology have seen the potential for automated layouts to be generated, this study used a manual approach for the design of a hypothetical teaching space layout. The layout generated was purposely simplistic, influenced by a review of literature and professional experience, and took into account the possibility for optimum positioning for students with Specific Learning Difficulties (SpLDs) especially ASD. The literature identified that students prefer a space that provides minimal distractions (Holtz *et al*., 2004) while having accessibility to their tutor for ease of communication, as those with ASD can struggle with verbal correspondence. Ganz (2007) and Jansen *et al*. (2016) determined that visual organisation and environmental components should be contemplated when choosing consistent accommodations for students. The preceding presented plausible positioning for the student to be the front of the classroom, aiding them to focus and understand that once in this location, expectations are required for learning. The position facilitates fewer visual and tactile aberrations which can cause students with ASD to become overwhelmed within an environment. However, ultimately the student and their mentor would determine the best location for the student positioning within the classroom. Hence the benefit of them being involved in the design process. Each individual with ASD responds differently to certain scenarios, where some individuals like to have sufficient space and other individuals prefer to be situated closer to assistants or teachers. Suggested layouts generated as part of this workflow could help ascertain a student's ideal location on a case-by-case basis, thus simplifying the process. The layouts provide a suggestive method for space layouts within the classroom while allocating specific or ideal locations for students with ASD or other SpLDs. Once the design layout was confirmed, Step 4 involved importing the layout into a communication platform. In this study the application analysis presented Dalux as the most suitable current construction tool with AR capabilities via its TwinBIM plugin. When uploaded, the model can be downloaded onto any mobile/tablet device with AR Core, via a Dalux BIM Viewer application. In this study a Samsung Galaxy Tab S3 was used for downloading the model data onto the viewer to showcase the newly established layouts. The design layout of the space was aligned through the application to allow the digital layout to overlay with the real-time studio (Figure 3).

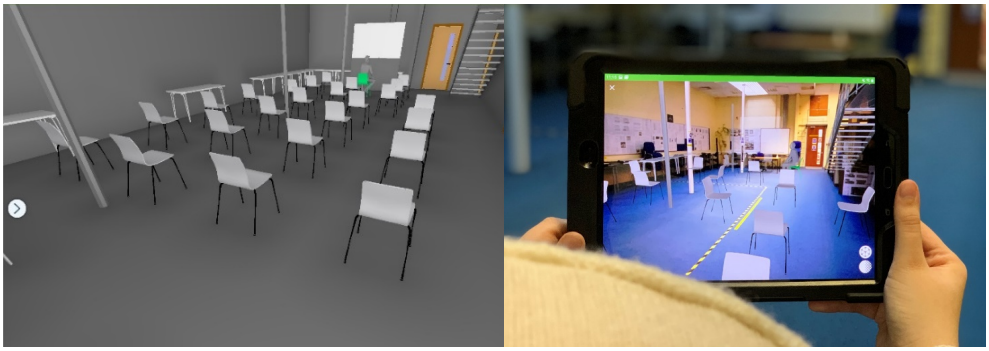

Figure 3. Design layout displayed using both virtual and augmented reality.

The proposed workflow resulted in hypothetical layouts being developed that could aid space layout design and communication. This method can allow designers and users to analyse and define the necessary links to evaluate solutions for the specified space, determining functionality and whether proposals are feasible. The output obtained from this workflow elevates its potential in aiding space layout planning, suggesting that the AR views could be exhibited to help those who need assistance in understanding the newly formed layout.

5. Discussion

This paper has shown the potential for a technology enabled workflow to have the ability to provide elevated assistance in the space planning and communication process. There is potential for resources such as Dynamo scripting, or the generative design tool available in Revit, to enable the generation of a variety of layouts, potentially determining the optimum layout to suit the circumstances required which can then be produced through AR. Incorporating visual methods can assist the designer in reconfiguring and understanding a space. Alongside supporting designers, the design platform and AR output provides a visual aid for students on the autism spectrum, benefiting their needs and stimulating their confidence in transitioning to new teaching environments. AR provides them with an exact visual representation of the room from their perspective, promoting familiarity within their classroom environment. The use of technology can provide a comfortable environment, thus promoting their educational experience. Looking forward, the integration of pre-recorded AR sessions, catered to the students, could provide the individuals with the opportunity to review the layout and process the changes over a period of time. These images could be incorporated into a social story (a personalised short story depicting a social situation that may be faced by the individual affected by ASD). Using this tool gives the ASD learner time to process the information prior to entering the social situation. It is however acknowledged that this is a first stage scoping study, with more work required to develop the overall concept and refine

the workflow. Future work could explore the opportunities afforded by generative design and trial additional AR and VR products to determine the optimum solution.

Acknowledgement

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Technology as gamification means in mathematics learning

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Abstract

Discrete Mathematics is a highly complex university subject. Its classes are taught in a traditional way, so in many cases they do not motivate students. This study develops dynamics of gamification to promote a better learning of Discrete Mathematics, in the same way, it seeks to influence the engagement of students in this university subject. 178 students participate in this quasi-experiment (90 in the control group and 88 in the experimental group). The pretest and posttest data of the academic performance and engagement of the experimental group and the control group display that, in terms of progress, the experimental group showed significant progress compared with the control group. The study is concluded by raising the possibility of applying other games and game dynamics that promote a greater variety of gamified activities. In this sense, it is proposed to investigate the effects of the use of games in mobile application format on both engagement and academic performance in Discrete Mathematics.

Keywords: *Mathematics; gamification; academic performance; engagement; educational technology.*

1. Introduction

Within engineering, mathematics plays a much more relevant role than in other subjects, the content and the need for its learning become more complex. A part of mathematics known as Discrete Mathematics (DM) takes on special interest within computational careers, in charge of the study of discrete processes and in which uncommon contents are grouped in university "classical mathematics" such as Graph Theory, Logic , Combinatorial Theory, Recurrence Relations, among others (Pokorny, 2013). The objectives of the Discrete Mathematics are directed, among other aspects, to the modeling and simulation of structures and processes involved in the computational solution of problems (González-Ramírez & García-Hernández, 2020).

Traditional teaching methods are used today in the DM teaching-learning process. As a result, some students find this subject boring. If there is no interest, students do not focus on the classes and make little effort to learn. This is a challenging problem for teachers (Liang, Zhang, Long, Deng, & Liu, 2020). Among the different activities that can be used to implement an active learning methodology, previous research shows that the use of games with educational purposes facilitates students' assimilation of the ideas and concepts introduced in class as well as improves students' academic performance and engegament (Gil-Doménech & Berbegal-Mirabent, 2019)

Gamified learning is defined as a strategy to employ game elements (e.g., points, levels, and challenges) in learning contexts to promote students' learning. For example, in gamified learning activities, students earn experience points after successfully accomplishing certain tasks by themselves (Sun-Lin & Chiou, 2019). The gamification design would facilitate students' learning because game elements encourage students to engage in learning tasks, perceive what they experience, and decide what to do in learning process (Chiu & Hsieh, 2017).

2. Material and Methods

The aim of this study is to investigate whether the use of game based assessment activities in the classroom is more effective than traditional evaluation for improving the academic performance and engagement of discrete mathematics learning.

A quasi-experimental design was employed in this study to asses the efects of the gamification in the engagement and academic performance of Discrete Mathematics. 178 freshman students from the same university participated in this experiment, with 88 participants assigned to the experimental group and 90 to the control group. The experimental group learned Discrete Mathematics through gamified activities. Traditional classes methodology was employed for the control group in this teaching experiment. In this passive

teaching method, the teacher typically explains the unit content according to the university syllabus, with the students listening in their seats and solving exercises in their notebooks.

In terms of dependent variables, academic performance refers to the pre- and post-test results of an institutional test on academic achievement in Discrete Mathematics (with an evaluation scale from 2 to 5, where 2 is failure and 5 is excellent). An instrument that we designed and validated in a previous investigation (González-Ramírez & García-Hernández, 2020) was used to assess engagement towards learning Discrete Mathematics (the other independent variable). This scale includes seven dimensions: level of autonomy, satisfaction with study materials, student well-being, student self-efficacy, activity in the classroom, feedback and learning environment. A Likert five-point scale was used, and a higher score indicated a higher satisfaction toward the learning system. The teaching duration for both groups was eigth lessons (25% of whole course).

2.1. Data analysis

First, the nature of the dependent variables was determined to check if their distribution is normal, applying the Normality Tests with the Kolmogorov-Smirnov statistic. In this research, the variables followed a normal distribution, so Parametric Contrasts were performed, in this case Student's T-test for two independent samples in order to determine the equality of means, to which the Levene Test was previously performed, to analyze the equality of variance.

2.2. Intervention

Students face a virtual game where they answer various questions associated with Discrete Mathematics to obtain points. Depending on the complexity of the question, points are awarded from 1 to 5 (where 5 represents the maximum complexity) (Figure 1). The highest scoring students get academic rewards as validation of assessments.

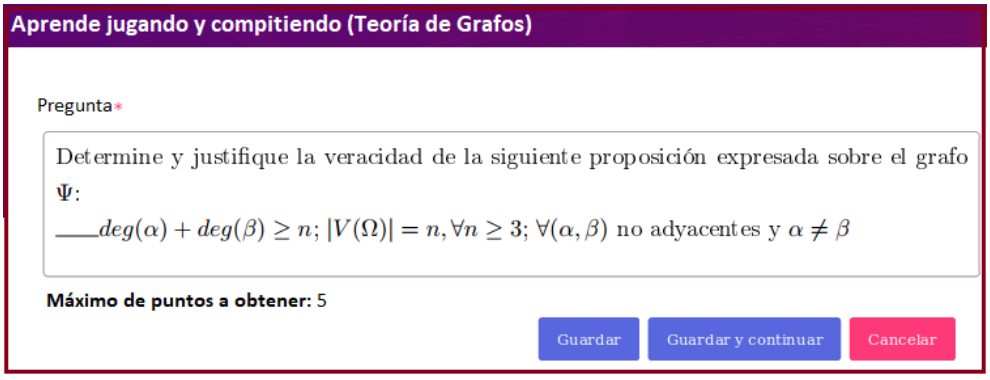

Figure 1. Interface where the student learns by competing in solving problems.

Similarly, students get points if they propose an exercise for the competition and it is accepted by the professor. They can also solve crosswords as a game (Figure 2). Completing a crossword represents a level of mastery over the topic at hand.

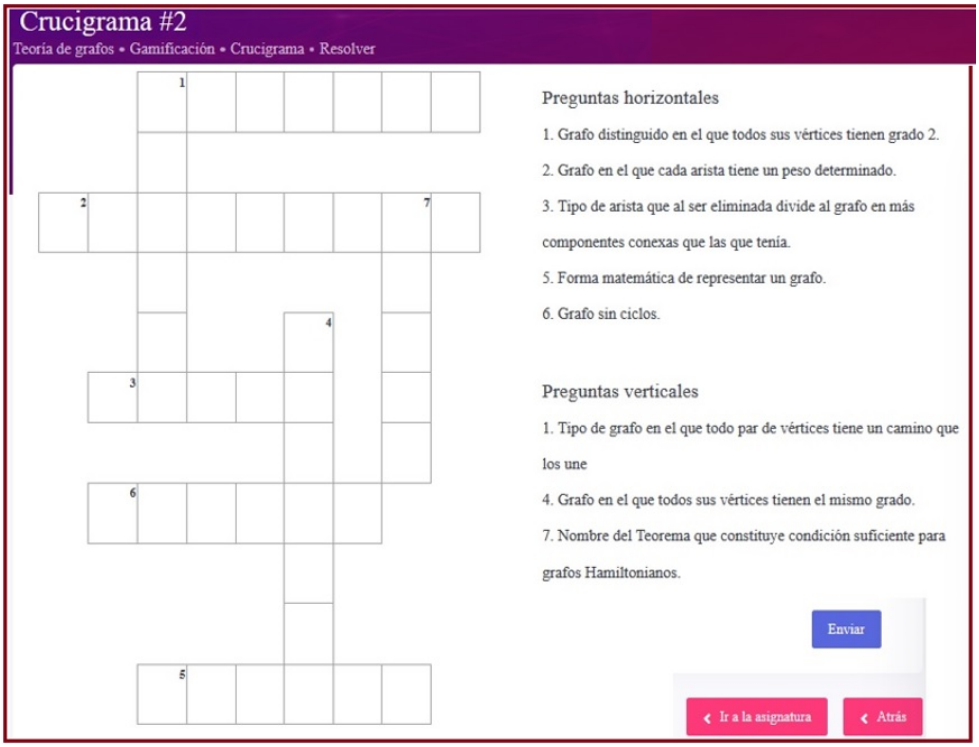

Figure 2. Interface where the student learns by solving crosswords.

3. Results

The pretest and posttest data of the academic performance of the experimental group and the control group are shown in Table 1. Results of the "t-test" analysis showed significant difference ($p < .001$) between the groups. In terms of progress, the experimental group showed significant progress in academic performance compared with the control group. The control group, on the contrary, showed almost no differences between the pretest and posttest. This indicated that the application of gamification was effective in promoting significant progress in academic performance of Discrete Mathematics.

Table 1.The pretest and posttest data of the academic performance.

Variable	Control group n=90			Experimental group n=88			Difference Both groups	t-test p
	pre-test	post-test	progress	pre-test	post-test	progress		
Academic performance	2.78	2.89	0.11	2.81	3.97	1.16	1.05	0.000

$p < .001$

Similarly, as shown in table 2, results of the "t-test" analysis showed significant difference ($p < .001$) between the groups in each factor of the scale to assess engagement towards learning Discrete Mathematics. The experimental group increased their levels of engagement towards learning of Discrete Mathematics.

Table 2. The pretest and posttest data of the scale to assess engagement towards learning Discrete Mathematics.

Variable	Control group n=90			Experimental group n=88			Difference Both groups	t-test p
	pre-test	post-test	Progress	pre-test	post-test	Progress		
Level of autonomy	3.54	3.62	0.08	3.21	4.28	1.07	0.99	0.000
Satisfaction with study materials	1.93	1.85	-0.08	1.78	4.57	2.79	2.87	0.000
Student well-being	2.18	2.23	0.05	2.08	3.12	1.04	0.99	0.000
Student self-efficacy	1.78	2.01	0.23	2.12	4.19	2.07	1.84	0.000
Activity in the classroom	2.21	2.87	0.06	2.52	3.99	1.47	1.41	0.000
Feedback	2.72	2.58	-0.14	2.64	4.15	1.51	1.65	0.000
Learning environment	3.02	3.17	0.15	2.99	4.15	1.16	1.01	0.000

$p < .001$

3. Discussion and conclusion

We can highlight, after empirical processing, that there are significant differences between the average score obtained in the pre and post-test evaluation with the academic performance in Discrete Mathematics in the group that performs the experiment. This result confirms that

the use of gamification is a determining factor in academic performance (Gil-Doménech & Berbegal-Mirabent, 2019; Liang et al., 2020; Sun-Lin & Chiou, 2019).

Similarly, there are significant differences between the average score obtained in the pre and post-test evaluation in the Questionnaire to measure the levels of student engagement with their learning of Discrete Mathematics. The students of the experimental group made a greater effort to pass the subject, coinciding with Reyes-de Cózar (Reyes, 2016). The students considered that the use of the games led to better communication with their classmates and teachers; it also motivated them to win the course.

They also perceived greater feedback from their teachers both in their constant doubts and in the review of evaluations. This coincides with the theoretical references on the subject and makes us empirically evidence the importance of feedback for student engagement (Kyaruzi, Strijbos, Ufer, & Brown, 2019), enhancing the use of the possibilities offered by technologies to contribute to the learning of students (Amaya, García-Hernández, & Cañas, 2017). It is worth noting that the activities in the classroom were characterized by a better management of the teacher, favoring an accurate technological mediation that raised the levels of engagement towards the learning of Discrete Mathematics (García-Hernandéz & Gonzalez-Ramirez, 2017).

This study allows us to validate that gamification is also effective in Higher Education to promote better learning in highly difficult subjects. It is worth noting that it would be interesting to apply other games and game dynamics that promote a greater variety of gamified activities. In this sense, it is proposed to investigate the effects of the use of games in mobile application format on both engagement and academic performance in Discrete Mathematics.

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Considerations when using an Automatic Grading System within Computer Science Modules

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Abstract

This paper aims to investigate the effectiveness of automatic grading systems, with a focus on their uses within Computer Science. Automatic grading systems have seen a rise in popularity in recent years with publications concerning automatic grading systems usually linked to a specific system. This paper will discuss the factors that need to be considered when using automatic grading, regardless of which system is being used, and will make recommendations for each factor. This discussion is based on the authors' experience of using an automatic grading system in a CS1 environment. From the research conducted, many elements should be considered when using these systems. These include how the code will be tested, the need for plagiarism checks and how marks are awarded. The findings of this study suggest there is a lack of defined standards when using these systems. This analysis of the considerations provides valuable insight into how these systems should be used and what the standards should be built on.

Keywords: *Automatic grading system; CS1; programming; student feedback.*

1. Introduction

An "Automatic Grading System" (AGS) can be defined as any grading tool which provides instant feedback to students or teachers about assignments. However, every AGS handles the amount of feedback given, the amount of data collected, the way it handles errors and other considerations, differently. From a programming perspective, there are more considerations to keep in mind, for example, differing ways to solve a problem, syntactic and semantic errors. In this paper, we discuss the efficacy of AGSs and their usage in Computer Science (CS), with a particular focus on considerations when setting up, and using, an AGS. Discussion and recommendations will be borne from the authors' history of using AGS, and from a deep examination of other similar tools. Before examining any specific use-cases, the overall placement of AGS in the pedagogy of CS must be examined.

Caiza & Del Alamo (2013) performed a literature review looking at AGSs and their implementation. One of the key outputs from the work was determining, for a given set of tools, what programming languages they supported, their architectural design, technologies used by the tool, and how the tool handles code evaluation to grade a student. They found that many of the existing AGSs perform very similarly. The main differences lay in language support and grading metrics. The authors suggest that grading metrics should be normalised to have some form of industry standard. Some of the grading metrics that were discussed include test cases, compilation tests, correctness, typography tests, syntactic analysis, and others. However, we should ask "Are all of these metrics needed in the "perfect" AGS?"

Keuning, Jeuring & Heeren (2016; 2018) examined some of these automatic feedback metrics and techniques and discussed their efficacy by way of a systematic literature review. We will examine this paper in detail in Section 3, but overall, the authors conclude that many AGS are not very diverse. Most simply identify mistakes without providing much context on how to proceed with an incorrect solution. This appears to be the biggest issue with AGS from the literature. They are either too basic to allow for ease of creating questions and solutions, but with little available to "help" students, or they are too specific and complicated meaning the average educator won't be able to immediately begin using it. A recent literature review on Introductory Programming states that "carefully managed automation can increase student performance while saving teaching resources" (Luxton-Reilly, et al., 2018). The perfect balance of ease-of-use and extensive feedback, therefore, is desirable. This is what we aim to discuss in this paper, among other considerations when using an AGS.

CS1 is traditionally the first module that students take at third level when studying CS. This module introduces students to computer programming and threshold concepts. Typically, students will take CS2 in the second semester, which introduces more advanced concepts. We use Java as our teaching language, but research shows the choice of language is not as important as how the language is taught (Noone & Mooney, 2018). Our CS1 and CS2

modules comprise of three hours of lectures per week and a further three-hour lab, where students work on assignments. With approximately 400 students, several initiatives have been used to try to deal with associated issues of teaching large classes, including the opening of a dedicated support centre and the use of PBL, Lego Mindstorms, and response systems.

All of these initiatives were beneficial, but none were addressing perhaps the biggest issue within the class; the amount of time spent in labs grading student assignments. Traditionally, students would attempt their assignments and if they were struggling would seek assistance from demonstrators. Each week, demonstrators would spend a large amount of time grading a random selection of assignments meaning valuable support time was lost. Another issue was the unconscious bias amongst demonstrators grading student's work.

In 2015, we trialled an AGS, the Virtual Programming Lab (VPL) (Rodríguez-del-Pino, et al., 2012). The feedback from all involved was extremely positive and we decided to incorporate the tool in our teaching. This system ensured that a standard grading rubric was applied to all students while also ensuring students were graded for all completed work.

2. Related Work

The field of automatic grading has become increasingly popular in recent years. A survey published on the presentations at SIGCSE looked at the breakdown of papers between 1984–1993 and between 1994–2003. Valentine (2004) showed that the percentage of papers relating to such tools had grown from 18.5% between 1984–1993 to 24.6% between 1994–2003. Software to support AGS was included in the tools papers.

Keuning, Jeuring & Heeren (2016; 2018) examined feedback generated by an AGS, the techniques for generating it, how to create effective questions for a tool and if the feedback was effective for students. They examined 101 different tools with 96% of these tools giving user feedback about their mistakes (to different levels), but only 44.6% of the tools gave ideas on how to proceed. In terms of feedback techniques, automated testing was present in 58.4% of systems with other techniques such as static analysis, tracing, and constraint modelling in a lower percentage of systems. In terms of effective question creation, the authors posit that a good AGS should provide an easy manner of adding new questions with 50.5% of the tools examined making use of model solutions, while 47.5% used some form of test data or test cases. These are the primary option for a functional grading system, with both proving effective depending on the question type. Importantly, however, the authors found that evaluating the effectiveness of these tools is a very detailed task, and most tools do not provide detailed technical analyses for their efficacy.

Examples of the comparison of the students' output to an expected output can be found in Repl.it (Repl.it Classroom, 2021), CodeRunner (Lobb & Harlow, 2016) and Stepik (Stepik,

2021). Code is evaluated against a set of predetermined test cases, made up of given inputs and expected outputs. A grade is assigned based on the number of test cases passed. With Web-CAT (Edwards & Pérez-Quiñones, 2008), students must supply tests with the code to ensure the correctness and validity of their programs. In addition to checking the output of the programs, some AGS have checks for plagiarism. Autolab (Autolab, 2021) uses MOSS (Measure Of Software Similarity) to check for plagiarism between students and past submissions. HackerRank for Schools (HackerRank, 2021) flags submissions that have a similarity of over 70% to other submissions.

OK (OK, 2021), along with checking for plagiarism and expected outputs, provides realtime assignment statistics. These statistics include what questions students are working on, how many students have completed a question, and which students have not started. OK also has integrated automatic feedback and targeted conceptual hints (DeNero et al., 2017). In addition to testing outputs and providing feedback, it may be important to consider the constructs students have used to complete the programming assignment. MULE (Culligan & Casey, 2018) uses pattern matching to look at the constructs within the students' code, as well as looking at test cases. Pattern matching allows for feedback based on what they have written to be provided to the student (Hegarty-Kelly & Mooney, 2021).

3. Considerations and Recommendations when using an AGS

Cheang et al. (2003) notes three components involved in grading programming assignments based on their priority: Correctness, Efficiency, and Maintainability. The maintainability of code is vital in large business settings; it is not viewed as highly within a CS1 environment. These three components are the basis for how AGS should award marks to students. In the following section, we discuss some considerations when using an AGS.

3.1. Complexity of Questions

Students need a clear understanding of what is being asked of them. When wording questions, it can be of benefit not to give them a list of instructions, but rather an open-ended question where they need to determine what constructs are needed in their code. It's also crucial to consider what idea the question is aiming to test. Students need to have a strong understanding of a concept before the complexity is increased (Wang & Wong, 2008).

3.2. Flexibility in Answers

When comparing the expected output to the students' output, only key information should be matched. For example, if the student is asked for the sum of an array, the value they print as the sum is what the system should check for. When a question's output is a Boolean value, additional information is required to ensure the student is not gaming the answer. For example, if a student is asked if a number is prime, and the expected output is True or False,

a student could simply print both True and False to all test cases. The system will find the correct answer each time and award marks. Asking students to print information, such as the number's factors if it is not prime, ensures that they have coded the solution.

If a system is checking for a particular construct, it is essential to note that there are many ways of answering a question. Giving students feedback of how to proceed needs to allow for alternative solution strategies (Keuning et al., 2016). When pattern matching, only constructs that are fundamental to the question should be searched for.

3.3. Test Cases

Test cases are small unit tests that ensure good test coverage. For example, if a question asks students to find the row with the largest sum in a 2D array, the row number should not be the same in each test case. The students' code might need to respond to an invalid input, such as what to do if a number is entered as words rather than numerically. These test cases are important to show students how to respond to incorrect inputs. The required response, such as an error message, should be specified in the question. The number of test cases used should also be considered (Cheang et al., 2003). If there are many test cases all testing the same aspect, some are redundant. However, if there are very few test cases, students may get marks easily even if their code is not properly implemented. The test cases must cover a range of values while not overloading the student with outputs to check.

3.4. Awarding Marks

Students may be awarded marks solely for matching the expected outputs or for also having correct code constructs. Regular expressions can be used to search for patterns within the students' code. For example, if students were asked for a *for* loop in Java then the following regular expression could be used to detect the presence of a valid *for* loop:

```
for\s*\([^;]*\s*;[^;]*\s*;[^)]*\s*\)
```

Figure 1. Expression for the detection of a valid for *loop*

Using regular expressions ensures that the testing coverage is extensive across code. The benefit of pattern matching is that students can easily build up their marks even if their code is not complete or correct thus improving their confidence and motivation levels. Marks can also be awarded if the program compiles successfully. The unwarranted awarding of marks, to students who are hardcoding, can be avoided too.

Some systems store the highest mark achieved, meaning students can continue to submit attempts retaining their highest score. Some systems will take one submission and the mark achieved is the mark awarded. Other systems may have penalties for each incorrect submission. The decision on which approach to take can depend on the human grader's

preference and whether it is a weekly assignment or an exam or for formative assessment purposes.

3.5. Inputs and Provided Code

If students have learnt how to take input into their code, test cases can become simpler to design. If this has not been covered yet, another solution is required. By providing a variable declaration for the test case input, the testing is eased as the system finds the variable provided, changes its value, and the code recompiled to run with the test value. This can be useful for questions where the student needs to take in multiple inputs. Providing the definition of a class or method can also ease issues in the same manner, depending on the language. However, providing this code should be avoided in the early stages of learning. Students need to be competent in declaring a class, method, or variable.

Should students be shown all inputs, all expected outputs, and their incorrect outputs? If shown the expected outputs, it may be easier to hardcode answers. However, it may be easier to solve an issue if they can understand the differences between their output and what is expected. In lab assignments, it is useful for students to see the inputs and expected outputs. However, in exam situations, it may be better to not show expected outputs.

3.6. Feedback

An AGS can be daunting if adequate feedback is not given to the students at all stages of writing code. Compilation errors can be difficult for students to interpret the first time they are seen, as shown in student feedback from Hegarty-Kelly and Mooney (2021). It is useful to give the compiler errors to students in a manner that is easy to interpret. When pattern matching is used to look for constructs, it can also be used to provide feedback to students. If, for example, the question asks the students to use a *for* loop and one is not found by pattern matching, the student can be told that there is not a syntactically correct *for* loop in their code.

3.7. Timing Out

While we may not aim for novice programmers to achieve the best possible run time, the program must run promptly. If there is a loop that will run indefinitely, it is necessary to terminate the evaluation of test cases and give appropriate feedback indicating the issue. When a submitted program will not run due to the time out, there is ambiguity about the grade the student should be awarded. If there was a human grader, the student would get marks for the concepts and constructs they used correctly. This is where pattern matching can be capitalised on, allowing the student to be awarded the marks.

3.8. Plagiarism

Cheang et al. (2003) noted a large increase in the number of plagiarism cases detected after using an AGS, compared to the years prior. Plagiarism is a serious offence and AGS can help solve this, especially in large classes where checking for plagiarism by hand is near impossible. While most programs will contain many of the same basics, programs which are found to be clear substrings of each other can be flagged as suspicious.

3.9. Aesthetics

Comments and indentations tend to have a high importance with human graders as it makes code much easier to read. With an AGS, it can be hard to detect an appropriate comment and indentation (Caiza & Del Alamo, 2013). Pattern matching can find the comment structure, and award marks for using these. Finding indentations with pattern matching is not as straightforward. Students learning languages where indentation is not vital may fixate on it. This will decrease the amount of time spent focusing on the correctness and efficiency of the code. For most, the understanding of the indentation comes with a better understanding of the language. The need for an AGS to find correct indentation is not a high priority.

3.10. Peer Review

Once the questions have been created on the AGS, having a colleague test them can be beneficial. By allowing a colleague to answer the questions, one can ensure the pattern matching is running correctly. It can also uncover other solutions that might use different constructs or exhibit the need for extra pattern matches.

4. Conclusion

We have examined the history of AGS within the CS, how they function and what kind of feedback they provide. We discuss considerations and recommendations for those who are using or plan to use AGSs. The field of AGS is missing a defined standard for what should be included in a tool, and how it should perform. We believe an AGS should do much more than simply give a student a grade. When utilised correctly, an AGS can be of huge benefit to the development of a student's knowledge, providing additional scaffolding. Through effective feedback, effective use of test cases and all the other considerations, a student will have access to what is essentially a "digital tutor". We hope that these recommendations go some way towards defining a standard and helping educators make effective use of AGSs.

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Causal Attribution Habits and Cultural Orientation as Contributing Factors to Students' Self-Efficacy: A Comparison Between Female Students in the United States and Saudi Arabia

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Abstract

In the present research, we examined the extent to which explanations of desirable or undesirable outcomes (grades) can account for the self-efficacy of female college students from two societies with dissimilar cultural traditions: The United States of America, which is characterized by a dominant individualistic culture, and the Kingdom of Saudi Arabia, which has a dominant collectivist culture. A matched-pairs design (N=560; 280 matched pairs) was used to ensure that students' self-efficacy levels were equated between cultural groups. We found cultural differences in the choice of explanations and in the extent to which explanations contribute to self-efficacy values. These findings are relevant to the development of curricula and instructional methods that are intended to prepare students from different cultures for academic success.

Keywords: *Self-efficacy; causal attribution; cultural orientation.*

1. Introduction

One of the most important contributors to students' success is self-efficacy, a psychological trait that denotes a general confidence in one's abilities to overcome challenges and solve problems (Bandura, 1977; Majer 2009; Bartimote-Aufflick *et al*., 2016; Roick & Ringeisen 2017). A review conducted by Bartimote-Aufflick *et al*. (2016) identified value, intrinsic motivation, learning strategy use, locus of control, and self-regulation as the factors most highly correlated with students' self-efficacy (see also van Dinther *et al*. 2011). While studies in the field of education have explored cultural differences between countries, the present research offers a novel contribution in that it collects individual-level data on culture instead of applying a country's values to the individual (see Bartimore-Aufflick *et al*., 2015) and includes an understudied population for comparison (female students from the Kingdom of Saudi Arabia, KSA).

Self-efficacy is a universal construct that applies across cultures although group differences exist. For instance, Scholz *et al*. (2002) found that individuals from collectivist cultures (e.g., Asia) have lower self-efficacy than those from individualistic cultures. There are also differences in how individuals explain actions and outcomes (i.e., causal attribution habits; Choi *et al*., 1999). It is unclear, however, to which extent causal attribution habits for desirable or undesirable outcomes may shape students' self-efficacy (Bandura, 1989) when self-efficacy does not differ between cultural groups. That is, does it matter whether students believe that their academic successes or failures are due to internal (ability or effort) or external (luck, professor, friends) factors?

To assess whether cultural differences in causal attribution habits contribute to self-efficacy, our study compares female college students from two countries: the USA and the Kingdom of Saudi Arabia (KSA). As a western country, the USA can be characterized as guided by individualistic culture; in contrast, the culture of KSA tends to emphasize collectivist values while also acknowledging the role of the individual (De Jong & Moaddel, 2013; Haykel *et al*., 2015). KSA is a traditionally patriarchal conservative county ruled by the collectivist principles of Islam, but it is also a country that has strong Western influences and a younger generation that is somewhat bicultural because of increased modernization and second language education (e.g., English or French; Selvi & Yazan, 2017). Female university students are selected for comparison because they are an understudied sample.

2. Method

The participants were 280 female students enrolled in a Core course (American Government) at the University of Central Florida in the USA, and 280 students enrolled in a Core course (Arabic Studies) at Prince Mohammed University in KSA. Participant ages ranged from 18 to 25. The KSA sample included students of Middle Eastern descent, whereas the USA

sample included students from a more diverse ethnic background (White: 43.9%; Hispanic: 26.8%, Black: 11.8%, Asian: 5.0%, and mixed or unclassified: 12.5%). As such, samples not only reflected cross-national differences in university enrollment, but also ensured the ecological validity of the study. Core courses, which are foundational courses taken by students irrespective of their major, were selected to ensure a sufficiently representative sample of students of each university. At the start of the course, students completed three questionnaires. The New General Self-Efficacy (NGSE; Chen *et al*., 2001) questionnaire assessed confidence in their abilities across a variety of competencies, behaviors, and situations. Students' agreement with each of the eight items of the questionnaire was measured on a 5-point Likert scale from 'strongly disagree' to 'strongly agree'. Cronbach's reliability coefficient (i.e., a measure of internal consistency) was .84.

The causal attribution questionnaire of McClure *et al*. (2011) assessed students' explanations of their best and worst performance (Cronbach's Alpha = .60). The questionnaire asked students to recall the time when they received either their best grade or worst grade on a test. Their task was to rate the contribution of seven causes to the respective grade on a scale from 0 (not at all) to 6 (entirely): ability, effort, test (either difficulty or ease), luck, family, instructor, and friends.

The cultural orientation questionnaire of Triandis and Gelfland (1998) measured students' orientation towards collectivism and individualism (Cronbach's Alpha = .80). The questionnaire assessed four types of beliefs about the self and others on a 9-point Likert scale from 0 (never) to 8 (always). It included vertical collectivism (VC; see oneself as a member of a hierarchically organized collective who is inclined to accept its inequalities), vertical individualism (VI; see oneself as independent who is inclined to accept its inequalities), horizontal collectivism (HC; see oneself as a member of a collective of equals among equals), and horizontal individualism (VC; see oneself as independent in a collective of equals among equals). On this scale, 4 was the neutral point.

General self-efficacy ratings were used to match each U.S. participant with a KSA participant on self-efficacy rating, thereby creating 280 pairs of U.S. -KSA participants. The subject pool from which selections were made included 1265 students. If a perfect match did not exist, the closest match was selected. When multiple candidates for a given match existed, random selection was used for pairing. The treatment of participants complied with the guidelines of the Office for Human Research Protections of the U.S. Department of Health and Human Services as well as the code of ethics of the American Psychological Association.

3. Results

All results described below were considered significant at the .05 level. When analysis of variance (ANOVA) was used, significant effects were followed by tests of simple effects,

which were submitted to the Bonferroni inequality procedure to adjust for familywise alpha. Table 1 presents the descriptive statistics (mean, M, and standard error of the mean, SEM) of the main variables: self-efficacy, causal attribution preferences for desirable and undesirable outcomes, and cultural orientation.

Table 1. Descriptive statistics.

Variable	USA		KSA		
	Mean	***SEM***	***Mean***	***SEM***	***Sign.***
Self-Efficacy	3.03	.031	3.03	.034	*ns*
Best Grade					
Abilities	4.80	.067	4.03	.069	<.001
Effort	5.11	.067	4.81	.074	.003
Test	3.06	.084	3.32	.098	*ns*
Luck	1.88	.096	2.27	.110	*ns*
Family	1.52	.102	2.69	.123	<.001
Instructor	3.78	.084	4.16	.092	.003
Friends	1.45	.101	2.25	.115	<.001
Worst Grade					
Abilities	3.02	.099	2.49	.099	<.001
Effort	4.21	.097	2.97	.110	<.001
Test	4.37	.075	4.34	.097	*ns*
Luck	1.55	.094	2.14	.114	<.001
Family	.73	.074	2.00	.126	<.001
Instructor	2.93	.099	3.65	.112	<.001
Friends	1.01	.082	1.06	.092	*ns*
Cultural Orientation					
HI	6.244	.0689	6.397	.0677	*ns*
VI	4.018	.0830	4.439	.0962	.001
HC	5.788	.0739	6.237	.0824	<.001
VC	5.430	.0803	6.494	.0858	<.001

Note. Significant differences between U.S. and KSA students are displayed in the last column.

Participants' self-efficacy did not differ between countries, $F < 1.00$, *ns*. Thus, the matching of participants on self-efficacy was judged successful. A 2 (country) X 7 (cause) mixed factorial ANOVA, conducted on the ratings for best grades, displayed a main effect of cause, $F(6, 3348) = 427.43$, $MSE = 2.06$, $p < .001$, $\eta p^2 = .434$, and a main effect of country, $F(1,558) = 16.02$, $MSE = 4.66$, $p < .001$, $\eta p^2 = .028$. There was also a significant interaction, $F(6, 3348) = 28.56$, $MSE = 2.06$, $p < .001$, $\eta p^2 = .049$. Tests of simple effects (Bonferroni alpha: .007) indicated that, compared to KSA students, U.S. students preferred abilities and effort (internal causes) as explanations for desirable outcomes. In contrast, KSA students preferred family, friends, and the instructor (all external causes).

The same ANOVA performed on worst grades yielded a main effect of cause, $F(6, 3348) = 350.19$, $MSE = 2.43$, $p < .001$, $\eta p^2 = .386$, and a main effect of country, $F(1,558) = 3.05$, $MSE = 4.54$, $p = .005$, $\eta p^2 = .005$. There was also a significant interaction, $F(6, 3348) = 40.40$, $MSE = 2.43$, $p < .001$, $\eta p^2 = .068$. Tests of simple effects (Bonferroni alpha: .007) indicated

that U.S. students again preferred abilities and effort (internal causes) as explanations for undesirable outcomes. In contrast, luck, family, and the instructor (external causes) were preferred by KSA students. Thus, there were differences between countries, but U.S. students explained desirable and undesirable outcomes in the same way. KSA students also selected similar explanations for desirable and undesirable outcomes with one exception. To account for a desirable outcome, they saw friends as a potential agent of responsibility, but when an undesirable outcome was considered, they called upon luck.

Ranking the different explanations showed that U.S. students mentioned effort and ability as the most frequent accounts for desirable outcomes, and test difficulty and effort as the most frequent accounts for undesirable outcomes. Thus, U.S. students distinguished between different outcomes. For KSA students, desirable outcomes were preferentially attributed to effort and instructors, whereas undesirable outcomes were preferentially attributed to instructors and test difficulty. Thus, they were more likely to select an external cause than U.S. students to explain relevant outcomes.

A 2 (country) X 4 (cultural orientation) mixed factorial ANOVA conducted on ratings for cultural preferences displayed a main effect of cultural orientation, $F(3, 1674) = 401.58$, $MSE = 1.25$, $p < .001$, $\eta p^2 = .418$, and a main effect of country, $F(1,558) = 44.08$, $MSE = 3.46$, $p < .001$, $\eta p^2 = .073$. There was also a significant interaction, $F(3, 1674) = 16.55$, $MSE = 1.25$, $p < .001$, $\eta p^2 = .029$. Tests of simple effects (Bonferroni alpha: .001) indicated that KSA students were more likely to endorse HC, VI and VC than U.S. students. Students from the U.S. and KSA displayed no differences in HI.

3.1. Do explanations for best and worst grades account for self-efficacy?

We carried out regression analyses for U.S. and KSA students separately to determine whether explanations for either best or worst grades, treated as the predictors, contributed differently to self-efficacy. Tables 2-3 illustrate the results of these analyses. Students from the U.S. and KSA differed in how they rated variables contributing to their self-efficacy. For U.S. students, self-efficacy benefited from the attribution of desirable outcomes to effort but was damaged by the attribution of desirable outcomes to luck. For KSA students, self-efficacy benefited from the attribution of desirable outcomes to abilities, whereas it was hurt by the attribution of a desirable outcome to the test difficulty. For U.S. students, self-efficacy was hurt by the attribution of undesirable outcomes to instructors. For KSA students, self-efficacy was hurt by the attribution of undesirable outcomes to abilities and luck.

Table 2. Regression analyses for "best grade" with attribution preferences as the predictors, and self-efficacy as the outcome variable.

Best Grade-USA	***B***	***SE***	***Beta***	***t***	***Sig.***
Constant	2.283	.192			
Abilities	.049	.027	.107	1.790	*ns*
Effort	.088	.027	.194	3.198	.002
Test	-.011	.023	-.030	-.489	. *ns*
Luck	-.044	.021	-.138	-2.077	.039
Family	-.001	.018	-.003	-.049	*ns*
Instructor	.039	.022	.107	1.745	*ns*
Friends	.022	.020	.073	1.113	*ns*
Best Grade-KSA					
Constant	2.302	.144			
Abilities	.155	.027	.352	5.722	.000
Effort	.033	.026	.080	1.273	*ns*
Test	-.047	.020	-.150	-2.389	.018
Luck	-.022	.017	-.081	-1.282	*ns*
Family	.026	.015	.104	1.747	*ns*
Instructor	.024	.020	.071	1.172	*ns*
Friends	-.011	.017	-.041	-.652	*ns*

Note. USA: R = .343. KSA: R = .437.

Table 3. Regression analyses for "worst grade" with causal attribution preferences as the predictors, and self-efficacy as the outcome variable.

Worst Grade-USA	***B***	***SE***	***Beta***	***t***	***Sig.***
Constant	3.181	.155			
Abilities	-.031	.018	-.099	-1.656	*ns*
Effort	.003	.019	.009	.150	*ns*
Test	.024	.026	.059	.926	*ns*
Luck	-.002	.022	-.007	-.095	*ns*
Family	-.044	.028	-.106	-1.562	*ns*
Instructor	-.039	.020	-.128	-1.976	.049
Friends	-.029	.026	-.079	-1.129	*ns*
Worst Grade-KSA					
Constant	3.212	.111			
Abilities	-.042	.019	-.137	-2.224	.027
Effort	-.013	.017	-.048	-.770	*ns*
Test	.022	.021	.070	1.065	*ns*
Luck	-.056	.017	-.209	-3.273	.001
Family	.019	.015	.076	1.214	*ns*
Instructor	-.016	.018	-.058	-.884	*ns*
Friends	.004	.021	.011	.170	*ns*

Note. USA: R = .246. KSA: R = .247.

3.2. Does cultural orientation account for self-efficacy?

We carried out regression analyses with self-efficacy as the outcome variable and cultural dimensions (HI, VI, HC, and VC) as the predictors, separately for KSA and U.S. students. Table 4 illustrates the results of these analyses.

Table 4. Regression analyses with cultural dimensions as the predictors, and self-efficacy as the dependent variable

Country	*B*	*SE*	*Beta*	*t*	*Sig.*
USA					
Constant	1.343	.188			
HI	.177	.025	.400	6.945	.000
VI	.018	.019	.049	.924	*ns*
HC	.036	.023	.089	1.571	. *ns*
VC	.054	.023	.143	2.308	.022
KSA					
Constant	1.877	.187			
HI	.127	.028	.281	4.462	.000
VI	.027	.020	.084	1.346	*ns*
HC	.058	.027	.158	2.165	.031
VC	-.023	.027	-.064	-.841	. *ns*

Note. USA: $R = .514$. KSA: $R = .372$.

For U.S. students, beliefs in horizontal individualism and vertical collectivism both contributed positively to self-efficacy. For KSA students, beliefs in horizontal individualism and collectivism contributed positively to self-efficacy. Thus, an appreciation for equity contributed to confidence in KSA students, whereas a mixture of conflicting orientations contributed to confidence in U.S. students.

4. Discussion and Conclusion

The present study examined the extent to which explanations for desirable and undesirable outcomes as well as cultural orientation accounted for self-efficacy. Our matched-pairs design suggested that both causal attribution habits and cultural orientation are related to several dimensions of self-efficacy even when students from different cultures are matched on their self-efficacy rating while holding sex constant (all participants were female). These findings are relevant to educators and administrators who wish to ensure that choices of curricula and instructional methods can adequately prepare students from different cultures for success. For example, U.S. students might be able to improve their self-efficacy if they are trained to attribute poor grades more to internal factors than to instructors. Further studies should look into how the context of a masculine culture such as that of KSA (see Hofstede 2001) may shape individuals' perception of self-efficacy. Comparing male students would also be of interest.

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Recent Advances in Academic Performance Analysis

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Abstract

Academic performance analysis has gained popularity in the past decade. Using various prediction and classification methods, researchers aim to provide clues to help students to improve their performance, and to assist educational institutions to improve quality and make better administrative decisions. This work provides a brief survey of 56 papers related to academic performance prediction, published in 2019 and 2020. Statistics and analysis on the prediction target categories, the target population size, prediction and classification methodologies used, and evaluation metrics are presented. It is found that the most commonly used techniques are decision tree, ensemble methods, and neural networks. Futhermore, these techniques also give the highest accuracy in their target prediction.

Keywords: *Academic performance; prediction; classification; student population; performance evaluation.*

1. Introduction and Motivation

Academic performance analysis has become an important research area, to predict student performance and to identify at-risk students. Proper analysis not only helps students to improve their academic performance and to prevent failure, but also helps educational institutions to improve quality and make better administrative decisions. In this work, a brief survey on academic performance related literature published in 2019 and 2020 is given.

From IEEE Xplore, 56 papers related to student performance prediction and educational data mining are collected (available here). Seven papers are published in journals while the remaining 49 are presented at conferences. Figure 1 shows the countries where the institutions are located. The top three referenced countries have the highest world population, and logically associated with a large number of universities (India has 4004, USA has 3281 and China has 2310). In addition to the ones shown, a single instutition is referenced in 18 individual papers.

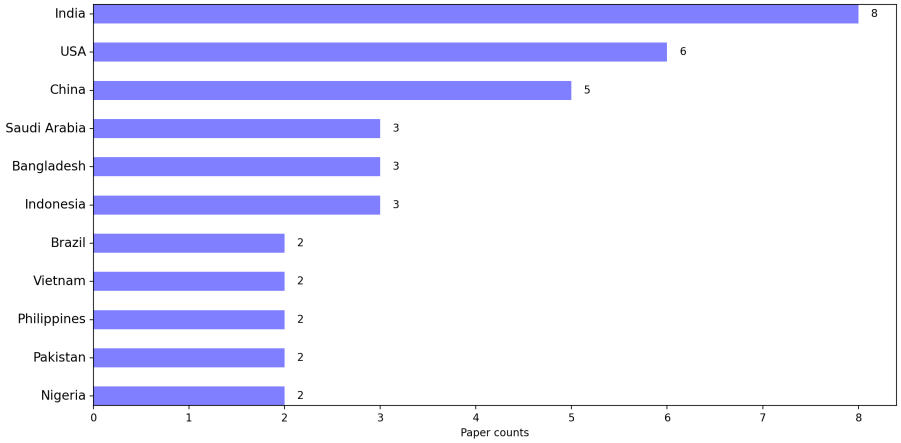

Figure 1. Paper count in countries of institution location.

For the 56 papers, the analysis targets are discussed in Section 2, while the prediction methodologies used and performance evaluation are presented in Section 3.

2. Analysis targets

2.1. Target population

The analysis target statistics are shown in Figure 2. The "information technology related" group includes computer science, electrical and computer engineering, information system and technology, and software. There are two papers, Nakagawa *et al.* (2019) and Zhang *et*

al. (2020) use the same online open-source datasets, the ASSISTments 2009-2010 "skill-builder" provided by the online educational service ASSISTments, and Bridge to Algebra 2006-2007 used in the Educational Data Mining Challenge of KDDCup.

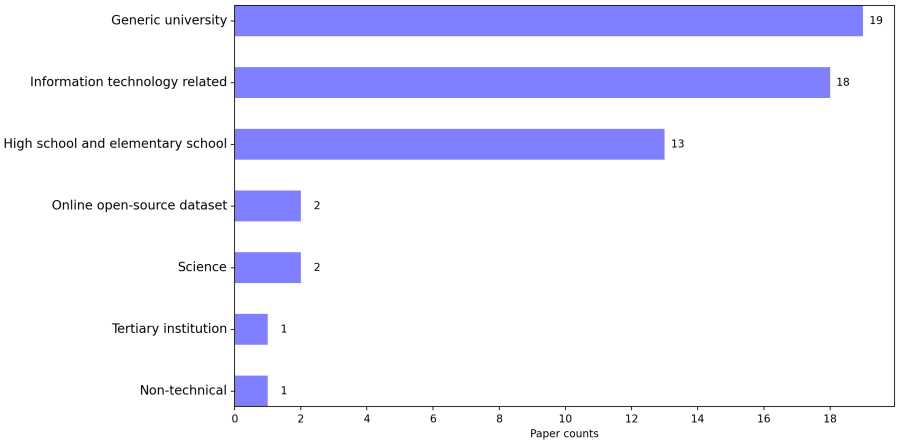

Figure 2. Analysis target and paper count.

About 73% of the papers target higher education, while 23% focus on high school and elementary school students. Many papers investigate students from information technology related departments. This seems natural as authors from these departments probably are researchers in data mining and analytics, and therefore are applying their expertise to analyze students within their department.

2.2. Target population size

Table 1 shows the target population size of the 56 papers. There are two papers that collect information from over 50,000 students. These investigations are conducted by the same authors, Mai *et al.* (2019a, 2019b), and the data are collected from 2009 till 2019 from the entire university.

Typically, population size from a department is much smaller, with 62.5% of the papers having a population size under 1000 (35 out of 56). Three papers have target population size less than 100. Khan *et al.* (2019) study 50 students from the department of system and networking and only focus on predicting a student's final grade in a course. Lai *et al.* (2019) investigate 55 students and present a model to identify students who are likely to fail in reading. This is an interesting project as the students are provided with a science text to read. All participants wear a mobile headset to record electrocardiogram-based attention, an eye tracker to track eye movements, and a mobile webcam to capture facial behavioral cues. Olalekan *et al.* (2020) gather statistics on 44 students from a department in a tertiary institution. The number of papers in each target population category and the corresponding

average population size are shown in Table 2. The impact of target population size on the prediction model's performance is addressed in Section 3.2.

Table 1. Target population size and corresponding count of papers.

Target population size	Paper counts
unknown	10
size <= 200	9
200 < size <= 400	9
400 < size <= 600	10
600 < size <= 1000	7
1000 < size <= 2,000	5
2,000 < size <= 5,000	3
5,000 < size <= 10,000	1
10,000 < size <= 50,000	0
50,000 < size <= 100,000	2

Table 2. Paper count and average size in each target population category.

Target population category	Paper count	Average population size
Generic university	19	9,133
Tertiary institution	1	44
High school and elementary school	18	1,379
Information technology related	13	569
Non-technical	1	145
Science	2	269
Online open-source dataset	2	2,000

3. Prediction methodologies and evaluation

3.1. Prediction and classification techniques

In academic analysis, the major goal is to predict a certain outcome or to classify an instance as pass/failure, grade point average (GPA), graduated or not, etc. Figure 3 shows the prediction and classification techniques used in the surveyed papers. Most works employ more than one techniques with decision tree, ensemble methods, and neural networks being the most frequently used.

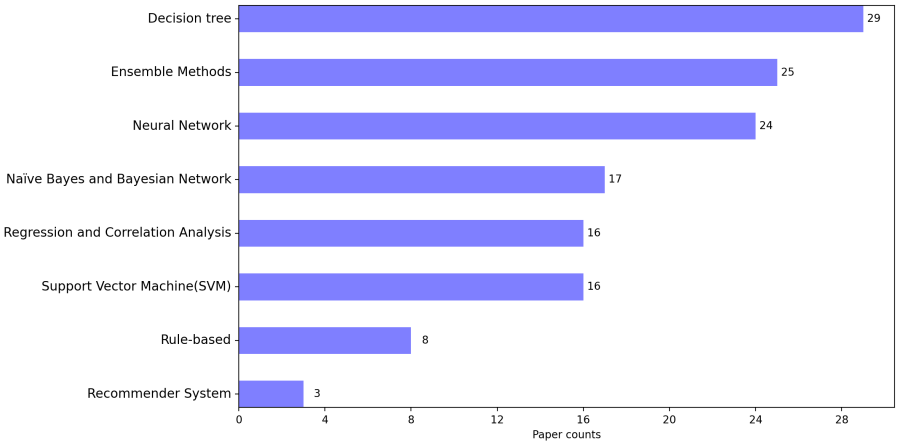

Figure 3. Prediction and classification techniques used in surveyed papers.

3.2. Prediction performance analysis

The most commonly used metric to evaluate prediction performance is accuracy found in 40 papers, followed by ROC (receiver operating characteristic) curve and MSE (mean squared error) each in 3 papers, and RMSE (root MSE), MAE (mean absolute error), and f-score each in one paper. Seven papers have not made any evaluation. The highest accuracy attained by their prediction of the 49 papers is shown in Figure 4. Four papers, Alsalman *et al*. (2019), Akram *et al.* (2019), Jayaprakash *et al.* (2019) and El-Rady (2020), obtain over 95% accuracy, while Islam *et al.* (2019) achieve only 64%.

From the correlation line in Figure 4, it can be observed that as the target population size increases, the prediction accuracy improves too. Another reason for some of the high accuracy obtained is the prediction and classification methods used.

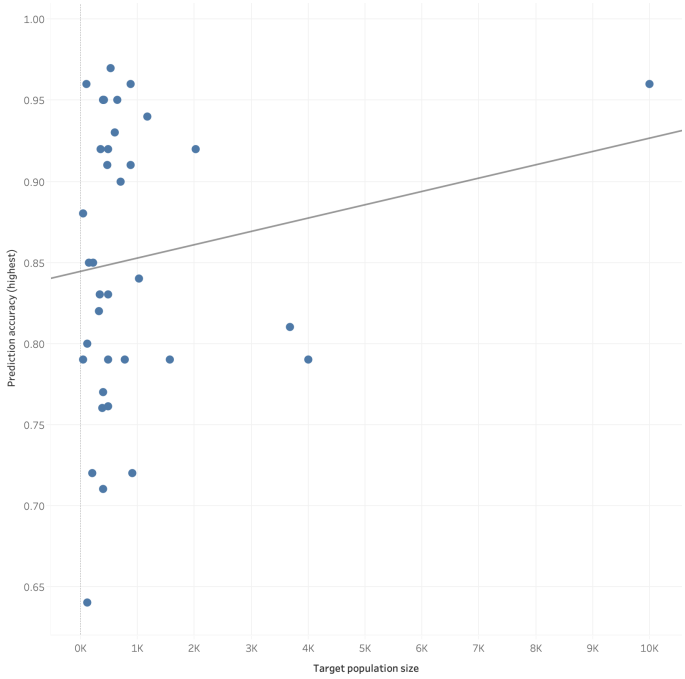

Figure 4. Accuracy measure and target population size.

On the other hand, small population size seems to be the reason for low accuracy. For instance, the paper by Islam et al. (2019) with 64% accuracy in predicting grade, has only 120 students as samples. Small dataset might have bias or easily lead to overfitting. In addition, the prediction methods deployed in this paper is logistic regression, which is one of the least accurate among all prediction methods, as illustrated in Table 3, which shows the accuracy of the prediction methods.

Table 3. Accuracy of prediction methods.

Prediction method	Mean of accuracy	Standard deviation
Decision Tree	89%	6%
Ensemble Methods	86%	9%
Neural Network	84%	8%
SVM	83%	6%
Naïve Bayes and Bayesian Network	83%	17%
Regression and Correlation Analysis	71%	9%

As shown in Table 3, the most accurate prediction method is decision tree, while it is also the most frequently used prediction method (see Figure 3). Interestingly, ensemble methods

(random forest) and neural network (multi-layer percentron) are the second and third most commonly deployed prediction methods, and also the second and third most accurate, respectively, as noted in Section 3.1.

4. Conclusion and Future works

This brief survey provides a glimpse of the academic prediction work in the literature in 2019 and 2020. Decision tree, ensemble methods and neural networks are the most commonly implemented prediction techniques, while also achieving top performance in accuracy.

We are currently working on a comprehensive survey that covers academic performance literature in the 2010s. Investigation includes data preprocessing, feature selection, and other influencial factors on prediction performance.

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Evaluating Learning for the Multiple Constituencies of Higher Education: A Call for Action, A Call for Research

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Abstract

This paper explores the rapidly changing world of higher education and the need for different ways to identify learner outcomes and evaluate student learning. In recent years, higher education has experienced significant demographic shifts in student populations. These shifts were the result of numerous variables including the increasing cost of higher education, the demand from business and industry to get people into high-demand occupations faster, and the decreasing number of individuals choosing post-secondary education immediately following high school. The year 2020 brought unprecedented challenges to the world with the pandemic caused by the coronavirus known as COVID-19. The pandemic accelerated the change that was already taking place in higher education. From how education was delivered to where it was delivered, higher education was forced to rapidly change a centuries-old model. This paper explores a tier one research university's response to the changes in higher education by employing a proven process of mapping learning outcomes, assessing both new and prior learning using innovative technology, issuing microcredentials, and working with policymakers and employers to meet workforce demands.

Keywords: *Higher education; microcredentials; learning outcomes; mapping; assessment.*

1. Introduction

Ten years ago, the United States adopted policies that sought to increase college enrollment and graduation rates. Both federal and state governments established goals to increase the adult population's share with postsecondary credentials to 60 percent or higher by 2020 (Fry, 2017; Obama, 2009). This goal has yet to be met with about half of the adult population holding some type of postsecondary credential (including workforce certificates), although there are significant differences across the 50 states (Lumina, 2019). Postsecondary education plays a vital role in income and wealth mobility (Chetty et al., 2017) and adds to people's resiliency to the effects of economic downturns (Bureau of Labor Statistics, 2020). Resiliency and adaptability in postsecondary and higher education are not system challenges unique to the U.S. context alone. Globalization and rapid technologization have strained education and workforce readiness systems and structures worldwide. As a potential solution to this continued problem, we present within this paper an ambitious and broad set of solutions around developing learning maps, creating an authentic outcomes assessment system based upon the learning maps, using the learning maps to communicate competencies across courses and document the relationship of the mastered outcomes to business workforce needs, and issuing stackable micro learning credentials all while using and extending proven processes, technology, and lessons learned from the K-12 education sector.

In recent years, higher education has experienced significant demographic shifts in student populations. These shifts resulted from numerous variables including the increasing cost of higher education, the demand from business and industry to get people into high-demand occupations faster, and the decreasing number of individuals choosing postsecondary education immediately following high school. It is imperative that higher education look for diverse ways of filling the projected financial gap due to decreased enrollment. One possible solution is to engage learners across their lifespan and career span. For example, in the state of our tier one research university, it is projected that high school-age cohorts are getting smaller. Smaller cohorts limit the traditional pool of students and, therefore, tuition upon which universities and colleges rely.

The world of work, education, and industry have always been interconnected, complex, and dynamic. However, there have been consistent limits of infrastructure and challenges to the rate of change and responsiveness of learning systems. Simultaneously, in the U.S. higher education has seen decreasing public funding while student debt is mounting. Add to this the need for employers to find just-in-time training and development for employees. Therefore, it is the rate of change and, more importantly, the multiple convergences of change that we seek to discuss here. This work addresses the concomitant change across six different areas within the context of higher education: (1) the changing constituencies of postsecondary learners; (2) the need for and articulation of diverse competencies; (3) the need to track or at

least recognize cross-cutting skills like critical thinking and teamwork which although critical often remain invisible in terms of outcomes to potential employers; (4) enhanced theories and methods in assessment research; (5) the evolution of learning progressions into more holistic learning maps; and (6) the maturation and interoperability of technology infrastructure.

2. The Five Components

We propose that the major constituencies of higher education – university administrators, faculty, students, potential employers, and policymakers – will all benefit from a well-articulated system that has five components:

1. Learning maps that communicate the relationships among learning outcomes and competencies within a program of study.
2. Credit for life experiences.
3. Multiple assessment approaches for demonstrating mastery of learning outcomes.
4. Degrees based on stackable microcredentials.
5. A technology platform that articulates the components and facilitates interactions among universities, businesses, and students.

2.1. Learning maps

Learning maps are a model that articulates a network of precursor and successor skills, where mastery of a particular precursor skill or learning outcome increases the probability of mastering a successor skill. Learning maps make learning visible which supports the diversity in knowledge and experience that learners bring with them as well as showing the equally diverse pathways learners can take to gain mastery. Figure 1 presents a view of a portion of a learning map developed for a K-12 assessment program. The information within the specific nodes shown below are not relevant to this paper; it is presented to show that the structure can include one to one, one to many, and many to one relationship among nodes.

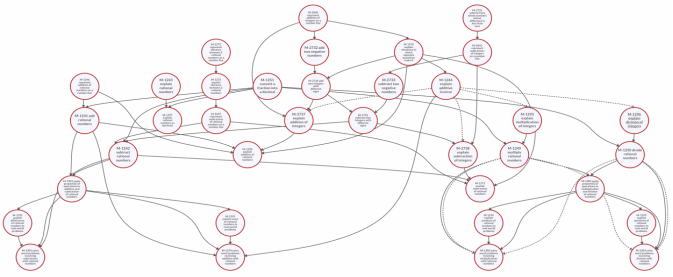

Figure 1. A demonstration of the structure of a learning map.

Learning maps can be created based on existing empirical research or be based on expert opinion and validated based on the collection of assessment data (Adjei et al., 2014). Learning maps have served as the basis for formal assessment systems (Kingston et al., 2016) as well as an organizing structure for instructional practices (Kingston & Broaddus, 2017). Learning maps can be tagged to show which courses address which learning outcomes and which outcomes are deemed critical for which career paths. They can help administrators (and businesses) understand course overlap, outcomes not explicitly addressed by any courses, and outcomes intentionally addressed across the curriculum, such as ethical behavior and critical thinking. Using critical thinking as an example, we assume there are nodes related to critical thinking in our learning map and that our assessments gather information about student critical thinking that we can pull out and report associated with that node. In the past, all anyone ever saw was a grade for a course; i.e. Biology 101 or English 203. By using learning maps and appropriate assessments, students could demonstrate the mastery of learning outcomes attained over multiple courses, that were previously invisible within the grade for a single course.

2.2. Credit for life experience

While credit for life experience has long been considered by institutions of higher education, a variety of factors make it important to accelerate this trend. High performing businesses are increasingly self-identifying as learning-focused organizations and investing increasing amounts of resources into training. However, some common approaches to evaluating past learning experiences are expensive and do not provide evidence of validity and reliability or are not direct evidence of attainment of learning outcomes and workplace required competencies. Workplace competencies manifest in accomplishing tasks, not demonstrating answers to questions on related areas of knowledge. Given an increasing policy focus on adult education and training, stackable credentials provide a pathway for increasing educational attainment and career training among working adults who already hold a postsecondary credential (Meyer et al., 2020).

2.3. Multiple assessment approaches

At the heart of assessment in the service of learning is the use of principled approaches to assessment design, development, and implementation, along with the ongoing accumulation of evidence to support the claims of the assessment (Ferrara et al., 2017), which represent a validity argument (Kane, 2013; Sireci, 2013).

Criticisms of assessments have stimulated their evolution and transformation. Assessments have been criticized for not effectively capturing complex knowledge and skills as emphasized and needed in today's curriculum and workforce (Resnick & Resnick, 1992); measuring a relatively narrow range of knowledge and skills (Glaser et al., 1997); capturing

information about performance set in one point in time and not the progression of knowledge, skills, and understanding over time (National Research Council, 2001); and not measuring what is taught (Black & Wiliam, 1998; Shepard, 2000). The evolution of assessments involves the reconceptualization of the nature of assessment to represent the documentation and inference about (a) developed competencies, (b) the process by which competencies are developed, and (c) the potential for the development of competencies.

To ensure the evolution of assessments is high quality representing competencies articulated in learning maps, the assessments should (a) assess the competencies, (b) be aligned to and inform the process of developing these competencies, and (c) be valid, reliable, and fair as demonstrated by evidence (Darling-Hammond et al., 2013; The Gordon Commission, 2013). The evolution of assessments represents an assessment enterprise collecting a variety of evidence of the competencies (e.g., portfolios, performance events, artifacts, paper-and-pencil tests, computer-based tests, among others). This evolution of assessments to capture evidence of learner outcomes in higher education is growing internationally (Tremblay et al., 2012).

Several characteristics must exist to develop a sound assessment. These characteristics, as implied by using a validation framework approach, need to be based on evidence that support the claims made by the information that comes from these assessments. The competencies used as the basis for the assessment should be representative of the important elements of the domain they are supposed to represent by (a) competencies aligned to what they are supposed to represent; (b) the scoring of evidence produces accurate scores; (c) the scoring rubrics adequately reflect the differentiated performance indicated by the performance level descriptions; (d) the scored evidence empirically reflects the competencies; (e) the scores produced correspond to actual performance on competency; (f) the scores are fair; and (g) the scores are useful in representing the competencies.

2.4. Stackable microcredentials

Microcredentials are related to a formally approved or accepted set of standards or competencies. They can be "stacked" up to achieve a credential that is recognized both within institutions and business and industry. Therefore, they offer a more granular way to move through content/competencies than a traditional degree or certification program. They offer a timelier and more formative unit from which to be assessed resulting in both lower costs and stakes. However, we propose not merely microcredentials in and of themselves, but the analytical and cognitive process behind their development (i.e., learning maps and diverse assessments).

2.5. Technology platform to articulate components and facilitate communication

A technology-based infrastructure is necessary to allow the various components to work synergistically. It must include a bank of academic program-based learning outcomes from which faculty can choose their course outcomes, as well as the facility to add outcomes. This component must be able to communicate with existing learning management systems to reduce duplication of effort. Another component must support the development and visualization of the learning maps. A third component must support assessment via evaluation of work experiences, performance assessments, and technology-enhanced assessments that foster authentic assessment. Finally, the results of the assessment component must support stackable microcredentials, where credit is reflected as specific course attainment, rather than just a general awarding of credit. While existing commercial platforms are available, most carry out only one or two functions needed for full articulation of the components.

3. Necessary Next Steps

In order to respond to the changes in higher education discussed in this paper, we suggest the following next steps:

1. Research agenda examining the alignment of the content, the alignment of the assessment, the reliability of the decisions about competency, the generalizability of the scoring, the concurrent and predictive informational value of the scores and microcredentials, and the fairness of the results to examinees including evidence of the appropriate use of the scores and microcredentials (Darling-Hammond & Adamson, 2010; Shavelson et al. 2018).
2. Operational studies to examine the efficiency of obtaining, scoring, and certifying competencies (Wei et al., 2014; Cresswell et al., 2015).
3. User studies to examine and monitor the understanding and use of score reports, as well as the effectiveness in dissemination activities and informational campaigns of the competencies and microcredentials (Zenisky & Hambleton, 2012; Kirsch & Braun, 2020; Bennett & Folley, 2020).
4. Validation of microcredentials by (a) gathering corroborating evidence that achieving a microcredential corresponds to competency in the knowledge, skill, and/or behavior implied by the competency and (b) examining whether the use of microcredentials predicts subsequent performance in sequent educational experiences or job performance.

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Style features in the programming process which can help indicate plagiarism

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Abstract

In the new situation, where more and more final programming assignments are performed outside the classroom, it is necessary to pay more attention to the possibilities of understanding whether a student has created the solution on their own. To do this, it is possible to use a programming environment that logs user actions. One such environment is Thonny, which also allows the programming process to be replayed. The aim of this study is to identify style features of different learners, based on solution logs of introductory programming courses, and to explore how permanent these features are and can these indicate whether learners have solved the tasks without external aids. It can be said that non-programming style features, like the order of writing brackets or quotation marks, are more permanent and can be used to detect plagiarism. However, programming style features, such as the use of variable names or increment, are very variable between courses, and students participating in introductory courses do not have an established style. They are greatly influenced by the style features of teaching materials and solutions of sample tasks. Therefore, programming style features cannot be used to automatically check if a student has solved a task on their own.

Keywords: *Style features; programming process; plagiarism; higher education.*

1. Introduction

As time goes on, programming becomes more popular, and people increasingly learn it at universities. During the learning process, students solve many programming tasks. Knowing various aspects of the programming process is helpful for understanding how different students study. In the new situation, with the increasing share of e-learning, it is increasingly the case that even final assignments are performed outside the classroom. More attention needs to be paid to the ways of understanding whether programs have been created by students themselves. It is possible to use different recording tools. One option is to use a programming environment which logs user actions and use the ability to examine logs. One such environment is Thonny, a Python programming environment designed for learning and teaching programming, and it has logging functionality. The logs contain information about user actions during the solution process, and the programming process can be replayed (Annamaa, 2015). Because of logging details, it is also possible to identify from the log the order in which characters were written.

In our study, we analysed Thonny logs collected from the courses "Introduction to Programming" and "Introduction to Programming II" which took place at the University of Tartu in the spring of 2020. The study is qualitative and looks at style features that can be distinguished based on the programming process. The focus is also on the persistence of style features because permanent ones can be used in detecting plagiarism. The detected style features can later be used in quantitative research. The article is based on the following research questions. 1) What style features of different learners in solving programming tasks can be identified based on task solution logs of introductory courses? 2) What style features are permanent and can indicate whether a learner has solved the tasks on their own?

2. Literature Review

The similarity between programs has been studied to a great extent. A number of tools has been created, and some of them are also based on programming style. For example, Arabyarmohamady, Moradi and Asadpour (2012) developed a tool focused on the similarity of programs, in which they looked at the programming style and used data collected from professional programmers and first-year students. The system performed better than other systems in detecting whether code was copied from the internet or received from somebody outside the course (Arabyarmohamady *et al*., 2012). Ganguly, Jones, Ramirez-de-la-Cruz, Ramirez-de-la-Rosa and Villatoro-Tello (2018) also analysed the coding style and took it into account. They used a set of features where they distinguished lexical, structural and stylistic features. Stylistic features were, for example, the number of lines of code, the number of white spaces, the number of tabulations, the number of empty lines, the number of defined functions, average word length, the number of uppercase letters, the number of lowercase

letters, the number of underscores (Ganguly *et al*., 2018). However, there are fewer studies that use information about the programming process. Some of them use the recording of keystrokes. Byun, Park and Oh (2020) analysed the keystroke data collected from the students in an introductory programming course. They showed that using common n-graphs (n consecutive characters while typing) is an effective way to detect plagiarism. They developed a system that observed all pressing and releasing actions in the author's activity at the millisecond level, and they used press-flight time, release-flight time, dwell time, and break time while analysing keystroke dynamics for detecting plagiarism.

Longi *et al*. (2015) distinguish students based on the average time it takes to type digraphs in programming. They analysed data from an introductory course of programming, which lasted for seven weeks, and they used data from all study weeks. Their results indicated that there was potential in using digraphs for identifying students. They compared the average time it takes for a student to type any character, to type a specific character, and to type a specific digraph. The average time of typing specific digraphs was the most accurate indicator for identifying students (Longi *et al*., 2015). Leinonen, Longi, Klami, and Vihavainen (2016) developed a methodology to automatically distinguish novice programmers from those who are experienced. Their results showed that students' programming experience can be identified using keystroke data (Leinonen *et al*., 2016). Some digraphs are common in programming and rarely occur in natural languages (Leinonen, 2019). More experienced programmers type these digital graphs faster than average. For example, such a digraph is "i+" in Java (Leinonen, 2019). There is also an analysis of plagiarism behaviour in introductory programming courses with take-home exams, and special software was used to record the programming process (Hellas, Leinonen, & Ihantola, 2017). Afterwards, the researchers interviewed the students suspected of plagiarism and developed a typology of plagiarism on the basis of these interviews. They also found patterns that can be helpful in identifying students who have plagiarised, for example, a linear solution process and pasting parts of the solution. It is also possible to detect collaboration through alignment of the programming process but it does not detect students who received help from someone outside the course (Hellas *et al*., 2017).

Schneider, Bernstein, vom Brocke, Damevski, and Shepherd (2018) developed a mechanism which compares program creation processes. They used logs containing sequences of events that were collected automatically during the programming process. Detection is based on comparing the histograms of command use in the logs. In plagiarised works, the log is too different from "honestly created" logs or too similar to another log (Schneider *et al*., 2018). Blikstein (2011) developed a technique based on hundreds of snapshots to analyse and categorise students by programming experience. He used logs that contained all users' actions, for example, keystrokes and changes in the code. He studied what strategies students use to solve a programming task, for example, using an existing program as a starting point,

taking breaks in coding while browsing other sample programs or thinking of solutions, linear growth in the code size, trial-and-error strategy, sudden increase in code size due to pasted code (Blikstein, 2011).

3. Methodology

Data were collected from the courses “Introduction to Programming” and “Introduction to Programming II” which took place at the University of Tartu in the spring of 2020. These were elective courses for students who were not studying computer science as a major. The course “Introduction to Programming” lasted for seven weeks, the main topics included: variables, conditional statement, loop, list, reading from a fail, writing to a fail, function, simple user interface. Those students who completed the course "Introduction to Programming" could, if desired, continue with the course "Introduction to Programming II". The course “Introduction to Programming II” lasted for six weeks and covered the following topics: nested loops, dictionaries, tuples, sets, graphics and recursion. Both courses were organised in Python. At the beginning of the course “Introduction to Programming”, there were both lectures and practical sessions in the classroom. Then, however, an emergency began due to the pandemic, and the course was completely transformed into an e-learning format. “Introduction to Programming II” was entirely in the e-learning form. The final assignments also took place outside the classroom.

The first course had 140 participants, 118 of whom completed it. 39 students continued with "Introduction to Programming II" and 22 of them completed it. In addition to homework, students had to submit a Thonny log file each time. They also had to add a Thonny log file when they submitted the solution to the final assignment. Students who met the following conditions were included in the study: 1) Studied in both courses; 2) Submitted final assignment programs and logs for both courses; 3) Submitted homework logs for both courses for at least 50% of the weeks. There were 17 such students.

All logs submitted during the two courses by the 17 students were analysed using Thonny’s functionality of replaying the programming process. In addition, the submitted programs were reviewed. Before the analysis, a table was compiled for each week with characteristics that could differentiate students. Information about each student was added to the table during the log analysis. If potential new style features were noticed during the analysis, these were added to the tables. When all logs were analysed, the information collected from each student's logs for different weeks was compared. Also, the materials used by the students in the study process were analysed. In particular, the extent to which the students' style features overlapped with those in the study materials was compared. The style features in students' homework were compared with those from the corresponding chapter of the study material.

4. Results

The style features that were focused on in the study can be divided into two types: 1) non-programming style features; 2) programming style features. Non-programming style features include the order of writing brackets, quotation marks, apostrophes, and square brackets. For example, they can start by writing an opening bracket, then text and finally the closing bracket (in Table 1 (x) "x" [x]) or an opening bracket, the closing bracket, and finally the text inside (in Table 1 () "" []). Based on the main writing order of brackets, quotation marks, apostrophes, and square brackets, the students were divided into seven types (Table 1).

Table 1. Writing parentheses, quotation marks, apostrophes, and square brackets.

Type number	Type	Number of Students
1	(x) "x" [x]	8
2	() "" []	4
3	(x) "x" []	1
4	() "x" []	1
5	(x) 'x' []	1
6	Mixed: (x) "x" [x] and () "" []	1
7	Mixed: (x) 'x' [x] and () " []	1

Students' style of writing brackets, etc., was the same from week to week and did not change significantly during either course. The order of writing is intuitive, and they probably do not think much about it. It was also examined whether students use quotation marks or apostrophes while programming. 15 out of 17 used mainly quotation marks. There were also quotation marks in the study materials. Generally speaking, the basic style of writing quotation marks or apostrophes was the same from week to week. Some students used apostrophes in specific contexts, even when their main style was to use quotation marks. One student, who usually used apostrophes, began writing in quotation marks while writing the final assignment and later corrected them into apostrophes. It could be an indication of plagiarism.

Also, it was examined whether or not the students used spaces in expressions. 1 out of 17 wrote without spaces, 2 used a mixed style, and 14 wrote mainly with spaces. However, while the use of spaces is not persistent, the student who systematically did not use spaces continued to write without spaces during the two courses. One student sometimes added a space between the function name and the following opening bracket. She did it somewhere every week, including in the final assignment of both courses. Also, it was noticed that study materials influence the use of spaces. Generally, spaces are used in study materials. There

are some examples in some chapters, where there are no spaces somewhere, and the same use of spaces was found in students' solutions.

In the following, the features that are more related to programming are analysed. For example, the writing of a print statement was considered. Most students used concatenation of strings in the print statement; only some of them used commas. In the course "Introduction to Programming", the results were as follows (including only the weeks with tasks using print statements): week 3 – student 2, 4, 6, 8; week 4 – student 4, 8; week 5 – student 4, 6, 8; week 6 – student 2, 4, 6; final assignment – student 4, 6, 8, 12. In the course "Introduction to Programming II", only some used commas: week 1 – student 4, 8, 12, 17; final assignment – student 4, 6, 8. Most students who used the alternative variant did so several times, but not every time. In the study materials, there is a print statement with concatenation of strings. One student previously preferred joining the strings, but used commas in the final assignment. When the logs were analysed, it was clear that he had a solution of a sample task with commas open during the programming. Based on this example, we can see that sample solutions also affect the style.

The use of variable names was also considered. Most students wrote multi-word variable names with a lowercase letter or used an underscore. The following students used capital letters in the middle of variable names: week 3 – student 5; week 4 – student 5; week 5 – student 5, 6, 9, week 6 – student 1, 3, 6, 9 (the 5th student did not upload logs and programs); final assignment – student 5, 9. In the course "Introduction to Programming II", only some used capital letters in the middle of variable names: week 2 – student 5; week 3 – student 8; final assignment – student 9. In the other weeks, no one used the alternative variant. Students varied the variants and using variable names was not persistent. Variable names are separated by underscores in the materials or several words are written together. In the materials of week 6, it is different: there, capital letters are used in the middle of a word in variable names. Students used the second style the most in week 6.

Next, the use of i += 1 vs i = i + 1 was studied. Students used both options. It was often the case that they tried one of these at first and then the other one. More use of i += 1 was observed towards the end of the course and during the second course (Table 2). The topic for the third week was a loop, and they used it then for the first time. The variant i = i + 1 is used at the beginning of the 3rd-week materials and then i += 1 is used in the following subsections. The 4th-week materials have i += 1, and the 5th-week and 6th-week materials also have i += 1. Comparing the student's choices with the materials, it can be said that the materials significantly influenced what choices students made in their programs.

The writing of the module import was also analysed. Most of the students used the variant shown in the examples in materials. For example, most students used the 'from random import *' style to import the 'random' module, not 'import random'. In week 3, students 6, 11, 17

used the alternative variant; nobody did it in week 6. In the second course, only the 2nd student used the alternative variant. Importing modules was only included in a few tasks. Therefore, no conclusions can be drawn about the permanence of module import writing.

Table 2. Use of i = i + 1 and i += 1.

Introduction to Programming			**Introduction to Programming II**		
Week	Style feature	Number of students	Week	Style feature	Number of students
Week 3	only i = i + 1	1	Week 1	only i = i + 1	0
	only i += 1	9		only i += 1	14
	both	7		both	3
Week 4	only i = i + 1	3	Week 2	only i = i + 1	2
	only i += 1	13		only i += 1	11
	both	1		both	1
Week 6	only i = i + 1	1		missing	3
	only i += 1	16	Final assignment	only i = i + 1	2
	both	0		only i += 1	15
Final assignment	only i = i + 1	1		both	0
	only i += 1	15			
	both	1			

To open the file, students mostly used the form 'file = open("data.txt", encoding = "UTF-8")'. The alternative option 'with open("data.txt") as file' was not used by anyone in week 4; in week 6 it was used by one student in one task. The same student used it throughout the second course, as well as in the final assignment. The form 'file = open("data.txt", encoding = "UTF-8")' is used in the study materials. The file opening form was also analysed in more detail (if the students added encoding or not or added, for example, ‘r’). It can be said that it varied from week to week, and the students did not do it the same way every time.

5. Conclusion

Based on the results, it can be said that non-programming style features are more permanent. They can be used to automatically check if a student has solved a task on their own. However, since some students belong to the same type, it is necessary to use various style features and combine them with, for example, the average time of typing digraphs, etc. The non-programming style features can also be combined with methods that check the similarity of the programs. However, the programming style features vary and change during the course. The students participating in introductory courses do not use programming style features in a persistent manner; it is significantly influenced by how these features are used in study materials. Final assignment solutions are also influenced by the solutions of sample exercises

that the students use while writing the program. Programming style features cannot be used to automatically check if a student has solved a task on their own.

It is important to further explore the style features with quantitative methods that help differentiate the students' programs and develop tools to help control possible plagiarism cases as, because of the current situation, there are more and more cases where students solve final assignment tasks at home and teachers cannot see who exactly solved the task. Finally, it should be noted that the main limitations of this study are the small sample and the length of the courses. It is possible that the results are not quite the same if the target group of the course is different or if it is not an introductory course.

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Expectations and outcomes: How technologies drive virtual teaching

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Abstract

We evaluate the effectiveness of using Zoom for learning Modern Physics topics in a large engineering physics class at a land-grant university in Texas. This virtual technology challenged both students and professors. By implementing different approaches: providing ahead of the lectures reading assignments, PowerPoint presentations, and pre-recorded videos, administering attendance mini-quizzes during the class and afterward, giving homework on WebAssign, elements of an effective virtual class setting complimented also by some asynchronous approaches were introduced. Passion and mutual understanding united students and instructors in active learning process helping to endure the challenging teaching environment. We describe the implementation of the technologies, the learning expectations and outcomes. The evaluation of outcomes was done in two ways: quantitatively, by statistical measures, and qualitatively, through an anonymous student survey and a university-wide teacher evaluation.

Keywords: *Zoom virtual teaching and learning; undergraduate engineering-physics class; student performance; surveys.*

1. Introduction

The COVID-19 pandemic in 2020 strongly affected or made impossible traditional classroom activities and forced the transition to methods relying more on modern communication technologies and remote learning, which is commonly labelled as e-learning. As disastrous as it is, this pandemic also motivates instructors to introduce novel teaching modalities, and embrace technological innovations (Popa et al.,2020; Anderton et al., 2021). The requirements of distance learning provide educators with an opportunity to explore new approaches as well as the merits and weaknesses of different aspects of e-learning.

Two modes of e-learning are distinguished: asynchronous and synchronous (O'Brien, 2020; Hrastinski, 2008). The first type is usually implemented with content available online for students to access at any time, and it commonly employs pre-recorded videos, email, and discussion boards. The second approach takes place in real time with a predetermined class schedule and required login times, but assignments must be completed by certain deadlines, and it uses a combination of videoconferencing and chat platforms (Zoom, WebEx, Skype, etc.). The commonly used in the literature term "virtual" learning refers to the synchronous approach, whereas another term "online" refers to asynchronous. The onset of the pandemic created conditions, which forced educators to urgently transition to e-learning methods of content delivery and interaction with students (Delgado,2021; Naciri et all., 2020). Such a transition put forward several challenges: (1) How to replicate the collaborative learning experience afforded by a physical classroom? (2) How to substitute physics demonstrations that relate theory with real world experiences? (3) How to encourage and maintain student engagement throughout the course?

In our teaching approach we used synchronous teaching delivering lectures and answering questions on Zoom, and we also used the asynchronous mode providing lecture recordings online and administering homework assignments with Webassign. Such a combination of the two approaches offered more flexibility to students for their optimal time management.The transition to online teaching requires relying on modern communication technology and providing study materials via the internet. In this paper, we describe the organization of the major components of the teaching process in a large public research-oriented institution, where undergraduate science lectures in physics are given for a class with hundreds of students. The final grades and the surveys conducted at the end of the semester show positive outcomes in the level of knowledge and problem-solving skills acquired by students as well as their overwhelming approval of the learning experience and the course as a whole.

2. Technology and Course Organization

Several aspects of the teaching process to which students pay particular attention (Blau, 2009) were addressed, and this determined the overall success of the course work. The course

extensively relied on the resources placed on the internet and various communication means (Zoom, Google forms, surveys, homework with WebAssign, eCampus exams, and the class webpage). The course website contained all information relevant to the course, starting with the syllabus and instructions and including also lecture presentations and recordings, a direct link to send questions to the lecturer, as well as links to internet materials that would illustrate and complement the topics discussed on the lectures. Google Forms were used for questions that students could ask any time, if they needed more detailed explanations. The course website also presented exam preparation instructions and a summary of the functions of the lockdown browser Respondus. The class interaction with students went through Zoom, and all the links were also integrated into Canvas and eCampus and allowed for efficient interaction between students and content, students and the professor, and among students. Canvas is a course management system and eCampus is the university supported learning management system. Homework was completed through Webassign (online instructional application for faculty and students, acquired by Cengage). The course Modern Physics covers relativity, models of the atom, an introduction to quantum mechanics, atomic physics, nuclear physics, and modern astrophysics. As a prerequisite, a student must have a working knowledge of geometry, algebra, calculus and be proficient in the use of vectors. This online course required students to be able to access the online course content, assuming usage of a computer and internet connection. In addition, to verify student identities during exams, a web camera was required. The students were supposed to achieve the following conceptual learning outcomes: (1) Understanding of the physical laws of the topics described above. (2) Learning about the historic context of the physical developments and their implications for science and technology today. (3) Learning to think critically/scientifically and developing the skills needed to attack complex problems.

Lectures were delivered online using Zoom video conferences. It was the students' responsibility to attend lectures regularly, and their attendance was monitored with short quizzes during the lectures, which also served to provide the feedback. In addition to the Google Forms, class interactions were performed through the use of breakout rooms, Zoom polls, and the raised hand/chat notifications that were available through the Zoom chat. The course TA was also available to answer student questions in real time through the Zoom chat. Because of the difficulty of having a dialogue in such a large class, especially since it was occurring virtually, live class question sheets were implemented. A Google form was opened before each lecture and students could submit questions they had about that day's material.

If the question was not answered in class, it was covered either in a personal email or at the start of the next class. Prerecorded video lectures have been uploaded to the class webpage. Their initial set was sequentially posted before each lecture and removed the day after the first exam. Then the next set covering the material of the second exam was available until the day after this exam. The posting of MP4 lecture videos continued in this way until the final

exam. While these lectures could be watched at any time when made available, they were not considered a substitute to class lectures, as they are prerecorded and did not allow the same level of interaction as a live lecture. While homework contributed "only" 15% to the grade, its importance for the learning success was highly emphasized. Exams generally consisted of problems similar in content and difficulty to the homework, and they included both multiple-choice and short free-response questions. Exams were open book and open notes, but students had to work independently, and seeking outside help from anyone or through answer services was not allowed. In order to proctor the exams remotely, especially with such a large class, exams were conducted only with the use of the Respondus LockDown Browser. This browser, unlike other more common web-browsers (such as Google Chrome, Edge, Firefox, etc.) opens only if all other applications on the computer are closed, and it does not allow any other programs to be opened during the exam. Additionally, Respondus makes use of the computer's camera and microphone ensuring that only the student himself is taking the exam without any outside help. Should any suspicious activity occur, Respondus flags it and records the activity for later review by the instructor. Respondus itself does not determine if violation of test protocols has occurred. At the conclusion of the course, students were asked to fill out an optional survey about their demographics and opinions on the course. This survey was conducted through a Google form emailed out to the students during the final two weeks of the course, and all information student provided was voluntary. One of the advantages of an online class was that even students with mild illness and those on quarantine could participate in the course-related activities remotely, not affecting other students.

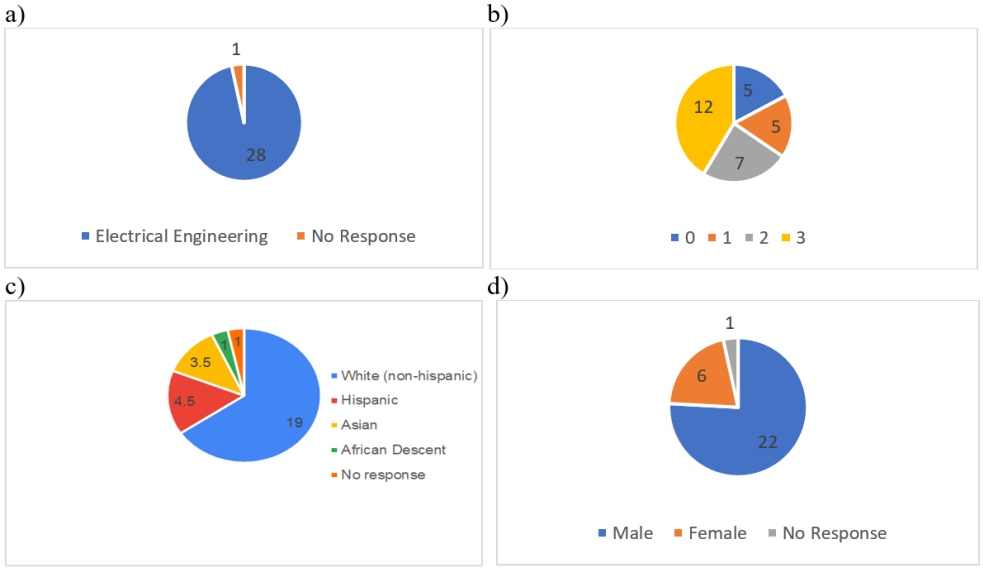

Figure 1. a) Breakdown of student majors. b) Time in years students have spent at Texas A&M. A response of 0 indicates first semester student. c) Breakdown of student ethnicity. d) Breakdown of student gender.

Table 1. Instructor's Survey. Questions and Student Responses.

Questions	Student Responses (n = 21), three select responses represented here.
Were the Zoom lectures a reasonable substitute for face-to-face teaching?	1. Yes, I think for the most part Zoom lectures were okay. The pre-recorded lectures were nice to have to go back to. 2. Yes, all of the information was provided by the slides. 3. To get material across yes, for an overall learning experience no.
Was the use of the lockdown browser and class attendance quizzes appropriate?	1. The lockdown browser feels the most questionable because of privacy concerns. 2. No. Since everything was open note, lockdown browser only posed as an extra hurdle which gave few students issues. A proctored zoom call could likely suffice. 3. Yes, it never felt overused.
Which aspects of the course facilitated your learning?	1. The homeworks and the lectures are where I gained most of my knowledge from. I think the Webassign homework is good. 2. The engagement of the class in chat and actual passion by the professor. 3. The practice quizzes on Cengage, the homeworks were very helpful for the test, and having class website really helped me feel organized in this class.
Which aspects of the course impeded your learning?	1. I wouldn't say any part of the course in the professor's control impeded my learning. 2. Nothing really. It was a good atmosphere to be in for me. 3. Some of the lectures were definitely hard to follow, because some slides were skipped and others were on screen for a long time.
What can be done to overcome any learning obstacles you experience in this course?	1. The professors thought because it's not in person we have more time to study the material, but I found that to be the exact opposite. 2. If anything, lab demonstrations, although over zoom it would be very difficult, unfortunately 3. I just need to study the material and do the quizzes more.
Were the posted video recordings helpful?	1. Yes, the recordings were beneficial, especially if I wasn't able to attend class. 2. I didn't look at any, because I always attended lectures and everything taught was on slides or was easily answered by the TA. 3. Yes, even though I only used them once.
Were the posted lecture PowerPoints helpful?	1. Yes, equally as beneficial as having the lectures recorded. 2. Very much so. 3. Very!

3. Evaluation and Outcomes

3.1. Survey on Student demographics, Suggestions and Comments for the Course

This survey conducted by the instructor was meant to give an overview of student demographics, opinions on how the course was conducted, and suggestions for improvements (see Table 1). A correlation between the extend students participated in class and their overall grade can be seen in Fig. 2. Students who participated often and earned a higher number of participation points tended to score better in the class overall. The larger amount of time spent on the homeworks led on average to higher grades (Fig. 3), however some of the students spent more time on the homeworks not achieving the highest grades (the right side of the graph).

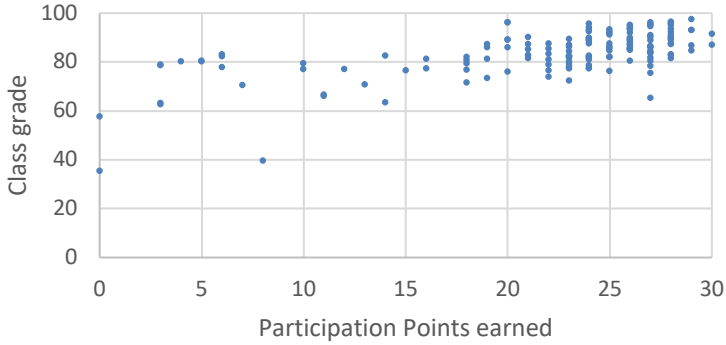

Figure 3. Student participation points vs the final grade earned in the class.

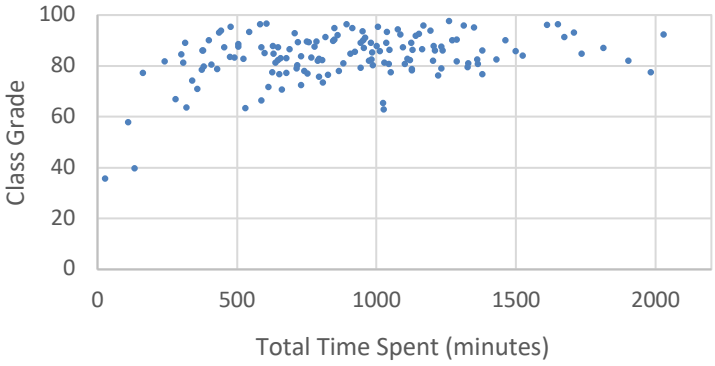

Figure 2. Time student spent on homework vs the final grade earned in the class.

3.4. University Student Course Evaluation

The use of student course evaluations can be a highly effective way to provide feedback to instructors about the student experience. This course evaluation invited students to contemplate on different aspects of the course and indicate what class preparation activities (e.g., readings, online modules, videos and assignments) were most helpful for them to learn the material and prepare for exams.

Table 2. University Survey: Student Course Evaluations.

Course Aspects	Student Evaluation Responses (n = 52), 3 select responses represented here.
Based on what the instructor(s) communicated, and the information provided in the course syllabus, I understood what was expected of me.	1. The professor and TA outlined exactly what was expected from us at the beginning of the semester, and this was very helpful. 2. The syllabus well explained the course outline, schedule, and main componets of the course. 3. I liked that I always could ask questions and get answers.
This course helped me learn concepts or skills as stated in course objectives/outcomes.	1. This course definitely helped me learn the concepts/skills. 2. The slideshows/lectures and practice problems were all very helpful in allowing me to reach the objectives of this course. 3. Very interesting subject matter.
Please rate the organization of this course.	1. Very well organized. All of the materials were located in the eCampus and were easy to find. 2. Everything was appropriately laid out from beginning to end with minor adjustments along the way that didn't disrupt the curriculum. 3. Clear due dates and layout of coursework. Course website was really helpful.
Feedback in this course helped me learn.	1. Feedback provided was extremely helpful. Both the professor and TA always encouraged us to ask questions, and were very clear in their responses to the class. 2. The TA was awesome. Professor was very caring and knowledgeable. 3.Feedback was given in attendance quizzes, indicating our understanding. Professor clearly explaned the problems during lecture.
The instructor fostered an effective learning environment.	1. Strongly agree. Professor was very passionate about his work. 2. The professor was engaging as an instructor and enjoyable to learn from. 3. Wonderful instructor. Very motivated and always wants to help his students.
The instructor encouraged students to take responsibility for their own learning.	1. Frequently encouraged. 2. He always recommended reading the chapters before lecture, and it helped. 3. Yes, you had to actually study to do well in the class.

In addition, in the discussions of the advantages and disadvantages of the virtual learning students mentioned the following positive aspects of this approach: (1) Online lectures help to attend late-night classes and with accessibility issues (e.g., bad weather, distant locations), saved a lot of time (no need to drive, find parking or walk). (2) Zoom has the chat and breakout rooms, making it possible to answer short questions in real-time. It is very convenient to have the professor and the TA offering office hours on Zoom – there is no need to rush around campus. (3) It is very helpful to have all lectures recorded, as one can go back and re-watch for deeper understanding. (4) The internet environment is more flexible and has helped to develop a better routine, but it requires good time management to avoid procrastination. However, some aspects were negative: (1) Students missed face-to-face communication and forming connections with peers and faculty. (2) Laboratory work, demonstrations, study on group projects were missing. Consequently, still more improvements are needed.

4. Summary and Outlook

Taking into account students' level of acquired knowledge, their grades and evaluations of this virtual course, we conclude that overall it was a success. Several aspects contributed to this positive outcome: (1) the course was well organized and all aspects of the course as well as the expectations were well described; (2) the course inherently had a modular structure; (3) questions-answers sessions, office hours, quizzes and e-mail messages allowed to realize an efficient feedback from the students, so the instructor and the TA could timely respond to the questions and address material misconception and misunderstandings.

In the future, we will explore several additions to the arsenal of our teaching methods. To take advantages of learning in a social context, which is commonly considered an effective approach to learning (Dunlap et al., 2009), learning in groups using breakout rooms in Zoom will be further investigated. Usage of smartphones as an educational tool also deserves some thorough consideration (Moradi et al., 2018). The lack of experimental demonstrations can be compensated by the introduction of software-based simulations and environment of augmented reality (Khan et al., 2020), especially taking into account fast development of cloud computing and the achievements in the fast data transfer that will be even more enhanced with the general adaptation of 5G networks.

Acknowledgments

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Sustainability and Communication in Higher Education

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Abstract

Sustainability Sciences need communication to communicate knowledge effectively and to engage audiences toward sustainable development. Therefore, the present study examines to what extent media and communication aspects are integrated into sustainability science curricula of higher education institutions in Europe. For this purpose, a total of n=1117 bachelor and master's degree programs and their related curricula/program specifications from 31 European countries were analyzed by means of content analysis. Results show that the level of curricular integration of media and communication aspects in the field of sustainability science is not (yet) far advanced (18%). This leaves room for a reflection on the perceived (ir-)relevance of communication as a crucial discipline and competence in the sustainability science area, as well as on the social and educational responsibility of higher education institutions.

Keywords: *Sustainability science; higher education; media and communication, third mission, sustainability communication.*

1. Introduction

In recent years, sustainability has increasingly occupied a prominent role in our society, developing from the buzzword of the last decade to a fundamental concept in finding a new balance between the ecosystem and society. Nonetheless, in observing current societies, it is evident that current paradigms, deeply anchored in our (economic and social) system, contribute rather to an unsustainable development. In this regard, education can play a decisive role. As historically demonstrated several times, universities and higher education institutions in general have driven social change both through scientific breakthroughs as well as through the opportunity to train and educate the next generation of intellectuals and future makers (Cortese, 2003). In terms of a comprehensive responsibility, universities must therefore recognize current, future, and socially relevant topics and include them in their teaching programs (Mintz & Tal, 2013). Consequently, if universities want to contribute to sustainability meaningfully, this relevant issue has to be integrated into their study programs (Tilbury, 2011).

As one of our time's most significant challenges, sustainability, sustainable development, and the achievement of the 17 Sustainable Development Goals (SDGs) seem to have already reached higher education, as the various range of so-called "Sustainable Science" study programs shows. Sustainability Science is defined as a transdisciplinary academic field that helps understand and contribute to solutions “for complex challenges that threaten the future of humanity and the integrity of the life support systems of the planet, such as climate change, biodiversity loss, pollution and land, and water degradation” (ESG, 2021), by integrating research from natural, engineering, medical, social sciences, and humanities. So, while it is clear that higher education institutions recognized the need for sustainability science education and fulfill this way their responsibilities in the sense of responsible science, as part of their “third mission”[1] it also becomes clear how dominant research modes are not enough to guide the societal transformation necessary to achieve the 2030 agenda (Messerli *et al*., 2019). Here the role of communication becomes particularly relevant since “knowledge alone does not motivate action” (Mullholland, 2019, p. 7). However, it is not just about the question of how scientists can communicate more effectively what they know, how they know it, and how sure they are of it (Hassol, 2008). Knowledge transfer or creating awareness through traditional and/or social media is just the initial part of it. Instead, communication is required to initiate a whole-of-society transformation process toward sustainable development. Indeed, communication has the ability to engage audiences, as "communication

[1] For a definition and further information, see, e.g., Zomer and Benneworth, 2011; Trencher *et al*., 2014; Pinheiro *et al*., 2015.

and behavior are linked, and behavior cannot change without communication" (Karmasin *et al*., 2021).

Against this background, the study at hand examines to what extent communication and media aspects are integrated into sustainability science curricula of European post-secondary institutions. Thus, *n= 117* bachelor and master degree programs and their related curricula from 31 European countries were analyzed by means of content analysis. Looking at curricula is relevant from a heuristic perspective and helps verify whether Humboldt's ideal model of education is maintained in tertiary education. The analysis also provides information on to what extent sustainability sciences have already recognized and integrated the need for effective communication in their teaching programs.

2. From Sustainable Development to Sustainability Science

The central role of higher education for the promotion of sustainable development was addressed and identified by the United Nations as early as 1972 at the "United Nations Conference on the Human Environment" (UNCHE) (UN Documents, 2020). This was followed by numerous other conferences and official documents that further emphasized this role, such as the "Belgrade Charter" 1975 (UNEP, 1975), the "Tbilisi Declaration" 1977 (UNESCO, 1977), the Brundtland Report – which particularly emphasizes the teacher's role (WCED, 1987) – and the Agenda 21 (UN 1992). More recent examples are the so-called "Ubuntu Declaration" 2002 (UN, 2002), the global plan of action "Education for sustainable development" 2005 (UNESCO, 2005), or the SDGs mentioned above (UN, 2015). However, the duty to (higher) education to contribute towards sustainable development did not only come as an attribution of responsibility from policy. Instead, there has been a significant increase in self-commitment since the 1990s, starting with the Talloires Declaration 1990 – the first official statement made by university presidents for incorporating sustainability in teaching and research (ULSF, 1990). All these (self-)commitment by higher-education institutions to support and promote sustainable development led to establishing the new research area of "Sustainability Sciences". However, communication's key role as a central process to optimize knowledge transfer, engage audiences, and initiate societal transformation processes toward sustainable development is even largely ignored here. This is the starting point of the presented study, aiming to analyze what role communication plays in sustainability science curricula.

The analysis of curricula as well as of curricular change processes are traditionally seen as an essential decision-making process in and for higher education management (see, e.g., Drake, 1998) since the curriculum is mainly perceived as an educational project that is developed in a specific historical, social and political context and has the ability to form identities. In addition, sustainability-related formal changes – such as curricular changes –

are considered to be more successful than informal, non-binding measures (Cortese, 2003). Furthermore, suppose we understand communication as a core dynamic of social behavior and consider the importance of communication – primarily through media – in the construction and communication of risks and crises and the attempts to achieve attitude and behavioral change. In that case, the investigation of how communication aspects are integrated into sustainability science curricula should be seen as essential.

3. Methodology

The presented study aims to analyze the extent to which media and communication aspects are integrated into the sustainability science curricula of post-secondary institutions in Europe.[2] To this purpose, we analyzed *n=1117* English-language bachelor and master degree programs and their related curricula/program specifications by means of content analysis. The sample results from a keyword search on the leading study choice platforms at the European level: For study programs on a bachelor level on www.bachelorsportal.eu, while for master degree programs on www.masterportal.com.[3] The keywords used to identify sustainability sciences study programs were chosen in line with the definition of the academic field mentioned above (see ESG, 2021): *sustain**, *environment**, *ecol**, *clima**, *natur**, *resource**, and *green*. As a result of this process, a total of *n=270* bachelor and *n=847* master study programs in the sustainability science's field in 31 European countries[4] were included in the sample.

To investigate to what extent communication aspects are integrated into sustainability science curricula, we also took a closer look at online content. We analyze the study program's description on the official website and the curriculum/program specification, including the detailed course descriptions through content analysis. For this purpose, we ran a second keyword search. The keywords used were: *media*, *communicat**, *journal**, *public relations*, *publish** and *report**. For each hit, the corresponding paragraph was analyzed by means of qualitative content analysis, following an inductive approach (Mayring, 2014), in order to understand the word in its context. The results are presented in the sext section.

[2] Europe refers here not to its political definition, i.e., a country's membership in the European Union, but Europe's geographical borders.

[3] Both platforms are affiliated with studyportals.com and provide information on more than 200,000 study programs offered by more than 3,750 educational institutions (studyportals, 2020).

[4] These are: Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, England, Estonia, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Nord Ireland, Norway, Poland, Portugal, Romania, Scotland, Slovenia, Spain, Sweden, Switzerland, Wales.

4. Results

The results show that the level of the integration of communication and media aspects in sustainability science's curricula is not (yet) far advanced. Out of a total of *n=1117* examined study programs and the associated curricula and/or module handbooks, communication and media aspects could only be found in *n=202*. That corresponds to 18.1%. The result of *n=202* relates to the presence of one of the keywords (media, communicat*, journal*, public relations, publish* and report*) either in the study program's description on the official institution website or in the related curriculum itself. However, in this context, a differentiation between study programs at the bachelor and master level has to be made. At a bachelor level, *n=270* study programs and related curricula were analyzed. Here the analysis identifies 85 curricula integrating communication and media aspects. This corresponds to about a third (31.8%). Therefore, the integration of media and communication aspects in sustainability sciences curricula is much more advanced at bachelor than at master level. Indeed, here the analysis identifies only *n=117* curricula integrating communication. To a total of *n=847* master's degree programs, this only corresponds to 13.8% (see Fig. 1).

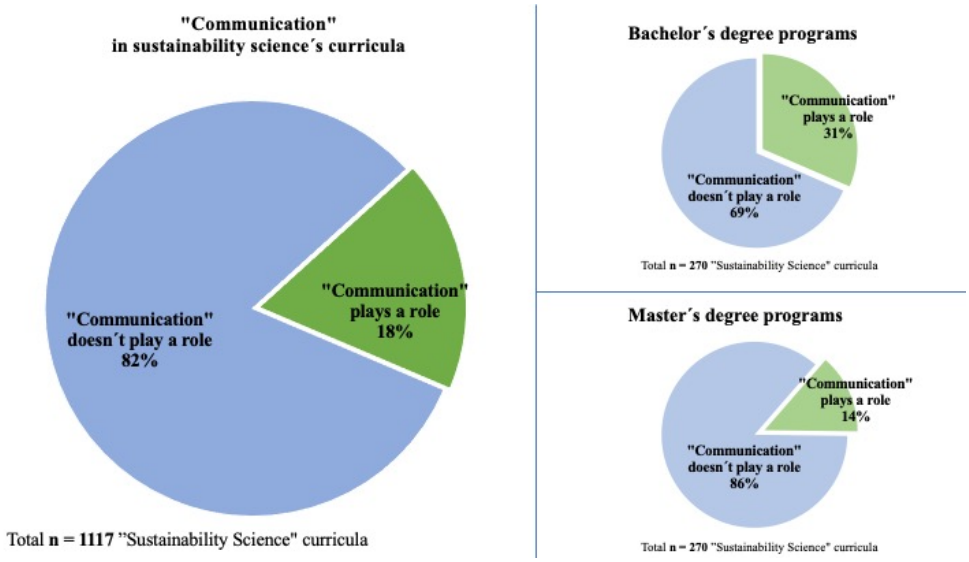

Figure 1. Communication and media aspects in sustainability science's curricula

It is noticeable that almost half of the study programs that integrate communication aspects can be assigned to the field of "Natural Sciences" (47%), while 20% of the study programs integrating communication aspects can be assigned to the area of "Social Sciences" and 16% to the area of "Engineering Sciences".

The aim of the present work is, however, is to investigate whether and to what extent communication and media aspects are integrated into higher education teaching. For this

purpose, the analysis was set one level lower, i.e., analyzing whether specific modules are dedicated to communication and/or media-related aspects. The analysis at module level shows that out of *n=202* study programs and related curricula that integrate sustainability issues, *n=119* (58,9%) also offer a total of 164 modules dedicated to communication and/or media aspects, of which 74 are offered at a bachelor and 90 at a master level.

Summarizing, this means: the analysis on a modular level reveals that the extent of the integration of communication and media aspects into higher education teaching of sustainability sciences study programs is equal to 10,6 % (Fig. 2).

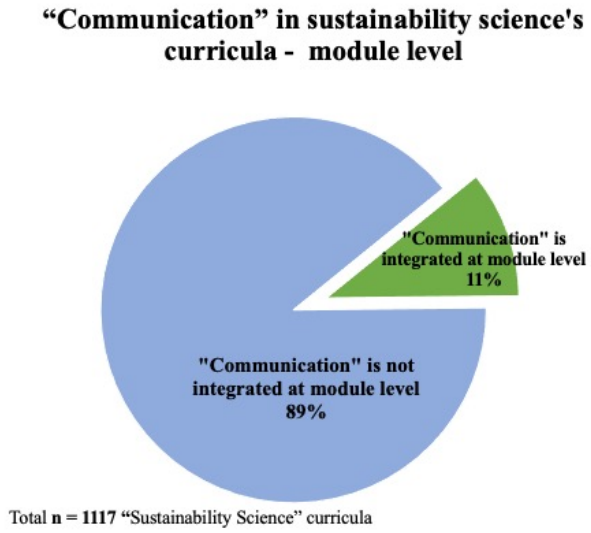

Figure 2. "Communication" in sustainability science's curricula-module level.

5. Discussion

The study at hand analyses the extent to which communication and media aspects are integrated into sustainability science curricula of European post-secondary institutions. The analysis reveals a relatively low (18%) degree of integration, which is further reduced at the module level (10,6%). The results can be interpreted as a confirmation of ignoring communication as a key discipline for and in the sustainability area, as practiced by policy and institutions in their action initiatives, as mentioned above (Chapter 2). However, a closer look at the data could also reveal a quite different picture. The integration of communication aspects is more advanced at the bachelor level (31.5%). So, if we assume that basic skills are imparted during a bachelor's degree, it can be said that communication is already recognized as fundamental competence in the sustainability science field of sustainability science, which enables studying at a master level. Of course, further and more specialized education in the

framework of master's degrees is desirable and needed since it can be assumed that students who have enjoyed a specialized education – i.e., those holding a master's degree – are more likely to be employed in leading positions, and thus have greater possibilities to engage audiences and stimulate a turnaround toward sustainable development in the near future.

The analysis shows that the journey in this direction will be a long one, though the results at the bachelor level are encouraging and suggest that the right direction has already been taken. Furthermore, the presented analysis should be understood as an opportunity to reflect on the conception of (media and) communication studies, especially regarding the discipline's attributed social relevance. (Media and) communication science has the potential to make a substantial contribution to the "third mission" of higher education institutions, in the sense of public outreach and responsible science, and needs to be positioned at the core of sustainability sciences. How the knowledge produced by sustainability science is communicated is as important as the content of that communication itself since communication can engage audiences so that they shift "from passive listeners to conscious actors of change" (Karmasin *et al*., 2021).

In conclusion, the authors are aware that not all teaching content is and can be displayed by curricula and program specifications. Nonetheless, the presented analysis should be seen as a first step to represent the status quo of the integration degree of communication and media aspects in sustainability science's curricula and highlight the related issues of a low integration level. Furthermore, the limitation of analyzing solely English-language curricula has to be pointed out. Further research in this area is needed in order to clarify whether this low integration level also occurs in "native-language" study programs.

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Learning sustainability by making games. The experience of a challenge as a novel approach for Education for Sustainable Development

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Abstract

Nowadays, the programs of Education for Sustainable Development (ESD) are designed for changing attitudes on environmental, economic, and social dimensions. In this context, and considering the varied ages of the participating students, it is necessary to implement appropriate pedagogical methods that are generally different from the traditional ones. Among the available approaches, Sustainability serious games (SSGs) appear to be an ideal candidate to facilitate ESD providing students with opportunities to experience the complex issues of sustainability. Besides learning by playing SSG, another relevant opportunity, capable of engaging teachers and students into a relevant and meaningful learning context, is learning by making SSGs, capable of engaging teachers and students into a relevant and meaningful learning context. In light of these comments, this paper proposes a major contribution to the research on learning by making games through a detailed discussion of the results obtained during a University Challenge experience, where students were involved in the design and development of SSGs. The Challenge involved 59 higher education (HE) students who were asked to work in groups to create a (per-group) prototype of a SSG aimed at improving the sustainability of our campus. Results of the Challenge assessment show that this learning approach can indeed be considered a valuable alternative for ESD.

Keywords: *Sustainability serious games; learning by making; sustainable development goals (SDG); education for sustainable development (ESD).*

1. Introduction

The concept of Sustainable Development (SD) is currently one of the goals of the world's policy agenda. For this purpose, in 2015, the Agenda 2030 defined 17 Sustainable Development Goals (SDGs) that are the blueprint for achieving a better and more sustainable future for the next generation. The concept of SD has thus been associated with environmental education to promote development models based on the wise use of resources that concerns economic, environmental, and social dimensions. Furthermore, it has become essential to convey behavioral changes to prioritize the Education for Sustainable Development (ESD) (Carteron, et al., 2014). ESD requires suitable pedagogical methods that are different from traditional teaching approaches since it should leverage collaborative problem-solving processes set in scenarios mimicking real-world issues eliciting the integration of diverse perspectives (Buckler and Creech, 2014). Among the available tools exploited in student-led learning experiences, Sustainability serious games (SSGs) appear to be an ideal candidate to facilitate ESD. SSGs can (i) engage players in problem-based transformative activities, (ii) promote exploration and critical analysis of events, things, relationships, and meanings in the game space, and (iii) foster collaborative decision-making and actions (Dieleman and Huisingh, 2006). SSGs help transfer knowledge while offering fun and entertainment among players, who eventually learn by doing (and failing), and offering shared experiences that promote collaboration and interdisciplinarity (Michael, 2006; Sawyer and Smith, 2008). While the educational effectiveness of SGs and SSGs is largely recognized in the literature (Al-Makhzoomy et al., 2020), one viable alternative to approach ESD through SSGs is turning the table, that is, making games for learning instead of playing games for learning. This approach stems from the constructionist theory applied to games (Papert and Harel, 1991) which builds upon Piaget's constructivist theory (Piaget, 2013). The general concept behind the idea of learning by making games is that the process of designing and creating games helps students to (i) improve their understanding of the subject matter, which needs to be broken down and analyzed in every detail to allow for the development of contextually appropriate game mechanics, (ii) construct new relationships with knowledge, (iii) express in more depth their ideas and feelings about the subject matter of the game, and (iv) develop collaborative (and creative) problem solving, which in the specific context of ESD has concrete benefits in terms of learning (Ke, 2014; Earp, 2015; Mercer et al., 2016). Nevertheless, while there is a certain degree of evidence pointing to the effectiveness of learning by making games (Kafai & Burke, 2015), sound empirical evidence is still lacking. This learning approach has primarily been exploited with kindergarten-to-12th grade (K12) students, whereas very few examples can be found for HE students. Moreover, although SSGs are widely adopted, to the best of our knowledge, examples of learning by making games for ESD are still lacking. Finally, the average length of these activities is mainly short in time, whereas complex topics, as ESD, might benefit from long

interventions to solicit more significant knowledge sedimentation. This work contributes to the state-of-the-art by presenting and assessing an educational experience where HE students were challenged to design and develop SSGs over three months. We assessed the Challenge experience through a post-experience questionnaire and structured interviews on nearly all the 59 students involved. Results show that students evaluated the challenge as an effective learning and motivating experience, fostering 21st-century skills like collaboration and communication. Finally, we believe our findings could guide future practitioners who wish to propose an ESD intervention in a learning-by-making fashion.

2. Related works

According to the literature, the primary goal of learning through game creation is programming (Denner et al., 2012, Al-Makhzoomy et al., 2020). The main reason can be found in the strong links that already exist between coding and digital game creation, where the use of language programs in implementing the game behavior and logic is a key element of game development. In this way, creating a captivating and engaging artefact (a digital game) is the main motivation that fosters students to acquire the first rudiments, or more advanced skills, of programming. However, in education for coding, the focus of learning-by-making is not on the game's subject but on the process of creating it. On the contrary, recent research explores the use of SG making to transfer knowledge about the specific topic addressed by (or the specific scenario involved in) the game. As for ESD, to the best of our knowledge, the only work proposing a learning-by-making approach is (Mercer et al., 2016), which demonstrates that the application of this method in the specific domain of ESD is almost unexplored. Concerning the assessment of the effectiveness of learning-by-making game approaches (in terms of learning outcomes), most authors could not find quantitative data demonstrating learning outcomes on the specific topics the interventions focused on, mainly due to the difficulty of evaluating learning effects (Garneli et al., 2013). However, through qualitative evaluation of the studies (conducted through interviews, questionnaires, and video recordings' analysis), researchers observed that learning through making games supported the development of 21st-century skills, such as creativity, innovation, communication, collaboration, critical thinking, and problem-solving. Furthermore, most of the students involved in these educational activities expressed high levels of engagement and, above all, manifested their strong interest in being able to repeat similar activities. As pointed out by several authors (Kafai and Burke, 2015), one of the drawbacks of current approaches to learning by making games, regardless of their scope, is that they primarily target K12 students in extracurricular activities, such as summer camps and after-school clubs. In contrast, far fewer examples can be found in higher education and almost none that target an adult audience (Earp, 2015). This fact is quite surprising, especially when compared to the

field of learning by playing games, where SG and gamified activities are generally directed at all age groups.

3. The challenge

From the academic year 2014/15, the Politecnico di Torino has started an educational program known as "The Path for Emerging Talents" to develop the potentials of promising students selected because of specific merit requirements. The Path for Emerging Talents has also become a field of experimentation for innovative educational initiatives that will complement traditional study plans. In the academic year 2019/2020, one of these educational initiatives has been envisioned as a challenge in which students were asked to develop a SG prototype focused on raising awareness on sustainability-related themes. In this regard, the Challenge's premise is that students' role as developers of SGs, would enable them to become active participants in the overarching learning activity. The final SGs could be either digital or physical (tabletop) and feature either single or multiplayer mechanics. However, all SGs were required to (i) promote sustainability within the Politecnico di Torino (ii) focus on at least 2 SDGs (iii) involve all the sustainability dimensions (i.e., social, environmental, economic) (iv) provide a minimal gameplay length of 30 minutes and (v) investigate the interconnections between different SDGs. In the end, the expected outcome is to make participants more aware of sustainability themes through a constructionist approach.

3.1. Organization

The Challenge took place from March 10th to June 12th, 2020. During this period, students attended teaching activities delivered by university professors and tutoring sessions guided by a team of four tutors, composed of industry professionals and Ph.D. students with a solid background on the Challenge's topics. It is also important to note that the Challenge was planned as a regular face-to-face teaching activity, but with the outbreak of the pandemic and the hard lockdown in Italy, the whole course had to be held online. In total, 59 students, divided into eight teams, attended the Challenge. The teams' composition was based on information gathered from a questionnaire submitted a couple of weeks before the Challenge's launch. Participants were asked to self-evaluate their technical and practical skills related to areas of expertise relevant to developing a SG.

The Challenge was divided into three main phases: (i) Preparatory and Design, (ii) Development, and (iii) Playtesting and Finalization. Each phase ended up with submitting specific assignments, assessed by the professors, whereas tutors monitored the in-phase advancements through a set of weekly day-long sessions. The Preparatory phase's first step was introducing the Challenge and presenting the requirements for the final SGs. To promote team-building, encouraging students to meet and interact with the different team members (students did not know each other before the Challenge), we asked them to play Fate of the

World collaboratively. In this game, players are in charge of a fictional international organization and must manage social, technological, and environmental policies. The playing session also introduced the first game design and game development lectures, which were then deepened throughout the following weeks.

In the following weeks, students attended lectures to acquire all the funding knowledge required to develop a sustainability SG. Moreover, during this first phase, students were supervised by the tutors in brainstorming and design sessions aimed at defining a game concept which students eventually pitched to the professors' board.

In the Development phase, students focused on creating a working game prototype (Minimum Viable Product, MVP) inclusive of the main mechanics and technologies. Students had completed all the lecturing activities, and during this phase, they mainly met with the tutors, which helped adjust and refine their MVPs. Once professors assessed the MVPs, students started the final phase (Playtesting and Finalization). They focused on improving the prototypes based on feedback received during playtesting sessions and from a revision session with the ETH Game Technology Center (GTC). This phase's final step has been the definition of a simplified "Production Plan" to make students reflect on the resources required to finalize their prototype into a commercial product. The final delivery was organized as a two-day activity. On the first day, four professors and four tutors played each SG for at least 45 minutes. They filled an evaluation questionnaire to assess the games' requirements fulfillment and overall playability at the end of each play session. On the second day, each team presented their SG to a board composed of the teaching professors and the Green Team, a university group in charge of promoting sustainable practices for the campus. We eventually prepared a leaderboard of the teams combining the audience votes, on a scale from 1 to 5, with the day one questionnaire. It must be noted that, before the pandemic situation erupted, the final presentation was envisioned as a physical exhibition composed of stands equipped with gaming stations where any visitors (students of the university, members of the other teams, teachers/tutors) could test the different SGs. The visitors would have been equipped with an evaluation card to evaluate at least two games.

Among the eight final SSGs, 7 are table games, and 1 is a smartphone app. The winners of the challenge were 4. “Patent” (1st place) is a cooperative game where players are the main characters of the sustainable transition and have to obtain more sustainable points as fast as possible by the end of the game. “Polinks” (2nd place) is a competitive card game developed to establish links and connections among different actions workable for the campus. “iPolito” (3rd place) aims to transmit knowledge on SD areas through the interactions among the cards in which wins who first reaches his game-objective. “4…3…2…1…Sustainability” (3rd place ex-aequo) is a challenging board game where players have to invest money and limited resources in sustainable projects within the campus.

4. Challenge assessment

Our assessment's objective was to qualitatively assess the students' experience and appreciation with this alternative form of ESD intervention. At the end of the Challenge, we submitted a questionnaire to all the 59 students and conducted structured interviews on a smaller sample (n = 32). In the following sections, we first describe the questionnaire's details and finally present and discuss the results.

4.1. Data Collection

The post-experience questionnaire was composed of 68 items, organized into four main parts, and formed of both open questions and statements to which participants had to express their agreement using a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). The first part aimed to collect information on students' habits and knowledge with playing and making games digital or non-digital. The second part focused on assessing the Challenge experience according to three sub-scales, evaluating three dimensions: (i) Teamwork, i.e., the effects on teamwork abilities fostered by the Challenge, (ii) Learnability, i.e., the self-assessed learning effectiveness, and (iii) Likeability to Repeat, i.e., the likeability of students to repeat a similar experience. In this part, we also asked students to self-evaluate their knowledge of sustainability themes according to Environment, Economic, and Social macro-dimensions using the same questions proposed in the initial questionnaire students had to fill at the start of the Challenge. In the third part, we examined the Challenge's phases (Section 3.1) to identify practices commonly adopted by groups and highlight students' main difficulties. Finally, in the last part, we gathered students' personal information (e.g., gender, age, the field of studies). The proposed questions have been either adapted from questionnaires used in similar activities (Hava et al., 2020, V. Garneli et al., 2017) or newly formulated to account for our particular investigation needs. Descriptive and inferential statistical methods were used to analyze the collected data. For frequency analyses, responses 4 and 5 on the Likert scales were aggregated to indicate agreement or positive viewpoints. Finally, to give a more precise explanation of the questionnaire's results, we conducted structured interviews with 32 students.

4.2. Results and Discussion

Nearly all students completed the questionnaire (56 out of 59), 93% were male, aged 21-22, and were evenly divided between those who frequently play digital games (47%) and those who do less frequently (53%). Only 12% reported playing non-digital games regularly, and 37% stated having had experience playing SGs, primarily in an academic context (e.g., high school or university). Also, students were mainly at their first experience (75%) with making games. The majority of students (61%) positively evaluated the learning effects solicited by the Challenge (i.e., Learnability sub-scale) alongside 65% of all respondents who stated

improved teamwork abilities fostered by this experience (i.e., Teamwork sub-scale). Unfortunately, only 37% expressed their likeability in repeating a similar experience in the future (i.e., Likeability to Repeat sub-scale). However, we detected a high correlation (r=0.76) between the Learnability and the Likeability to Repeat sub-scale, suggesting that this result was not caused by the Challenge's learning experience. This finding is important because it highlights the positive impact on learning of a similar activity (i.e., learning by making SGs) and shifts the focus on what did not work onto something else. What has emerged from the interviews is that students negatively assessed the Likeability to Repeat sub-scale due to the difficulties they faced at the beginning of the Challenge, mainly during the design phase (64% of students). As they reported, these difficulties were primarily caused by the current pandemic situation, which forced students to work remotely without ever having the chance to meet in person (and they had also never met before). According to the students' feedback, this limitation compromised their ability to establish a positive bond, resulting in an initial lack of group work commitment that jeopardized the brainstorming and initial design stages. Based on past group work experiences, most students agreed that carrying out similar activities in person could help surpass these issues. It should also be noted that students were able to overcome most difficulties once the game was designed and the development started. As a result, a significantly lower percentage (39%) of students declared having faced problems during this stage.

Furthermore, positive learning effects were also detected from the questionnaire items requiring students to self-evaluate their knowledge across the three sustainability dimensions (i.e., Environment, Economic, and Social). To compare statistical significance differences with the same questions submitted at the beginning of the Challenge, we performed a Mann-Whitney U test. We obtained significance across all dimensions as follows: Environment (alpha = 0.04), Economic (alpha = 1.1e-08) and Social (alpha=0.000105). Also, we detected an improvement for each dimension with different effect sizes (Cohen d) as follows: Environment small (d=0.358), Economic large (d=1.189), and Social medium (d=0.761). These results show a positive and detectable influence solicited by the Challenge. Through interviews, students highlighted that the economic sustainability dimension was the less mastered one at the beginning of the Challenge. Thus, the greater impact (i.e., larger effect size) detected might be attributed to knowledge acquired solicited by the requirement of producing an accurate and sustainable business plan for the production of the developed game.

Finally, we evaluated statistical differences across different groups for the overall sub-scale items (i.e., Learnability, Teamwork, and Likeability to Repeat) and the Sustainability Dimensions Knowledge (derived from the background information obtained from questionnaire). We analyzed statistical differences either with a standardized T-Test or a Mann-Mann-Whitney U test based on the normality or non-normality of the sample

(measured through a Shapiro Wilk test). All these subscales showed no statistical difference (alpha > 0.05) between users who had a different experience and familiarity with either playing digital-games or SGs (digital and non-digital). This finding is promising because it shows that the positive outcomes of this learning experience yield no difference regarding the student's background experience with playing and making games.

5. Conclusion

This paper describes a novel approach to ESD where we challenged university-level students in developing SSGs as a learning activity. This approach stems from the emerging and, yet entirely unexplored, paradigm of learning by making SG instead of merely learning by playing them. Organized in groups for three months, 59 students designed and developed digital and non-digital SSGs to raise awareness on sustainability-related themes within their university campus. Through a post-experience questionnaire and structured interviews, we qualitatively assessed the students' experience. Results show that students positively assessed the learning effect and their improved teamwork abilities solicited by the activity. Moreover, students' self-evaluation across the three sustainability macro dimensions (i.e., economic, social, and environmental) increased between the start and the end of the Challenge. Interestingly, all the positive effects measured in the questionnaire yielded no difference between students who had previous knowledge of playing or making games. Finally, although their likeability to repeat a similar experience was low, this was mainly due to the unique Covid-19 lockdown we faced in Italy throughout the entire length of the challenge, forcing students to work and collaborate entirely remotely. Future works will address the collection and analysis of qualitative and quantitative data to assess the developed SSGs' effectiveness through play sessions with other HE students.

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Teaching sustainability: How to visualize and change CO2 emissions and corresponding habits?

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Abstract

Teaching sustainability presents challenges due to the inherent complexity and required behavioral change. A special pedagogical approach is needed. In this paper, we focus on the research question how students' awareness of sustainability issues can be improved significantly in a brief workshop. The presented workshop let the students autonomously addressing problems and possible solutions in small groups – with no patented recipes given, nor any "finger-pointing" from the outside. The educational basis for this workshop is the concept of discovery learning in combination with sketchnoting. This is especially appropriate to present acquired knowledge in a compact and meaningful way, to show relationships and allow schemas to be developed by the participants. This paper also describes the workshop results from several executions and the lessons learned.

Keywords: *Sustainability; CO2 emission reduction; discovery learning; visualization; sketchnoting.*

1. Introduction

The world is going through numerous ecological crises that will significantly affect the economy and society in the future. Companies can no longer be efficiency-oriented, short-term and reactive, but must solve this situation with proactive, future-oriented and sustainable products and services. The Green Agenda is increasingly challenging companies and politicians, who do not have a sufficient concept (Lema *et al* 2020). Unfortunately, only a part of the students is aware of this situation.

How big is my personal ecological footprint? How much CO2 do I produce per year? And how is this CO2 generated by my current lifestyle? Participants in the uCORE workshop (derived from understand CO2 emissions' Reduction and Elimination) will be able to answer these questions individually after this workshop. But calculating the individual footprint is not the end of the story at this workshop: How can each individual contribute to active environmental and climate protection with very concrete, individual measures? The main objective of the workshop is to encourage participants to address this question.

The workshop was initiated by several professors at the University of Applied Sciences Munich in order to

- to move from a transfer of knowledge by the lecturer to the participants' own examination of the topic and in this way to increase motivation and knowledge,
- to anchor climate change as an important social issue in the minds of the participants,
- to fulfill our educational mandate and the initiatives for a Green Economy,
- to support the efforts of the Munich University of Applied Sciences for an active sustainability initiative.

In this paper, we focus on the research question how students' awareness of sustainability issues can improve significantly in a brief workshop. In the following, we explain the design principles behind the workshop and the pedagogical concept. Then we present results from several executions of the workshop as well as lessons learned and an outlook with future steps.

2. Related work

The authors Scarff & Ceulemans (2017) consider the field of teaching sustainability with a "transformative pedagogy required for learning". For this, on the one hand, awareness of the topic of sustainability must be improved; on the other hand, appropriate pedagogical approaches must be used. Segalàs *et al.* (2012) demand "the reorientation of the pedagogy and the learning processes is a must". Wooltorton (2002) also argues that sustainability requires different learning as transformation becomes necessary. According to Segalàs *et al*.

(2010), the reasons are often that students see little relevance in their social and attitudinal aspects. Therefore, Myers & Beringer (2010) suggests that sustainability should be taught in more community-oriented and constructive, active-learning pedagogical approaches. Segalàs *et al*. (2012) also states that for students the penetration of the complexity of sustainability is often very low. Lourdel, Martin, and Bererd (2006) even write that "students distancing themselves from the problem". Traditional teaching methods are described as inadequate and "leads to low yields in information retention and to decreased student attention" (Scarff & Ceulemans 2017). But alternative approaches are neither new nor undesirable, yet not used widely. However, their use depends on the pedagogical and educational goals and the situation (De Freitas & Oliver 2006).

3. Pedagogical concept

The educational basis for this workshop is the concept of discovery learning in combination with sketchnoting. The idea of discovery learning goes back to the psychologist Jerome Bruner (1961) and is based on the insight that knowledge is built up through the learner's own discovery and activity. According to Gücker *et al*. (2003), in discovery learning, the learner "uses his or her prior knowledge to search for new facts and relationships and to organize them with a view to finding a solution." Discovery learning is usually assigned to constructivist learning theory (Schunk 2014).

The workshop contains a sequence of mini-projects, so-called assignment, which the students work self-paced in teams of three. Each assignment begins with a description of the overall context and then poses specific questions that need to be answered. For this aim, there are defined solution steps, which ask the participants to discuss facts in the group and to search for information on the Internet. As an introduction to the analysis, some websites, e.g., for calculating one's own CO2 consumption are provided directly. Further research to answer the follow up questions is left to the participants themselves. The cooperation within the student teams and the independent research also promotes the active, self-regulated, emotional and social dimension of a constructivist learning approach (Reinmann-Rothmeier *et al*. 2001).

In order to summarize the findings from the discussion and research in the assignments, the participants should create posters by using sketchnoting. The presentation with sketchnotes is particularly appropriate to present acquired knowledge in a compact and meaningful way and to keep it well in mind (Sykula 2019). Notes, drawings, or diagrams are examples of visual representations that can be used to structure information. Visual notes can also show relationships and allow schemas to be developed by participants (Saunders *et al*. 1995) (Fig. 1). During the first execution of the workshop, to enhance the sketchnoting skills of the participants, a guest lecturer specializing in sketchnoting was included. He provided the basic knowledge necessary to develop advanced sketchnotes (see Fig. 1, bottom right).

Figure 1: Impressions from different implementations of the uCORE workshop

After the functional introduction and instructions for visualization, the participants are guided to individual emissions and reduction possibilities. The following details deepen several aspects such as heating resp. cooling buildings or electricity. In the overarching view, the individual perspective is left behind to discuss the level of industry, politics and energy production.

4. Principles of the workshop

The workshop can be used without prior knowledge and with participants from all disciplines to teach environmental and climate topics in a practical and engaging way. No special equipment, facilities or time-consuming preparations are required. The workshop components fulfill exactly these characteristics:

- The workshop is divided into 15 mini-projects (the assignments): Depending on the time budget (between two and six hours), a selection of the assignments can be used.
- The individual assignments are worked on largely independently by student teams of about three participants each, with the help of the documents provided. The teacher assumes the role of a coach without interfering in the team process.
- In addition to teamwork, discussions and internet research, visualization by means of sketchnoting is learned and applied. Even without special painting skills or

previous design knowledge, informative, convincing results are created in the form of posters. In addition, participants receive helpful tips and tricks as well as sketch ideas for various things, such as airplanes, animals, etc. (Fig. 2). After the first successful presentations of the sketchnoting principles in person by the professional visualizer, he recorded his core points into a 15-minute video, which is now used for further workshop executions.

– Lecturers can use the workshop as a "ready-to-use package" (with assignment, etc.). The further development of the workshop takes place within the community.

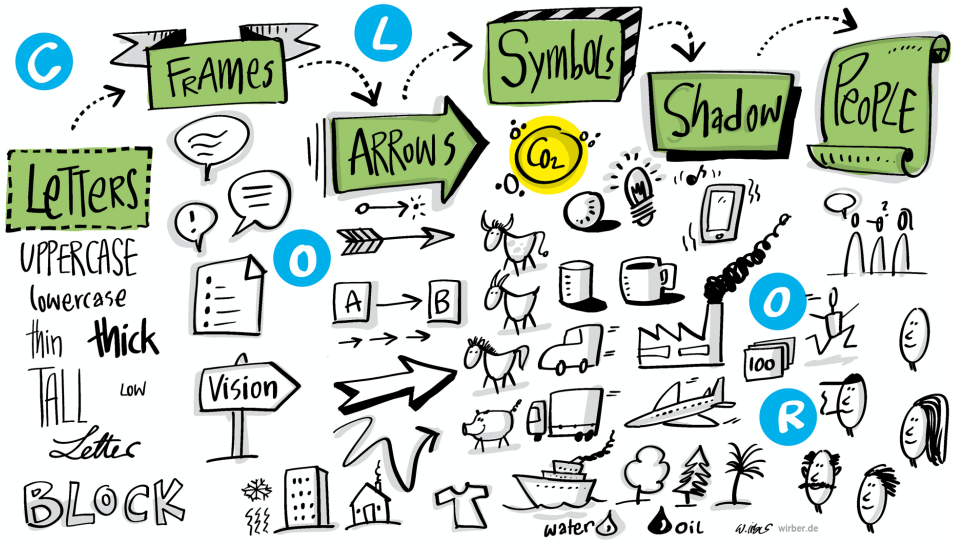

Figure 2: Suggestions for Visualization of Objects for the Participants (created by a Professional Visualizer)

In the course of the workshop, the participants develop an understanding of the CO2 emissions they generate and their effects. In the next step, ideas for solutions to reduce and avoid CO2 emissions are derived and evaluated in terms of impact and feasibility. A particular focus is on ensuring that participants develop an understanding of the relevant orders of magnitude and are thus able to appropriately classify individual challenges and proposed solutions. Rarely participants can relate 5,000 kilometers driven (in a car with an internal combustion engine) to a flight to the USA or heating their home.

By autonomously addressing problems and possible solutions in small groups, no patented recipes are given, nor is there any "finger-pointing" from the outside. By working on the assignments, the participants gain insights, which in turn lead to changing their own habits. In addition to one's own private environment, this topic is also becoming increasingly important in the professional world. For this reason, the workshop will also develop solution ideas for companies as well as the influence that politics can have. Equipped with this

knowledge, participants will not only be able to reduce their ecological footprint in the future, but also to convince others to adopt a more climate-conscious lifestyle.

5. Workshop results

5.1 Integration into a course

The workshop was deliberately designed to be modular and not tailored to one discipline so that it can be used in different application scenarios and for different student groups. The following is an example in the field of business administration of how it can be integrated into a course: Participants in a course on process management and optimization are advised that in addition aiming for "time reduction" and "quality increase", there are also ecological aspects such as "environmental compatibility", e.g. in terms of CO2 emissions, to be considered. For this purpose, a 3-hour version of the workshop is used at the beginning of the semester to increase the sensitivity of the participants with regard to that topic. Later in the semester points from the workshop are deepened. The integration into a course has to be adopted individually by each lecturer so that the participants see the relevance for the respective subject area and do not perceive the workshop as a useless "add-on".

5.2 Perceived benefits

Lecturers benefit from the possibility to integrate directly usable assignments into their courses ("ready to use"). Due to the modular design of the workshop, interested lecturers can vary the length of the workshop with little effort and thus integrate it into their course - a change of the curriculum or the examination regulations is normally not necessary. One lecturer can supervise up to 50 participants (in teams of three to a maximum of five participants) as a coach. Participants do not need any prior knowledge for the assignments. The workshop is interactive; participants can apply what they have learned directly or learn as they apply it. The step-by-step instructions deliberately leave many questions open for the teams to discuss together. In doing so, hurdles towards the topic are reduced ("I can't do anything anyway" or "the others have to start"). In addition to the technical input, other competencies such as teamwork, self-reflection, willingness to change and problem solving are practiced. The necessary equipment is deliberately kept to a minimum (flipchart, pen, computer/smartphone with Internet access), or is brought along by the participants themselves. An existing (flexible) seminar room can be converted into a suitable learning room in a few minutes and the equipment can be prepared. Alternatively, the workshop can be set up online using a communication platform with breakout rooms and a cloud platform for graphical documentation.

5.3 Lessons learned during development and implementation

In the preparation of the workshop, it became clear that the existing sources of information are either very scientifically in-depth and geared to a partial focus or are based on "popular sources" that lack a balanced basis for consideration and must rather be described as polarizing. Also, the "raised finger" for or against behavior change often stands in the way of the possibility of self-knowledge through rational discussion. Recognizing that the complexity, scope and different ways of looking at the issue do not allow for an all-encompassing consideration, the workshop therefore focuses "only" on the CO2 consideration and deliberately excludes other points of view. Nevertheless, it also became apparent during the creation of the workshop that one's own behavior with regard to power generation, power consumption, sensible or senseless journeys or also conference visits should be questioned.

The workshop can be conducted in different variants onsite or virtual and in various durations. Experience has already been gained with several variants. The concept of discovery learning usually leads to an "aha effect" in terms of the content. Due to research and discussion, connections are quickly recognized and new knowledge is built up. The task of graphically processing the findings and presenting them in the form of a sketchnoting poster promotes creativity and cooperation in the group.

In the positive feedback of the participating students the awareness building is explicitly emphasized. Furthermore, the building of the sketchnoting skills - especially in combination with the awareness building, is listed. Finally, enabling interactivity was mentioned. It was also noted as a need for improvement that other tools for CO2 calculation or sketchnoting could be tried out. Furthermore, there was a suggestion that sketchnoting education should be facilitated in advance of the workshop

6. Next steps

The positive response of the participants is to be measured in further rounds by questionnaires, especially with regard to the success of the content. A survey before and directly after the event - in particular on planned behavioral changes - is planned. The existing assignments will also be further developed by the community in terms of content. Interested lecturers or developers for further content can contact us at any time for free access to the documents.

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A self-evaluation tool of sustainability concepts in higher education institutions courses

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Abstract

In this paper, a self-evaluation tool is developed to allow educators and Higher Education Institutions to assess their efforts in pursuing Education for Sustainable Development. The composite index (which create a representation of a sector performance) here proposed allows the individual components that contribute to the pursuit of sustainability in education to be grasped in isolation and, at the same time, provides an overall evaluation measure of all the elements taken into consideration. The index is based on the identification of elements that measure the efficiency of the allocated expenditure. At the same time, it encompasses measures of the impact and perception of sustainability concept by staff and students. Albeit in a laborious way, the application of the tool leads to an assessment of education for sustainable development results. This composite indicator can be used in a replicative manner elsewhere and offers the advantage of being able to carry out comparative evaluative analyses. This is due to its adaptive flexibility.

Keywords: *Sustainability; higher education institutions; evaluation; measure; criteria; education for sustainable development.*

1. Introduction

The growing sensitivity towards the issues of well-being, sustainability and social responsibility stimulates the production of statistics and analyses useful for evaluating their features and trends. Nevertheless, none structured and shared systems of evaluation has been developed so far by scientific literature. At the level of statistical data collection, experimental projects have been launched to collect information directly from the subjects involved and produce some indicators on the diffusion of the orientation towards sustainability in education and training (Boer, 2013; Alghamdi *et al*., 2017; Boeve-de Pauw & Van Petegem, 2018). The goal of these instruments is to increase the information available to users and evaluators, exploiting the existing information and designing new information sources based on adequate experimentation (Patterson *et al*., 2020). Nevertheless, a tool that enables the qualitative and quantitative classification and analysis of Higher Education Institutions' (HEIs) CSR-/sustainability related courses is still lacking. We believe that it is essential to raise the next generation into eco-conscious, self-sufficient world citizens who understand the immediacy of environmental responsibility. We filled this gap by developing a self-evaluation tool that provides an overall assessment of higher education courses and takes into account both course and institution level criteria. The tool can be employed by any HEI, as well as by Universities, already integrating or interested in integrating sustainability and/or CSR issues into teaching. The self-evaluation tool could also be of special interest for institutions promoting responsible management education. Anyway, the tool proposed here will be further developed to supply different solutions according to the type of institutions and aspects that need to be investigated. Concrete applications will be presented in the near future.

In the first part of this article, we briefly propose a literature framework related to the sustainable measurement and consideration in evaluation exercise. Then, a composite index is presented as a novel contribution in the self-evaluation context of higher education institutions. Concluding remarks are included in the final part of this paper.

2. Literature framework

Although relevant differences in approaches, the current literature on sustainability applied to learning and education, considered as a measure or an indicator of social, economic, and environmental paradigm, is growing in terms of original contributions. Qualitative and quantitative approaches have been followed so far. The most relevant of them are briefly reviewed afterward.

2.1. Qualitative approaches

Filho et al., 2018, Kankovskaya, 2016, and Ojala, 2017 point out that in order to include sustainable teaching concepts in HEIs policies, existential, emotional, cognitive, and action components need to be taken into account. Furthermore, it is important to assume that a more holistic integration of sustainable development principles in the different university functions leads to a higher awareness of the role played by different university actors, fostering cultural and transformational shifts to their learning frameworks and visions related to sustainable development (Katsoulakos & Yannis Katsoulacos, 2007; Singer-Brodowski et al., 2019). Since a large variation in perceptions of sustainability is to be expected, flexibility, continuous training and routines provides essential opportunities for integration (Sammalisto et al*.,* 2015). Niedlich *et al*., 2019 remarked the importance of soft elements like organisational culture, responsibility for sustainable development and behavioral change. Ultimately, the need to formulate principles for the national innovation system based on the concept of sustainability is underlined in several studies (Waples *et al*., 2008; Kemper *et al*., 2019, to cite only a few).

2.2. Quantitative approaches

Bask *et al*. (2020), Vargas, V.R. *et al*. (2019), de Gaulmynn & Dupre (2019), propose an innovative quantitative evaluation of the sustainable performance of student projects throughout their design processes. They suggest how to change organizational processes by integrating sustainable development in different areas of education. The analytical techniques they proposed were coding, stakeholder centrality, and network density measures focused at highlighting areas for policy development and implementation. Two instruments proposed to measure value priorities are surveys and questionnaires. Their results suggested that the existing networks identified in the policy frameworks may not support the effective integration of sustainable development in higher education. Low-density of the national networks, the lack of a clear governance vocabulary for national policy frameworks, and the lack of explicit funding flows between organizations pose problems for institutional change towards sustainable development in higher education.

The evaluation tools used elsewhere show a systematic separation of the single elements to be assessed. In these papers the authors do not elaborate a composite indicator that allows an overall assessment of the sustainability within the courses attended and provided. It is precisely this missing element that motivated us to propose an overall indicator useful for self-evaluation analyses.

3. Definition of a composite indicator

The issue of aggregating the different criteria (dimensions) in an indicator or composite criterion originates from the consideration that although a political choice is ultimately reduced to a decision about whether or not to take an action, and about the intensity of the measure, the decision may have a multiplicity of objectives. As a consequence, the evaluation (ex-ante and ex-post) of the corresponding public interventions will be guided by a multiplicity of indicators, capable of capturing, with a certain approximation, to what extent the implemented policies, among which sustainability is included, are able to achieve results satisfactorily in terms of each goal (Pacheco *et al*., 2009).

Since the multiplicity of objectives must lead to a one-dimensional choice (provision or not of the service and its intensity), it is required that the multiplicity of objectives that can be reached by the choice are aggregated into a single indicator, capable of summarizing, in a manner consistent with administrations' priorities, the effects of the choice on all relevant dimensions. A composite index can be used for this purpose. A composite indicator makes it possible to guide the choices of the administration in a manner consistent with the priorities of the institution and to effectively communicate an understandable and objective choice criterion to the stakeholders and to the public. At the same time, attention must be paid to the problems that may arise if political and administrative choices are made by relying uncritically on a composite indicator (Asif & Searcy, 2014; Asif & Raouf, 2013; Asif & Searcy, 2013).

The main critical issues to be aware of, when a choice is guided by a composite indicator are the following (for a comprehensive overview see D'Inverno & De Witte, 2020; El Gibaria *et al*., 2018):

a. A composite indicator must be constructed transparently, highlighting the mechanisms that determine the final value of the indicator. Otherwise, it will be difficult to convince external parties of the validity and impartiality of the criterion used. Furthermore, the identification of possible remedies to critical situations could be complex in the absence of an unambiguous interpretative key.

b. There are wide margins of discretion in the choice of components, in the relative weight to be given to each of them, and about the assumptions regarding the level of complementarity of the various dimensions. These choices must be made explicit together with the illustration of the results obtained.

c. Including among the dimensions some phenomena that are difficult to directly observe and measure can be challenging and may lead to biased results.

Keeping these critical issues in mind, in this paper three categories of indicators have been identified:

1. Quantitative data. Indicators that represent a proxy of efficiency: i) cost of the single course/number of the enrolled students; ii) variation in the number of the enrolled students, a factor that may also reflect preference choices.

2. Strategic objectives of the higher education institutions. Indicators representing the relevant dimensions of sustainability interventions in university/course policy. For each course, a judgment of relevance is formulated with respect to the achievement of the same objectives. It derives from the judgment of higher education institution representatives for educational programs and of in-house committee. Twelve criteria, grouped into three dimensions are here integrated:

    a. people: identification, consultation, involvement, co-creation
    b. culture: the evaluation here regards the governance, the strategy related to sustainable policies, the inclusive context and the measurement of the results
    c. mission: curricula, research, outreach, funding.

3. Impact on students. Indicator resulting from judgments given by students with respect to the impact generated by participation in courses on a series of variables (for example, expansion of knowledge, possible improvement of employability etc.).

    The same weight, $w_j=1/N$, is assigned to each indicator, and the following formula is used to normalize the values of the individual indicators:

$$normalization = \frac{x - \min\{x_i\}}{\max\{x_i\} - \min\{x_i\}} \quad (1)$$

    However, different weights can be assigned if some aspects are considered to be more relevant than others. In Eq. (1) a neutral position is maintained.

With reference to the composite indicator, this is the result of the combination of a plurality of aspects both of an objective type, linked to the costs incurred for the realization of the courses and to the variation of enrollments, and of a perceptive type, linked to what is perceived by the HEI and by students. The ability to break down the indicator and consider the individual components, supports the institution in its choices in preferring some aspects to others. Henceforth, the decision-making process can be modeled according to the objectives and needs that the actuator wants to consider from time to time.

Table 1. Construction of a composite index.

Course	Quantitative data (A)		Strategic objectives (B)		Impact on students (C)	Total (A)+(B)+ (C) = (D)
	Efficiency (cost/no. of enrolled students)	Variation in the no. of enrolled students	In-house committee	Responsible officers for educational programmes	Students' index	Composite index
X	0…	0….		0...	0…	....
Y	0...	0...		0...	0...	....

The component (A) is the parameter measuring efficiency related to the service costs and the number of students enrolled in each course. Variation in the number of students enrolled is an additional information which can be considered as another important tool of benchmarking performance based on historical performance. The component (B) is representative of strategic objectives which are considered reachable by the institution through the supplied courses. To successfully consider all the different aspects it is important to follow a comprehensive (whole institution) approach that takes the impacts of all core elements into account. Therefore, we propose to consider two groups of people who have a full knowledge of strategic objectives linked to the sustainability. Firstly, an in-house committee measuring Education for Sustainable Development (ESD) has to be selected. The ease of achieving the strategic objectives linked to sustainability will be verified through graduated responses with a scale from 0 to 100. Secondly, HEI representatives for educational programs express their evaluation through the same approach.

Component (C) completes the assessment by segments thanks to the contribution of the students involved in the courses in which sustainability is taught. The elements on which to express an opinion on the impact are:

- change of knowledge oriented towards sustainability
- effectiveness of the courses with reference to the new needs of the labor market
- correspondence between expectations and results achieved.

In addition, in this case an increasing scale from 0 to 100 is used to express the evaluation.

The individual components can be read and analyzed individually. However, a full appreciation of the inclusion of sustainability in courses by higher education institutions is given by the overall weighting of all components.

4. Concluding remarks

In this paper, we deal with the problem of the construction of a multidimensional composite indicator for a self-evaluation exercise. In our proposal, along with indicators measuring the efficiency of HEIs, a group of indicators that assesses the internal and the social dimensions of the educational system in terms of sustainability in taken into account. Flexibilities in the actual composition of the indicator assure consistency with evaluation aims and needs, and adherence with HEI's ESD policy. At the same time, arbitrariness in the choice of the components and in their weight induce possible bias in the assessment. Therefore, sound assumptions need to be validated in order to derive an unbiased composite indicator. Finally, a wider participation of relevant internal and external stakeholders in the process and a thorough transparency of the dimensions, the variables, the measures, the weights and the methods foster a larger recognition of the assessment results and further ideas and actions to improve ESD policies.

The methodology presented here will be further developed both with reference to university institutions and through the concrete application to some realities.

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Fashion Design for Sustainability. A transformative challenge across the European fashion education system

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Abstract

Today, we are witnessing the effects that the COVID-19 pandemic has had, and is still having, on social, economic and cultural life worldwide. The educational dimension has seen the regular operating of schools altered: an indeterminate closure of educational institutions, the impossibility to perform face-to-face lectures, and their transposition to digital platforms (Sà et Serpa, 2020). These difficult conditions can be a moment of opportunity to accelerate a process of digital transformation that was beginning to shift in higher education institutions (HEIs). HEIs are using digital transformation strategies to refine how they work, to digitalize their existing operations while designing new digital models, to create entirely new digital models or to fully digitize their current ones (Rodrigues 2017). In the European fashion education system this can result in addressing the transformative challenges that are nurturing the discussion on the future of HEIs (Moja, 2008; Sterling, 2011; Fletcher and Williams, 2013). Therefore, digital innovation becomes the means by which implementing a positive transformation of the sector on key issues that will permeate our daily lives and that can no longer be postponed. Among the pivotal topics there is sustainability which today is slowly trying to establish itself (Wolff, 2020).Trough the analysis of best practices, this paper will decode current behaviors in Fashion Design for Sustainability (FDfS) throughout the European fashion education system.

Keywords: *Fashion design for sustainability; education; innovation; paradigm transition.*

1. Addressing the role of Fashion Design HEIs in a sustainable transformation

The aftermath of the coronavirus pandemic has accelerated an existing process of hybridization typical of the Industry 4.0 paradigm which aims at bridging the physical and digital realms (Agrawal et al., 2021). Increased use of technology to work, socialize and stay connected with the world has given rise to new digital habits. While many European countries are in various stages of recovery, many players, from different sectors, have found themselves prepared for the change of direction thanks to the transformation paths of their activities that have allowed a rapid adaptation to the expectations and digital needs that have emerged in this period. For those who were not prepared, this period is a window of opportunity for accelerating their transformation. In the aftermath of the COVID-19 pandemic, this is especially true regarding the digital and sustainable transitions, which are the two main objectives set by the European Commission to make the continent thrive in the next thirty years (EEA, 2019; European commission, 2019). The post-crisis period will provide unique conditions for shifting supply and production systems to a more desirable state. Government mandates and other responses to the COVID-19 pandemic provide some initial indications of longer-term actions by policymakers, business managers, and others interested in sustainable supply and production, as well as the prospects for sustainability transitions more generally. In the presented context the Fashion sector is among the ones which are struggling to transitioning towards a positive paradigm. As reported by Mckinsy&Company (2021) some fashion companies won't survive the current crisis while others will emerge better positioned for the future. The criteria by which this will be achieved will mainly depend on their digital and analytics capabilities. These features will not only drive top-line growth but also significantly increase speed, cost, flexibility and according to current times they will guide the sustainability transition across the supply chain (Gonzalo et al., 2021). Within this context, we find the academy that seems obsolete in its effort to strongly include the digital dimension to take advantage of its highly implementable reality. But, as previously argued, the current period could be a period of large-scale re-learning across society capable of triggering sustainable change in many of our current constructs of education and learning (Williams, 2004). There is a growing interest in the university level education institutes and in reshaping their role and nature to address the challenges presented by these transformations. To address the issue related to a sustainable transition a profound change in fashion education is needed enabled and mediated by digital transformation that can reshape the whole fashion system into a more sustainable industry (Bertola and Teunissen, 2018). In support of this transformation, many studies have investigated the impacts of universities on their surrounding contexts, reporting how academies are able to build connections and interact with their external environment these have a positive influence on the growth of all the close systems (Saxenian, 1995). Thus, academic institutions should be vectors of a positive and holistic impact that extend beyond their internal boundaries within disciplines,

schools, and departments, but also engage outside the fields of business, culture, and civil society by creating awareness and critical consciousness (Weik, 1995; Chesbrough, 2005).

2. Methodology

HEIs can play a key role, as major asset to spread awareness about sustainability and embedding a holistic approach for the Fashion sector. There is an increasing need for the academy to be in line with current times, to be able to identifies and codify the patterns of change to transmit knowledge and educate the sector. This could happen through the formation of the new leaders to guide a positive change in this period of transition for the fashion industry towards a more sustainable paradigm. According to this, the paper aims to presents the result of investigation conducted into how HEIs, particularly those working in the FDfS field, are addressing the modern sustainable transition with the help of the digital medium. The data processed are drawn from the knowledge reservoir produced by the Fashion in Process research Lab at Design Department of Politecnico di Milano of which both authors are members. The data were generated from the research conducted by the research Lab (DGGROW, Mapping Fustainable Fashion Opportunities for SMEs, 2019; Erasmus+, FashionSEEDS, 2019) and further implemented with data provided by the PhD thesis of one of the authors (D'Itria, 2018). Methodologically, three main steps were performed to build an iteratively knowledge: the first step consisted of a desk research on the current practices in the FDfS academic field to map the current sustainability practices among the European HEIs and identified the best practices; the second step consist of an in depth qualitative analysis of the identified best practices; and the last step combined all the data to outline academia directions to implement sustainability through digitalization. The mapping led to the identification of 150 HEIs, located in 23 nations of the European continent, which have distinguished themselves for having reached a mature level within their educational offerings (courses) in relation to the theme of sustainability. The composition of the Institutions was heterogeneous. They were design schools implementing sustainability in their offer, not only in the design field but also in the economics/ management, technology/engineering, and humanities ones. Of the 150 HEIs mapped, 60 were selected as case studies. All these design-based institutions stand out for the way they are pursuing implementations of sustainable theories and practices within their system, often adopting a digital transformation approach as support. The following phase consist of a further analysis through selected face-to-face interviews with representatives from the HEIs which had previously distinguished themselves as best sustainable practices. All the case studies were characterized by a desire to evolve and respond to the new needs of the surrounding environment that is evidenced by the path they are pursuing towards sustainability. The third phase express thrugh the interpretation on the collected data how a transformation in the FDfS education is possible through the implementation of specific didactic aspects: HEIs

search for rethinking and implementing the traditional educational paths or designing new ones improving through the digital medium the experience of courses, teaching materials, and the training process in general (Abad-Segura et.al., 2020). Today, these qualitative knowledge implementations consider different directions: adopting/implementing a holistic approach, providing an education that facilitates the development of a relationship and transferability between the areas of knowledge and expertise with the world and others; enabling synergies between academia and industry, addressing the fact that successful research development and innovation are networked activities among different actors and sectors; and nurturing a sustainable transformation in FDfS field, imagining the purpose and role of education if humanity successfully transition from an unsustainable way of life to a regenerative one.

2.1. Holistic thinking

Modern HEIs deliver knowledge within the framework of their curriculum, but also train students with skills that will enable them to address real-world issues (Altinyelken, 2015). To meet these expectations about sustainability is necessary for HEIs to adopt a holistic approach to the knowledge: systematizing and combining the four founding pillars to offer elementary knowledge through a series of overarching topics which can guide students in facing the complexity of future issues they will meet on their path. This need for holism in the education field has been the focus of debate informed by several scholars who have theorized this approach in accordance with the themes of education for sustainability (Wiek, at al., 2011; Giangrande et al., 2019), as well as the theories about the Education for Sustainable development (Sterling, 2010; Huckle, 2010). Today, as HEIs have been permeated by the technological advancement that the current historical moment brings with it, the holistic passage must deal with a digital transformation in all dimensions. The presented holistic approach has been impacted by digital transformation and has responded to this phenomenon integrating the digital dimension to filter the complex relationships between actors in a technologically supported education domain. But this transformation is translated in more than just technology. The goal is to adopt new ways of working to continue delivering knowledge and services in the face of changing technology and the resuting competitions, audience needs, and behaviors. It is especially conceived to face the transition from the traditional vision of HEIs towards a multifaced ecosystem which asserts that everything exists in relationship, in a context of connections and meanings (Miller, 2005) which are facilitated by the digital medium that becomes the vector of this holistic approach.

2.2. Sustainable transformation in FDfS education

Over the past decades, international organizations have agreed on the role of education as a fundamental element of sustainable development. Today, this role is more relevant than ever as recognized by UNESCO in the formulation of its post-covid strategies (UNESCO,2020).

In this context, FDfS aims at incorporating the core issues of sustainable development into fashion design education and learning and supporting the passage to a new positive model. To reach this objective, HEIS operating in the FDfS field need to adopt approaches which can enable to successfully handle the issues which current times are prospecting to imagine feasible, plausible, and desirable visions of the future (Strunk, 2014). This is particularly true for the context in which they refer, fashion, as this is the second most impactful industry in the world after oil, both in terms of environmental and human capital (UN,2019). Therefore, a deep systemic change towards sustainability is needed: a transformative sustainable educational model. This new model needs to give a strategic guidance to facilitate the transition from the dominant mechanistic of transmissive educational model to the transformative one (Sterling, 2011). Today, FDfS HEIs translate this into further improvement of internal sustainability and transformation practices to address emerging fashion industry transformations on which to act simultaneously to solve problems and shift systems: the diffusion of sustainability issues, and the wide effects and improvements of digital transformation. This transformation becomes the means to accelerate the transition to more positive paradigms. This does not simply refer to the shift of lessons from the offline to the online paradigm, but in a deeper way it concerns the need to revise the approach between physical and digital reality. Indeed, technology becomes a vector of systemic change and accelerates and implements it by overcoming the physical barrier. Therefore, FDfS universities are developing specific digital strategies in reaction to the massive shift towards the use of new technologies but also in an attempt to break down their own internal barriers that tend to limit vision and block the development of practicess that can effectively implement a digital transformation (PSRC, 2018). A digital transformation in the field of FDfS is not only about technological advancement, but goes beyond that and generates profound changes that can affect pedagogical approaches, teaching practices and its activities, research, as well as the people immersed in it.

2.3. Academy-Industry collaboration/relationship

Today HEIs are involved in a transition towards a new sustainable paradigm which is transforming the current FDfS education system. The old compartmentalized one is giving way to new models that strategically view the system in which they operate as the union of different parts: no more separation among the different institutional spheres which operates - HEIs, and industry - but an open system to make innovations concerning knowledge, technologies, and systems thrive (Gomez-Gaquet et al., 2016). Therefore, is necessary to encourage an interdisciplinary approach as today we assist to a passage from knowledge transfer to knowledge exchange between HEIs and industry to reach common objectives (Eriksson, 2016), as the passage to a sustainable paradigm. The necessity of these collaborations between university and industry rises the needs for coordinating various disciplines within an organization, sharing information, experiences and creating an

understanding of the common systems. If all the actors involved in these mutual exchanges set their objectives and share their aims this can be translated in the creation of a stable environment to foster an ecosystem for a positive and sustainable innovation lead by digitalization. In this context, institutional perspective is a fertile lens for reading digital transformation as the effect of several technological innovations that result in new actors, and networks, models, behaviors, and values (Hinings, 2018). Heis, with the support of industry and professionals, through the spread of external advisory board or steering committee, become the channel for identifying, codifying, and modeling these new actors and how they relate to each other and their surroundings. Through a flow of mutual exchange, between HEIs and industry, multidisciplinary knowledge and skills are explored for application in increasingly changing educational, professional, and labor market contexts.

3. Conclusions

The study analyzed the main directions in FDfS education. A mixed methodology allowed to identify current directions in FDfS within European HEIs which are embedding sustainability in their systems. The main categories identified highlighted how they are often aided by the digital medium. This indicates that the relationship between sustainability and digital innovation in HEIs has connotations related to holistic practices, embedding technologies, interdisciplinary practices, and nurturing a transformative education model. This study has some limitations, it has been based on a mature sector, as is the fashion education system in Europe. The results should be understood in this framework. Future lines in this area of research must contemplate, among others, the possibility for lead actors in the HEIs system to explore new directions in order to meet the different needs of students and educators, as well asecternal partners as the industry, who aim to engage with sustainability topics and practices. They can be used as guidelines to address all the possible issues related to validating, planning, or re-shaping educational experiences in the fashion field. Finally, it is necessary to highlight how the Fashion educational practices presents a resource for the development of a sustainable curriculum, on a large scale. This could means a positive change for the European HEIs system from impacting to the sustainable paradigm.

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Implementation of the BIM Methodology in the Architecture Degree: Experience of the Architecture School of San Sebastian

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Abstract

The emergence of the Building Information Modelling (BIM) methodology in the design, generation, maintenance and data management of any type of building has meant the most important advance in decades in the construction sector. Moreover, current European and Spanish regulations require its mandatory use. In this context, the university degree studies related to construction must challenge this new reality. The aim of the project conducted in the University of the Basque Country (UPV/EHU) School of Architecture of San Sebastian, is the implementation of the BIM methodology in its Architecture Degree. The intention of this research is to implement the BIM methodology without subtracting competencies or content from the current Syllabus. This methodology should be gradually integrated into the different courses and intertwined with the contents of different subjects, in order to train Architecture graduates on BIM and preparing them to join a professional market that demands this knowledge. The purpose of this communication is to report the current status and the level of development of this study.

Keywords: *BIM; architecture; degree; university; teaching.*

1. Introduction

The construction sector is bearing a change in its traditional paradigm. The emergence of a new methodology based on digital technology, BIM methodology or Building Information Modelling, is going to change the way buildings are conceived, designed, constructed and used. The European Directive 2014/24/EU on public procurement (European Parliament, 2014) urges Member States to consider the use of technology to update public procurement processes. This Directive has been transposed into the Spanish 9/2017 Law on Public Sector Contracts (Jefatura del Estado, 2017), which allows public procurement bodies to require digital BIM tools for public works contracts, works concessions, services and project tenders.

In this sense, the university degrees linked to this sector will have to adapt to this new reality in a relatively short period of time. If future graduates must have enough technical skills to practice their profession, they must have sufficient knowledge of the subject. At present, BIM methodology is hardly implemented in the teaching content of university degrees. However, there are specific postgraduate and master's degree courses on the subject.

Something similar happens in the case of the university degree in architecture. At the moment, everything related to the acquisition of knowledge of BIM methodology is predominantly linked to postgraduate Masters, specific Masters and courses. Although there are specific experiences of implementation of the methodology in the Bachelor's Degrees, there is no known case where the BIM methodology structures a whole Syllabus in Architecture Degree. Hence the urgent need to implement BIM methodology in the Bachelor's Degrees in Architecture.

2. BIM methodology

BIM is a working methodology. It is a process of generating and managing building data during its life cycle, using dynamic 3D building modelling software in real time. It also reduces the waste of time and resources in the planning, design, construction and operation phase. It is not just about creating 3D model but also about generating a virtual building that contains additional information about elements and materials. In fact, it is a 3D database that enables tracing of all the elements that constitute the building. This database improves the operational management and maintenance of the building throughout its life cycle, making asset management much easier (Building SMART, 2020). The centralised digital data model allows recording all the modifications and processes that are carried out in the buildings during their life. Furthermore, the collaborative nature of the BIM methodology makes it an ideal tool for linking the various disciplines that take part the design-construction process.

3. Implementation of BIM proposal in the Architecture Degree

The University of the Basque Country (UPV/EHU) Architecture School of San Sebastian launched a project in 2018, together with the Basque Government, in response to the need to implement BIM in the Bachelor's Degree in Architecture. A Collaboration Agreement (ETS Arquitectura - UPV/EHU, 2018) was signed between the Basque Government and the University of the Basque Country with the purpose of promoting research in architecture, urban planning and construction. The project was presented and accepted and developed during the period of 2018-2021. The aim of this project is to implement BIM within the Bachelor's Degree in Architecture so that the graduates, once they have completed the Degree, get the BIM skills demanded by the construction sector labour market.

One of the fundamental premises established by the Management of the Architecture School of San Sebastian was that the BIM methodology should be taught as an integrated part of the Degree and not as a learning process in parallel to it. This will allow the integration of closely related subjects, which are closely related and which in traditional teaching are studied apart. Therefore, it will help students to have a global vision of all the design and construction process related to architecture and urban planning.

3.1. Current Syllabus

The current Syllabus for the Degree in Architecture at the UPV/EHU was approved on 24 March 2015 (ANECA, 2015). This Plan is based on the Orden EDU/2075/2010 (Ministerio de Educación, 2010) regulation, where the distribution of ECTS is established and structured on the basis of Competences and Modules that determine the learning objectives of the graduates. These competences are acquired through Basic Branch Subjects, Compulsory Subjects, Optional Subjects and a Final Degree Project (Figure 1).

DEGREE IN ARCHITECTURE - Currents Syllabus						
Type	YEAR 1	YEAR 2	YEAR 3	YEAR 4	YEAR 5	Total
Basic Branch Subjects	36	24				60
Compulsory Subjects	24	36	60	60	21	201
Final Degree Project					9	9
Optional Subjects					30	30
TOTAL	60	60	60	60	60	300

Figure 1. Current Syllabus and distribution of ECTS on the Architecture School of San Sebastian, UPV-EHU. Source: UPV/EHU Architecture School of San Sebastian (2015).

3.1.1. Modules and Competences

Four types of competences are established within the Degree: Basic Competences, Degree Competences, Transversal Competences and Specific Competences. All these competences are distributed in 10 modules which in turn contain the Basic Branch Subjects, the Compulsory Subjects, the Optional Subjects, as well as the Final Degree Project.

3.1.2. Compulsory Subjects, Optional Subjects and Integrated Workshops

As the current Syllabus stands, the acquisition of competences by the students of the Bachelor's Degree in Architecture is based on the subjects. Compulsory Subjects (201 ECTS) are the ones that prevail over Optional Subjects (30 ECTS). Implementing BIM methodology is among these subjects where the main emphasis should be done. The Optional Subjects can be used to complete the learning process. As stated in the current Syllabus, in Integrated Workshops various subjects participate so that the student can acquire transversal knowledge by integrating various subjects in a single Studio or Workshop. These Workshops could become one of the most interesting platforms to implement BIM as one of the main objectives of this methodology is to work transversally with several subjects at the same time.

3.2. Review of the Syllabus

At present, the UPV/EHU Architecture School of San Sebastian has begun the revision of the Syllabus where it is foreseen that based on the present study, the Implementation of the BIM methodology in the Degree will be included. It should be noted in this regard that, although the study is based on the current Syllabus, the modifications that could be introduced in the future are foreseen and proposed, so that the assessments and conclusions derived from this research are taken into account from the outset.

3.3. BIM Competences, Tasks and Uses

There is not enough experience to establish the correct pathway for acquiring BIM knowledge at the same time as acquiring degree regular competences. In order to establish the learning objectives of the BIM methodology, it is necessary to set a series of parameters that serve as tools to develop teaching. For this reason, and based on the research conducted to date, to establish what BIM contents are, the study stands on three basic concepts: BIM Tasks, BIM Uses and BIM Competences. BIM Competences are related to teaching, while BIM Tasks and BIM Uses are related to the professional field. These three parameters that are considered fundamental to implement the methodology in the Degree are presented below.

3.3.1. BIM Competences

BIM Competences are those linked to the ability to perform a BIM activity or provide a BIM result (Succar, Shed, et al., 2013). When defining BIM Competences, a list was prepared by selecting those that would allow greater interaction and compatibility with the Competences of the different Degree modules. The BIM competences proposed (Figure 2) must be related to the specific competences of subjects when implementing BIM (Barison & Santos, 2011).

	Basic and Advanced Architectural Design Module
BIM - E16	Analyse and use a BIM architectural design model
BIM - E17	Create and design a BIM architectural model
BIM - E18	Modify a BIM architectural design model
BIM - E19	Analyse and use an existing or planned urban model according to BIM methodology, for medium- and large-scale review
BIM - E20	Create and design an urban planning model using BIM methodology
BIM - E21	Modify an existing urban model using BIM methodology

Figure 2. BIM Competences established for the Degree in Architecture.
Source: Authors (2020).

3.3.2. BIM Tasks

The BIM Tasks refer to the way in which the methodology can be worked and developed. These Tasks focus on the use and development of the virtual building that is the object of design, analysis and subsequent construction and operation phase. All the tasks are grouped into five blocks: Visualization and Information, Modeling, Analysis and Calculations, Documentation and Graphics, Project Management (Messner, Anumba, et al., 2019).

3.3.3. BIM Uses

Finally, BIM Uses depict the different uses given to a BIM project throughout the life cycle of the building. A classification of 28 BIM Uses (Figure 3) has been proposed based on the research developed so far (Kreider & Messner, 2013).

BIM Uses	
01 CURRENT TERRAIN MODELLING	15 DRAWING PRODUCTION
02 COST ESTIMATION	16 INTERDISCIPLINARY 3D COORDINATION
03 PHASE PLANNING/ SCHEDULING	17 CONSTRUCTION SITE PLANNING
04 SPACE DISTRIBUTION	18 DESIGN OF BUILDING COMPLEXES. VR.
05 SITE ANALYSIS	19 DIGITAL FABRICATION
06 DESIGN REVIEWS	20 DIGITAL SITE LAYOUT
07 DESIGN MODEL	21 CONSTRUCTION QUALITY CONTROL
08 STRUCTURAL ANALYSIS	22 AS-BUILT MODEL
09 ENERGY ANALYSIS	23 FACILITY MANAGEMENT MODEL
10 LIGHTING ANALYSIS	24 ASSET MAINTENANCE SCHEDULING
11 HVAC ANALYSIS	25 ASSET PERFORMANCE ANALYSIS
12 SUSTAINABILITY ASSESSMENT L	26 ASSET MANAGEMENT
13 TECHNICAL CODE VALIDATION	27 SPACE MANAGEMENT AND MONITORING
14 OTHER ENGINEERING ANALYSIS	28 CONTINGENCY PLAN

Figure 3. BIM Uses proposed for the Degree in Architecture.
Source: Authors (2020).

3.4. Strategic implementation guidelines

In order to implement the BIM methodology, four strategic guidelines are established.

3.4.1. Main Objectives

Firstly, based on the duration of the Architecture Degree studies and taking into account the assignment of Modules and Competences, a series of Main Objectives are established (Figure 4). These objectives are linked to the BIM Competences, Tasks and Uses.

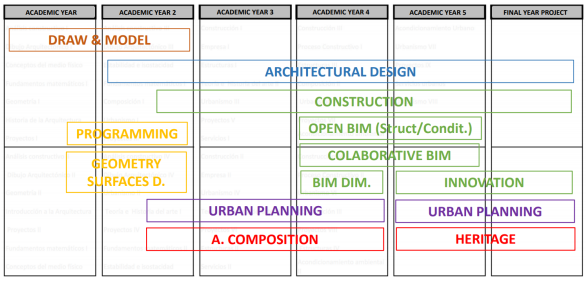

Figure 4. Summary table of the Main Objectives of BIM for the Degree in Architecture. Source: Authors (2020).

3.4.2. Compulsory Subjects

Based on the distribution of Compulsory Subjects in the Degree, a curricular path of BIM teachings is established. This distribution is carried out in three Learning Levels (Figure 5). Depending on the content of each subject, the knowledge of the methodology is taught in a Main Level, a Secondary Level and a Complementary Level.

ACADEMIC YEAR 1	ACADEMIC YEAR 2	ACADEMIC YEAR 3	ACADEMIC YEAR 4	ACADEMIC YEAR 5
Semester 1	Semester 1	Semester 1	Semester 1	Semester 1
Architectural Design I	Architectural Design III	Architectural Design V	Architectural Design VII	Architectural Design IX
Constructive Analysis I	Constructive Analysis III	Construction I	Construction III	
Architectural Drawing I	Architectural Drawing III	Business Administration I	Construction Process I	
Geometry I	Urban Planning I	Urban Planning III	Urban Planning V	Urban Planning VII
Physical Medium Concepts	Stability and Isostasy	Structures I	Structures III	
Math Fundamentals I	Math Fundamentals II	Services I	Enviromental Conditioning I	Urban Conditioning
History of Architecture	Architectural Composition I	Theory and History of Art II	Architectural Composition II	

Figure 5. Partial distribution of the curricular pathway based on 3 Learning Levels. Source: Authors (2020).

3.4.3. Optional Subjects

The contribution of the Optional Subjects distributed throughout the Degree can help to complement BIM knowledge. These subjects, although not fundamental for the acquisition of minimum knowledge of the methodology, can provide additional learning value.

3.4.4. Workshops and/or Seminars

To complement all the BIM training, the existing Integrated Workshops in the current Plan should be maintained and even increased. Workshops are the most suitable BIM implementation environments as they promote collaborative work. We must not forget that architecture degrees incorporate "project-based learning" from their very conception, and that group work occupies a substantial part of the teaching activities developed. This ability to work in groups will be one of the aspects that can benefit most from BIM methodology (Egea, 2016).

3.5. Experience gained

During the period of the project, training has been included for students who are currently studying for their degree, so that they can also acquire this knowledge without waiting the implementation to be completed. On the other hand, teaching staff is being trained so that those who are not initiated in the BIM methodology acquire the skills to implement the BIM methodology in the content of each subject after a period. This whole process is being carried out together with experts in the methodology at national level and in collaboration with the administration, specifically with the Department of Territorial Planning, Housing and Transport of the Basque Government, which is funding this project.

4. Conclusions

In the three years since the project began, several conclusions have been drawn so far. The first is that there is an urgent need to embark on the path to be able to implement BIM Methodology as soon as possible in the Bachelor's Degrees, in this specific case in the Bachelor's Degree in Architecture. To this end, the Syllabus must be revised and BIM Competences must be added to it. It should not be forgotten that, as stated in the European Directives and Spanish Regulations, public procurement, and consequently private procurement, should be promoted through technological advances.

On the other hand, it is an obligation of the university to prepare future professionals with the skills to develop the profession. In this sense, the experience acquired so far at the San Sebastian School of Architecture has been very positive. Several surveys have been conducted among students to assess the effectiveness of the proposed Plan. More than 350 surveys have been conducted among the students of the different courses of the Degree between 2018-2021. 90% of the students surveyed consider it important to acquire BIM knowledge for their professional future, while 97% would like to learn the BIM methodology. To this end, it is essential to integrate the methodology into existing subjects. However, the incorporation of these BIM Competences should not leave aside the current Degree Competences.

Finally, it must be said that a period of time will be needed before the BIM methodology can be fully implemented in the Degree. At the moment, neither the awareness of the importance of the methodology, nor the necessary infrastructures to develop it at the university, nor the current training of the teaching staff, indicate that it can be implemented immediately. A medium-term period will be needed to become this project a reality.

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The impact of the Covid-19 disruption on distance learning higher education students and activities

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Abstract

Higher education institutions are increasingly concerned about the impact of the disruption caused by the Covid-19 pandemic on students and learning activities. Yet, we know little about the effect of this disruption, specifically on students in distance learning higher education institutions. This study drew from survey responses of 555 undergraduate students at The Open University, UK. The aims of this study were to understand the impact of the Covid-19 disruption on learning, assessment and social activities that distance learning students commonly undertake and to explore how this impact relates to their background characteristics (socio-demographics and study properties). Findings showed that overall, students engaged in their study activities less frequently, with learning-related activities (e.g., joining live sessions) having the highest negative impact and social activities (e.g., accessing email for study purposes) the lowest. Female students were more likely than male to engage less across all three activity categories. Background characteristics, such as age, faculty and race, were associated with particular activity categories. This study is the first step towards enhancing our understanding of the engagement of distance learning, but also campus-based students in emergency distance learning, in online learning activities during the *Covid-19* pandemic *and other similar disruptions.*

Keywords: *Distance learning; higher education; online learning; Covid-19; student engagement.*

1. Introduction

The abrupt outbreak in January 2020 of the Covid-19 virus has created a crisis for many sectors, including the higher education (HE) sector. As a result, HE institutions (HEIs) have had to reconsider delivering effective learning using distance learning technologies following campus closures during the Covid-19 pandemic. Large-scale research involving 31,212 students in 62 countries (Aristovnik et al., 2020) indicates that switching from face-to-face to online teaching involved mainly delivering online lectures via real-time video conferences, but also asynchronous exchanges of resources between tutors-students and written communication via forums and chats. Sudden campus closures and lack of in-person support, led to students studying isolated at home in inappropriate learning environments while facing self-discipline issues (Bao, 2020). Moreover, this transition has resulted in students reporting increased workload and engaging more in completing assignments as a way to prove their participation in the course (Son et al., 2020). Further research reports that students' socio-demographics and study properties relate significantly to how they respond and experience this transition from face-to-face learning to online. For instance, female and art students reported to have a larger workload, and applied sciences and part-time students reported being less satisfied with their work-life balance (Aristovnik et al., 2020). Also, students from lower socioeconomic backgrounds reported experiencing stress about financial issues (Chirikov et al., 2020) and delayed graduations (Aucejo, 2020). Further, closures of schools affected households with school students resulting to higher demands on devices and internet access, and affecting parents' wellbeing (Garbe et al., 2020).

However, lockdown and shielding practices implemented by national governments have also affected students studying in distance learning HEIs. Motivated by the current lack of an empirical basis for insights into how the pandemic has impacted students and study activities in distance learning HEIs, we collected survey data from 555 students at The Open University (OU), during August-September 2020. The OU has been continuously developing its distance learning model since its foundation in 1969. The OU's supported open learning model includes delivering of courses via virtual learning environments, online tutorials and small tutor group forums, and evaluating student performance via tutor or computer marked summative or formative assessments. The OU also supports face-to-face exams and several other activities that were cancelled following the social distancing measures. Further, students at the OU are typically older than those of campus-based HEIs. To understand how the Covid-19 disruption has impacted the study activities at distance learning HEIs, we explored (a) the perceived change in time spent on learning, assessment and social activities that distance learning students commonly undertake during a course, and (b) how this perceived change relates to students' background characteristics, such as their gender, age, faculty, socioeconomic group, race and course start date. Our study extends previous research

on how the Covid-19 pandemic affected HE students, and sheds light on the implications on distance learning students and activities.

2. Methods

2.1. Development of 'study activities' list

The initial list drew from a previous iterative survey with OU students' use of handheld technologies (Cross et al., 2019) and reflects actions that OU students usually undertake during a course. These items were aligned with Conole's (2013) learning activity categories and represent assimilative, communicative, information handling and productive activity domains. The initial list was reviewed and agreed with experts in the OU's (a) Quality Enhancement and Innovation team and (b) Design, Development and Production unit. The final list was reviewed and piloted with a large group of student volunteers *(n = 201)*.

The study activities formed three self-report frequency scales designed to measure the students' self-perceived frequency change in undertaking certain learning activities: (a) the 7-item learning activity scale; (b) the 6-item assessment activity scale; and (c) the 4-item social activity scale. Likert scale responses ranged from 1 (much less frequently) to 5 (much more frequently). The score for each survey respondent equalled the mean score of the responses. Reliability analyses were carried out on the learning, assessment and social activity frequency scales. Cronbach's alpha showed the scales to reach acceptable reliability, with $\alpha = 0.93$ for the learning activity scale, $\alpha = 0.92$ for the assessment activity scale, and $\alpha = 0.85$ for the social activity scale.

2.2. Data collection

The survey was administered over two phases to students studying courses starting in October 2019 and February 2020. The students in the first phase were part of the Curriculum Design Panel, a group of students who frequently contribute their feedback to university matters, while students in the second phase were recruited via an invitation sent to a random university-wide sample. The survey ran between 29 July and 24 September 2020 and received 555 responses. Data collected include students' self-report on study activities, gender (female, male), age (25 and less, 25-34, 35-44, 45-54, 56 or over) and faculty (Social Sciences and Humanities/FASS; Science, Technology, Engineering and Maths/STEM; Education, Languages, Health and Sport Studies/WELS; Business and Law/FBL). Further information about background characteristics of phase 2 students *(n = 354)* was retrieved from the university database, such as their socioeconomic group (high/low), race (Black Asian or Minority Ethnicity/BAME or non-BAME) and course start (October 2019, February 2020). The dataset was anonymised on the 30th of September 2020, prior to initiating the process of data analysis. Ethical approval was obtained from the authors' university ethics committee.

2.3. Data analysis

Descriptive statistics were used to describe the impact on the frequency by which OU students were undertaking particular learning, assessment and study activities, compared to their pre-pandemic study habits. Then, to determine how gender, age, faculty, socioeconomic group, race and course start relate to OU students' frequency of engaging in activities, independent-samples t-tests and analysis of variances (ANOVA) were performed. Scheffe post hoc tests confirmed flagged differences between groups detected by ANOVA. In the cases that Levene's F test revealed that homogeneity of variance assumption was not met, Games-Howell test was used. Descriptive statistics of the items used in the tests can be found in Table 1. An alpha level of .05 was used for all the analysis. Descriptive statistics reported in this study are means (M) ± standard deviations (SD), unless otherwise noted.

Table 1. Descriptive statistics per study activity

Background characteristics	**Learning M ± SD, n**	**Assessment M ± SD, n**	**Social M ± SD, n**
Gender			
Male	2.75 ± 0.82, n = 182	2.79 ± 0.74, n = 176	2.83 ± 0.74, n = 179
Female	2.43 ± 0.86, n = 321	2.59 ± 0.78, n = 299	2.69 ± 0.85, n = 322
Age			
25 or less	2.44 ± 0.74, n = 64	2.69 ± 0.71, n = 63	2.74 ± 0.77, n = 64
26-35	2.42 ± 0.89, n = 142	2.59 ± 0.80, n = 133	2.77 ± 0.86, n = 142
36-45	2.45 ± 0.86, n = 122	2.59 ± 0.84, n = 112	2.71 ± 0.79, n = 123
46-55	2.57 ± 0.89, n = 91	2.63 ± 0.72, n = 88	2.58 ± 0.85, n = 91
56 or over	2.96 ± 0.74, n = 85	2.91 ± 0.68, n = 80	2.93 ± 0.71, n = 82
Faculties			
WELS	2.18 ± 0.85, n = 73	2.46 ± 0.84, n = 63	2.55 ± 0.84, n = 72
STEM	2.66 ± 0.81, n = 146	2.72 ± 0.73, n = 142	2.83 ± 0.75, n = 148
FASS	2.64 ± 0.86, n = 201	2.72 ± 0.70, n = 187	2.82 ± 0.80, n = 199
FBL	2.40 ± 0.95, n = 56	2.57 ± 1.03, n = 54	2.54 ± 0.98, n = 55
Socioeconomic group			
High	2.51 ± 0.88, n = 280	2.65 ± 0.74, n = 253	2.73 ± 0.83, n = 278
Low	2.67 ± 1.02, n = 21	2.67 ± 1.02, n = 21	2.90 ± 0.90, n = 22
Course start			
October 2019	2.51 ± 0.88, n = 259	2.64 ± 0.77, n = 230	2.75 ± 0.81, n = 254
February 2020	2.62 ± 0.95, n = 58	2.70 ± 0.72, n = 61	2.80 ± 0.93, n = 62
BAME			
Yes	2.54 ± 0.89, n = 297	2.67 ± 0.76, n = 276	2.78 ± 0.84, n = 298
No	2.31 ± 0.91, n = 18	2.33 ± 0.77, n = 13	2.31 ± 0.69, n = 16

3. Results

The data (N = 555) show the students' perceived change in time spent on certain activities. Overall, OU students reported engaging in their study activities less frequently or without change with an average score of 2.63, on a range of 1 (much less frequently) to 5 (much more frequently). Learning activities had the highest negative impact with students reporting less frequent engagement (2.56 ± 0.86) while social activities had the lowest negative impact with students reporting no change or less frequent engagement (2.75 ± 0.81).

3.1. Learning activities

The following table (Table 2) shows students' usual learning activities in order of negative impact on time spent on the activity, compared to pre-pandemic. Joining synchronous online tutorial sessions was the most negatively impacted learning activity, scoring closer to 'less frequently'. Other items with high negative impact, involve non-mandatory activities, such as reading non-OU learning material or search for academic report/papers. Finding information on the internet (an activity of low granularity) was the least negatively impacted, scoring closer to 'no change'. Survey respondents, overall, reported that they engaged in learning activities less frequently than before or without any change.

Table 2. Descriptive statistics for learning activity frequency, in order of negative impact. Ranged from 1 (much less frequently) to 5 (much more frequently).

Learning activities	n	M ± SD
Joining Live OU sessions	538	2.41 ± 1.08
Reading non-OU learning materials related to your OU studies	544	2.49 ± 1.08
Searching for academic reports or papers	530	2.50 ± 0.97
Watching or listening to OU learning materials	548	2.58 ± 0.96
Writing or taking notes	551	2.63 ± 0.98
Reading OU learning materials	552	2.64 ± 1.02
Finding information on the internet	546	2.74 ± 1.02
Average of all learning activities	*516*	*2.56 ± 0.86*

Findings from examining the relationships among frequency of engaging with learning activities and background characteristics of OU students show that female students were engaging less frequently than male (t[501]=4.08, p<.001); students aged 56 or over were engaging more frequently than students of other age groups (F[4,499]=6.54, p<.001); and students in WELS were engaging less than students in STEM and FASS (F[3,472]=6.74, p<0.001). There were no significant differences between students of high and low socioeconomic group (t[299]=0.08, p=0.45); BAME and non-BAME students (t[313]=1.06, p=0.29); nor students starting in October 2019 and February 2020 (t[315]=0.85, p=0.39).

3.2. Assessment activities

Table 3 shows students' usual assessment-related activities in order of negative impact. Revision was the most negatively impacted activity, scoring closer to 'less frequently', followed by practice quizzes and preparing an assignment. Accessing TMA scores (an activity of low granularity) was the least negatively impacted. Likewise, downloading marked TMAs was impacted less. Similarly to the feedback on learning activities, survey respondents reported that they engaged in assessment activities overall less frequently than before or without any change.

Table 3. Descriptive statistics for assessment activity frequency, in order of negative impact. Ranged from 1 (much less frequently) to 5 (much more frequently).

Assessment activities	n	M ± SD
Revision	523	2.47 ± 1.04
Practice quizzes	510	2.51 ± 0.95
Preparing an assignment (TMA)	547	2.61 ± 1.02
Acting on feedback from tutors	546	2.76 ± 0.86
Downloading your marked TMAs	545	2.78 ± 0.78
Accessing TMA scores	547	2.86 ± 0.83
Average of all assessment activities	*488*	*2.66 ± 0.77*

Findings from examining the relationships among frequency of engaging with assessment activities and background characteristics of OU students show that female students were engaging less frequently than male (t[473]=2.75, p=.006) and students aged 56 or over were engaging more frequently than students aged 26-35 and 36-45 (F[4,471]=2.78, p=0.03). There were no significant differences between students in different faculties (F[3,442]=2.35, p=0.07); students of high and low socioeconomic group (t[21.79]=0.05, p=0.96); BAME and non-BAME students (t[287]=1.55, p=0.12); and students in courses starting in October 2019 and February 2020 (t[289]=0.51, p=0.61).

3.3. Social activities

The following table (Table 4) shows students' usual social activities in order of negative impact. Social media for study purposes was the most negatively impacted activity, scoring closer to 'less frequently', while social media for socialising was the item with the lowest negative impact, with survey respondents reporting an overall 'no change' to this habit. Feedback on social activities indicates an overall less negative impact, compared to learning and assessment activities.

Table 4. Descriptive statistics for social activity frequency, in order of negative impact. Ranged from 1 (much less frequently) to 5 (much more frequently).

Social activities	n	M ± SD
Social media for study purposes	520	2.65 ± 0.97
Accessing OU forums	548	2.66 ± 1.02
Accessing email for study purposes	550	2.76 ± 0.87
Social media for socialising	524	2.95 ± 1.16
Average of all social activities	*514*	*2.75 ± 0.81*

Findings from examining the relationships among frequency of engaging with social activities and background characteristics of OU students show that female students were engaging less frequently than male (t[410.14]=1.99, p=0.048) and BAME studentsless frequently than non-BAME (t[312]=2.18, p=0.03). There were no significant differences between students of different age (F[3,497]=2.12, p=0.08); faculties (F[3,470]=2.40, p=0.052); high and low socioeconomic group (t[298]=0.90, p=0.37); and students in courses starting in October 2019 and February 2020 (t[314]=0.43, p=0.67).

4. Discussion

Overall, a negative impact on the frequency of undertaking study activities was reported across all three activity categories. The time spent on learning activities was highly negatively impacted by the Covid-19 pandemic, with students engaging less frequently with the equivalent activities, while social activities had the lowest. The most affected study items were joining Live OU sessions (Table 2) followed by revision (Table 3). Routine disruption, because of employment issues and childcare or other caring responsibilities that characterise older students (e.g., Garbe et al., 2020), could explain a perceived negative change in the frequency by which students were joining Live OU sessions (which is a synchronous event) or undertaking learning activities overall. Further, the OU's decision to cancel face-to-face final exams may explain why students reported negative impacts on time spent revising. This finding also contradicts studies (e.g., Son et al., 2020) reporting students of campus-based HEIs having an increased engagement with assignments to prove their participation.

With respect to how this perceived change in time spent on certain activities relates to students' background characteristics, the findings of this study show that female students reported engaging less with their study activities than male. This finding is consistent with gender-related studies in campus-based HEIs (e.g., Aristovnik et al., 2020), and it may be explained due to life expectations and changes in personal circumstances during Covid-19. Covid-19 personal circumstances (for example, self-isolation) may have also allowed more time for students aged 56 or over to engage in learning and assessment activities. WELS

students were engaging less frequently in learning activities than STEM and FASS students, perhaps because WELS involves students in activities, such as face-to-face visits at hospitals (nursing) or schools (education). BAME students were engaging less frequently in social activities than non-BAME students. This finding needs further investigation, and it can form a vital issue for future research. Regarding socioeconomic background, contrary to research on campus-based HEIs (e.g., Chirikov et al., 2020), there were no significant differences between students in high and low socioeconomic groups. Finally, no significant differences were found between students starting in October 2019 and February 2020, although the former had short notice about changes to assessment.

Our findings add to a growing body of literature on how distance learning, and also campus-based students in emergency distance learning, engage in particular study activities online during disruptions. An essential next step will be to scope and explore new opportunities for teaching and learning with practices that respond to broader social and economic change. Maintaining engagement during disruptions could be achieved by adopting inclusive programme designs and providing alternative activitiy types and modes.

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Exploring an Unfamiliar Space Reflections on the Socio-Psychological Aspects of Synchronous Online Teaching

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Abstract

Online technologies provide a myriad of new teaching and learning methods, and while those new technologies have a lot of advantages, the rapid change from face-to-face to online teaching and distance learning during the COVID-19 pandemic has made certain disadvantages visible, too. This paper focuses on the psychological impact of online learning on students, specifically in connection with the move from a well-known place, the university campus, to an unknown space, the online classroom. It explores why uncertainty and anxiety can result in reluctance to engage, a process that is caused by a lack of social information, low peer bonding possibilities and obstacles to create a sense of belonging. The findings are based on a general, theoretical understanding of psychological aspects that impact the virtual classroom, as well as on observations made during the lockdown period and its subsequent months of online teaching, drawing on concepts from social psychology, i.e. social cognition, social perception and conformity. What has become undoubtedly evident is that while the new technologies create new and creative spaces for teaching and learning, they are by no means free of stress and anxiety.

Keywords: *Synchronous online teaching; social psychology; social cognition; social perception; conformity; place; space; sense of belonging; peer bonding.*

1. Introduction

Online courses have vastly gained in popularity in recent years, and consequently, a lot of academic articles have been published on their benefits (e.g. Montelongo 2019), challenges (e.g. Davis et al, 2019; Khan et al, 2017; Paudel 2021) and possible pitfalls (e.g. Dumford & Miller 2018; Scherer & Hatlevik 2017).

Whereas the new technologies offer a lot of innovative and creative potential, it has also come to light that a mere transposition of course contents from the lecture hall to the virtual classroom is not satisfactory at all, especially in connection with the COVID-19 pandemic that forced (tertiary) educational institutions to switch from on-site to online teaching at very short notice. Digitisation has made it possible for such a swift changeover to take place at all, and it has certainly provided a valid alternative to on-site teaching under the circumstances. Furthermore, online teaching and learning has increasingly been implemented even before the outbreak of the pandemic as more and more students rely on flexible modes of studying because it frees them from fixed timetables and locations and therefore allows for independence in terms of both place and time. Yet despite its benefits, the digitalised everyday also clearly shows its limits.

The sudden change to online teaching and learning has raised a lot of methodological and pedagogical questions as the drastic remodelling of context and medium has had a huge impact on how students can be taught, supported and assessed. However, whereas most of the discussions have centred around questions of contents and the manageability thereof, the psychological factors exercising an incisive and sometimes detrimental effect on students have been conspicuously few in number (Akpinar 2021; Sundarasen et al 2020). It is important not to neglect the human perspective because the changeover from face-to-face to online teaching also has far-reaching psychological consequences and can result in insecurity, anxiety and even depression. Classroom community, peer bonding and a sense of belonging (Vayre & Vonthron 2017: 203, Dumford & Miller 2018: 459) are just as important in the virtual classroom as on campus, probably even more so.

Therefore, this paper seeks to address those factors which have a psychological impact on students, particularly in a synchronous online teaching context. Specifically, I will argue that three concepts of social psychology might help pin down the possible reasons for students' anxiety and reluctance to actively participate in synchronous online classes. My theoretical approach is based on the belief that online learning requires a safe and empathic social space that needs to be established in the absence of the familiarity that more traditional learning spaces (and places) usually provide.

My exploration is divided into three parts. First, I will elucidate why familiar places play a role in how people conceptualise contexts, in our case a context of learning, and associate those places with mental structures and habitual practices humans need to make sense of their

social world. In order to explain this specific correlation, I am going to draw on the concept of social cognition and schemas. Secondly, I will discuss how nonverbal communication is affected in the context of synchronous teaching and learning by making use of the theory of social perception, arguing that online communication does not really allow for nonverbal communication, which has a negative impact on self-assurance. In a third step, I am going to explore the relation between social influence and conformity prevalent in online classrooms.

2. From place to space – lack of established schemas

Place and space are often used synonymously, and while in certain contexts that may well be appropriate, the terms also have some distinguishing features. Some scholars claim that space is more abstract than place (Ellis & Goodyear 2016); a building that one knows is more likely to be called a place than a space. It therefore also follows that a place is familiar and evokes security. In an educational context, the familiarity of the university campus, the library, the cafeteria, the lecture hall, etc. contribute to that sense of familiarity and hence security and a sense of belonging. In contrast, the virtual classroom is a space, not a place, and while it offers a whole lot of new possibilities due to its innovative potential, it may also cause insecurity due to being new, intangible and obscure. It is therefore crucial that, as Ellis and Goodyear (2016: 150) put it, "to find ways of understanding learning spaces such that they can be managed efficiently, for a common good, without damaging the subtle processes of local, dynamic reconfiguration and habitation that help students and teachers make 'likely places' for learning."

People are social beings and need contact. This contact is given structurally by the teaching situation. Apart from the presence during the lessons, other aspects also play an important role. The walk to the lecture hall, the usual way across the corridor, the coffee just before the lecture starts, the chat with peers on the stairs, the smell and noise level of the building - all those things fall away. The spatial environment of the campus with all its visual, auditory and olfactory characteristics is non-existent in online teaching. We do not walk a building, nor do we congregate in a physical room as the room we are actually sitting in, is not shared by others. From the lecturer's perspective the students do not wait in a lecture hall, but in their private study, living room or kitchen. The spontaneous opportunity to clarify an urgent question shortly before or after class is eliminated, and even the larger concerns tending to be articulated in a live classroom context, do not always find the perfect ear, either not being voiced at all or simply drowned in the tinny surroundings of the online learning platform such as for example Zoom. There is no opportunity for informal chats just before a lesson; likewise, icebreakers at the beginning of a session pose a problem, too. In a traditional classroom situation, students may be welcomed individually as they drop in – in an online session this is far more difficult and socially challenging as the constant signalling of people logging on makes this kind of informal welcoming ritual almost impossible. Furthermore,

students often feel slightly anxious or even embarrassed when they first join a virtual session and hence do not react favourably to being called upon. What makes this sort of exchange even more difficult is the fact that most students do not feel comfortable entering the room with their camera switched on, a problem we shall consider in more detail in section three. In short, the whole sequence of arrival, settling in and being made welcome is rather different, and if not handled tactfully by the lecturer in charge, rather uncomfortably absent.

People are also creatures of habit. We associate certain surroundings with certain impending activities. Our brain tracks have stored these rituals coupled with their associations and thus guarantee a smooth and successful course for the required activities, which makes us feel safe. In order to perform these activities in a new, unfamiliar environment, our brain must first adapt and form new pathways. This does not happen from one day to the next and can therefore cause quite a bit of disorientation and insecurity. In social psychology, these associations are called schemas. Schemas are a blueprint according to which we behave and perform tasks in recurring situations. In other words, schemas are structures of thoughts and behaviour endowed with specific expectations and reactional patterns to them. Schemas are an important concept of the field of social cognition (the study of how people think about themselves and the social world) within social psychology (Bartlett 1932). We have schemas for commonly frequented places such as the supermarket, the dentist or the airport. In an educational context, schemas denote openly or (tacitly) agreed procedures, i.e. a certain way to go about things, and an orderly sequence of actions. Schemas are established over time and are triggered by contextual cues. If these are eliminated, we feel insecure since we have to construct new ones in order to rearrange our social reality and develop new mental processes that help us navigate new, emerging situations and spaces. In short, those schemas may not have been sufficiently established in the rather novel online teaching context, a reason why students find it difficult to orient themselves.

3. From community to isolation – lack of attribution cues

Another problem is nonverbal communication. Nonverbal communication helps people gather social information and interpret situations. In other words, it plays a major role in how we perceive our social space and our fellow human beings. Nonverbal communication includes gestures, posture, facial expression and eye contact. The latter is a vital source to make certain we are being acknowledged and listened to, and in the absence of other cues getting lost in the virtual space, actually play an even more important role in synchronous, online communication. It is, however, natural to make eye contact by directly looking at the person opposite, which does not work in front of a screen with a camera, because in order for the person opposite to feel perceived, one has to look straight into the camera and not at the person on the screen. Therefore, online eye contact is made indirectly, which takes some time and practice getting used to. Furthermore, eye contact is not only important between

interlocutors, but also to get reassurance from other people in the room, especially peers, that one is on the right track as far as meaning-making processes are concerned. Students rely on eye contact, for example, to verify whether their questions are justified or whether they might be the only ones having difficulties to follow their lecturer's explanations. It is a vital social tool to create a sense of security, community and belonging. In the virtual classroom, however, this direct, non-verbal communication is not available to them, which has a negative effect on self-assurance and also negatively impacts student engagement.

Nonverbal behaviour is a vital part of what social psychologists call social perception, the study of how human beings form impressions and make deductions about other people. Once nonverbal communication cues have been interpreted, we make a connection between our interpretation and the person who provided us with nonverbal cues. This is called attribution, which is an unconscious, automatic process our brain performs in order to avail us with the necessary information we need to read a social situation and our role in it. If vital cues get lost in the virtual space, this process does not kick in, which may cause anxiety and stress because neither self-assurance nor a sense of belonging develop without the appropriate information that facilitates social perception in terms of making attributions and, ultimately, sense of other people.

Nonverbal communication actually makes up about 90% of human communication whereas verbal communication plays a rather minor part. In online communication, however, verbal communication becomes, rather unnaturally, far more important. Online communication makes people more polite, which in itself is not such a negative thing, but it is also rather artificial. People are constantly apologising for interrupting each other. In 'ordinary' communication, there is often a brief overlap as one speaker ends an utterance and another begins. This overlap is rather natural because we are used to the prosodic contours and the rhythms of speech and therefore we can successfully anticipate when an utterance comes to an end. In online communication, natural speech is disrupted because of the slight time lag occurring between utterances, which, as a consequence, makes the natural overlap sound disruptive. In other words, natural human communication does not work in videoconferencing as those tools are made for a single speaker at a time, which again, has a negative impact on attribution processes and ultimately, on the possibility of peer bonding.

4. From individualism to conformity – lack of social information

As we have seen above, the virtual classroom deprives students of a number of important cues in terms of social cognition and social perception. The third issue we deem important in this context concern these missing cues that result in insufficient social information and in a sort of passive conformity. Conformity is another key concept in social psychology and describes the change in one's behaviour due to the real or imagined influence of other people.

The concept gained widespread recognition with the publication of Asch's and Milgram's seminal conformity experiments in the 1950s and 1970s (Asch 1951; Milgram 1974). The results of those experiments indicate that people use each other as a source of information in the sense that they base their judgment on what they perceive to be the majority's opinion about something. This happens either by private acceptance, i.e. they truly believe that their first conclusion may have been wrong and everybody else must be right, or by privately maintaining that their initial reaction to a problem was indeed right but conform to the majority's opinion, nonetheless. Apparently, this is especially true if the situation is ambiguous (Renfrow & Gosling 2006). In short, when in a confusing situation and unsure what to do, people tend to rely on other people to help them define the situation and model their behaviour based on other people's.

Ambiguity very aptly describes the virtual classroom; there is a lot of ambiguity because of the missing schemas and the lack of nonverbal cues as discussed in the previous sections, which at least partly explains why students' engagement is often a problem in synchronous teaching settings. The term 'presence' has acquired a rather different meaning because one is never quite sure who is actually there as rather a lot of students are just logged in without making themselves visible, i.e. lurk anonymously without exposing themselves or adjusting their microphone and camera. It is rather astounding how many of the so-called digital natives have a hard time with online teaching. They prefer to consume passively and are very reluctant to make themselves visible – the anonymity of the Internet is thus transferred to the virtual classroom. This is, however, not really their fault. Just because they grew up using the Internet does not mean that they are willing to embrace all the possibilities it offers. The main attraction of the Internet for the Millennials is that it offers anonymity, and that they can quickly access information and easily connect with peers through various channels, but it does not necessarily follow that they feel comfortable in an online lecture. Being anonymous may lower anxiety at times, but also impedes original, individual contributions and reduces the possibility to create a proper sense of belonging as "(it) takes away some of the knowledge of who is different from oneself in the course" (Dumford & Miller 2016: 461). Being anonymous in an ambiguous environment, which the virtual space is by definition and the virtual classroom by extension, where one never really knows what the peers are truly thinking, makes it seem rather normal to resort to this sort of passive conformity and not to make oneself visible as others do not do it either. It does, however, hinder smooth interaction as well as the creation of a safe and secure space of learning.

5. Conclusion

The list of challenging consequences online teaching has on natural human interaction is by no means complete and should be tested and complimented by means of empirical assessment procedures to create valid insights and practicable future guidelines for synchronous online

teaching. Furthermore, it would be interesting to investigate how different groups of students (age, gender, culture, social background etc.) deal with the challenges of online education. Here it must suffice to emphasize that by becoming more sensitive to the psychology of virtual spaces, we can at least make sense of those processes that are often neglected in online teaching research but have a great impact on students' engagement, sense of belonging and ultimately, their mental well-being. Online teaching is a great addition to traditional, live teaching. It provides the possibility to teach, support, and assess students remotely. However, despite all the opportunities the digital transformation offers, it will never replace proper, human contact. Or to speak with Yi-Fu Tuan (1977), one of the leading scholars in human geography and spatial theory: "Place is security, space is freedom: we are attached to the one and long for the other." As alluring as freedom may be, humans need attachment in equal measure.

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Students' learning can be enhanced via Centres of Teaching and Learning in Higher Education: A quick view all over the world

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Abstract

This paper studies the Centers for Teaching and Learning (CTL) of the 100 top Universities in the world and investigates their role and services. The vast majority of these Centers is located in educational institutions of the US, the UK, Australia and Canada. CTL services cover many areas and target several portions of the university population. They try to meet contemporary requirements and aim to enhance teaching, learning and research processes.

Keywords: *Centers for Teaching and Learning; services; university; support.*

1. Introduction

Continuous change in contemporary societies forces universities to discover efficient methods so as to be flexible and constantly updated (Raikou & Karalis, 2011). Kedraka & Rotidi (2017) point out the importance of higher education pedagogy. They consider it a multidimensional process which relates to specific teaching practices and approaches. They claim that training and support within the university environment can promote active student learning. Moreover, modern learning theories alongside the use of technology-enhanced pedagogical tools, call for more active student learning and a shift in the role of modern higher education institutes (Wells & Edwards, 2013).

Centers for Teaching and Learning (CTL) are relatively recent support structures, operating within academic institutions. They first appeared in the second half of the 20th century but they grew remarkably just in the last two decades. Given the particularity and variation among academic institutions around the world, there are significant differences both in terms of mission, functions, organizational structure (Hurtado & Sork, 2015), and in terms of the name used for these: usually we find them under the name Center for Teaching and Learning (CTL) or Centre for Enhancement of Teaching and Learning (CETL). Sometimes terms such as "excellence", "innovation" and "support" are also included.

According to Hurtado and Sork (op. Cit.), The Center for Teaching and Learning (CTL) at the University of Michigan was the first to be established in the United States in 1962. Over the last two decades, hundreds of tertiary education institutions in the United States have established such centers, responding to a similar national call, to support and promote remedial change in institutions. According to McDowell et. al. (2007), the corresponding offices in the United Kingdom (Centres for Excellence in Teaching & Learning - CETL) emerged from a "Government White Paper" entitled "The Future of Higher Education", published in 2003, which recognized that effective teaching and learning are essential elements for promoting excellence and opportunities in Higher Education. The Centres for Excellence in Teaching and Learning (CETLs) were proposed as a way to teaching and learning practices could be recognized, rewarded and good practice disseminated. In fact, successful CTLs would receive significant funding to enhance the learning experience of their students.

2. Our study of CTLs

We based this study on "The World's Top 100 Universities, 2020" and the "QS World University Rankings 2020" and we examined the orientation and character of CTLs. From the lists we included the first 100 institutions with a CTL or similar support structure.

According to *Table 1*, the vast majority of institutions with CTLs are in USA and UK (55%), other European countries (16%) along with Australia and Canada (14%) follow, while Japan and New Zealand (6%) and other Asian countries (9%) come last.

Table 1. Number of institutions with CTL per country.

Country	No of institutions having a CTL	Country	No of institutions having a CTL*
USA	35	Hong-Kong	3
UK	20	Belgium	1
Australia	9	Denmark	1
Canada	5	Germany	1
Japan	5	Finland	1
Netherlands	4	Norway	1
Sweden	4	China	1
S. Korea	4	Singapore	1
Swiss	3	New Zealand	1

*Total 100

CTLs mainly support faculty members in improving their teaching. By offering help and support to teaching staff, they aim to enhance students' learning (Fry et al., 2009). This kind of academic support derives from a student-centered approach to both teaching methods and teaching environment (Klemenčič et al., 2020). But as we can see in Table 2, almost half of the CTLs include students to their support services. That is a direct support approach.

24% of CTLs have special programs/courses for Teaching Assistants, while 29% offer support to post-graduate and 9% to post-doctoral students. They support and train these staff categories in order to obtain student learning enhancement. Apart from teaching support, research support is important for universities. So 15% of CTLs offer support programs for researchers in the fields relative to the teaching enhancement. While all CTLs must be in co-operation with other stuctures within the academic environment, 7% of them officialy support Schools, Sections or Teaching Units offering support during curriculum and program design, teaching material or teaching spaces choices.

Table 2. University population supported by CTLs.

Supported categories	No of CTLs (total 100)
Faculty members	99
Students	45
Researchers	15
Post-graduate students	29
Post-docs	9
Schools, Sections, Teaching Units	7
Teaching Assistants	24
Other staff	9

3. Services provided

The services provided by CTL are very widespread as the character of the institutions is not the same, the organization is different and they come from different countries/cultures. In Table 3 we tried to capture the main thematic areas, to which the CTL services refer.

More than half of the CTLs (52%) offer counseling support, very often personalized and tailored to the needs of the teaching staff that request them. A significant number of CTLs (40%) offer structured learning programs/courses/lessons for both teaching staff and students on a variety of topics. Also 44% offer labs/seminars/institutes, while the same percentage (44%) has teaching/learning resources-materials and/or libraries to support staff and students. On the other hand, only a 1/5 of CTL (21%) organizes events such as conferences or symposiums.

CTLs that enhance innovation and teaching excellence or offer corresponding teaching excellence awards reach the remarkable percentage of 44%. Similar is the number (42%) of CTLs that offer or promote scholarships or funding for teaching development, while enhancing professional development of teaching staff (16%).

Following the developments in digital technologies, more than 1/3 of the Centers (37%) offer ICT/educational technology training and mobile learning training. Almost 1/4 (23%) support the use of digital support platforms (Moodle, Zoom, Canvas, LMS etc) that have been developed or adopted by the respective educational institutions. In this context, several CTLs support online/distance teaching/learning or flipped classroom (Klemenčič et al., 2020).

Table 3. Services provided by CTLs.

Service / thematic area	No of CTLs (total 100)
Consultation services	52
Training programmes/courses/lessons	40
Labs/seminars/institutes	44
Teaching/learning resources/materials	44
Events	21
Innovation/ teaching excellence /awards	44
Scholarships/funding	42
Professional development	16
ICT/educational technology training	37
Digital support platforms	23
Online/distance teaching/learning	23
Learning communities/groups/networks	36
Research support	20
Course design	32
Teaching strategies /enhancement	18
Course observation/analysis	18
Curriculum/ program design	11
Assessment and feedback	42
Inclusive education	17
Studying strategies / academic success	22
Academic writing	12

In order to exchange knowledge and experiences, 36% of the Centers coordinate or encourage learning communities, exchange groups or special networks. At the same time, 20% offer support to researchers (undergraduate students to post-docs), as the universities themselves rely on research to produce knowledge.

Regarding the specific thematic areas, in which the Centers offer support, we could single out lesson design (32%), effective teaching strategies / teaching enhancement (18%), lesson observation/analysis (18%), curriculum/program design (11%), assessment and feedback

(42%) and inclusive education (17%). For students, in particular, support is offered in areas such as studying strategies / academic success and time management (22%) and especially academic writing (12%) (op. Cit).

4. Conclusion

CTLs were established to contribute in providing quality assurance concerning teaching and learning in higher education institutes. Academics are considered as the main and "most important learning resource" (EAQAHE, 2005:17) available to students and therefore a call for professionalizing higher education teaching is raised (European Commission, 2013; Pleschová et al., 2012). A student-centerd culture has been emerging in the framework of these academic learning communities, in order good practices, experiences, and concerns can be shared among academic teachers along with their ability to create and understand how to facilitate students' learning in digital environments and distance learning which are crucial after COVID-19 pandemic (UNESCO, 2020).

The aim of this study was to examine the main areas where CTLs offer services, courses, and support for teaching staff and students. Regarding the distribution of CTLs of the top 100 universities, it is rather not surprising that the vast majority of them are situated in the US, Canada, Australia, and Europe, following the relevant ranking of universities. It is worth mentioning that the majority of them do not restrict their fields of activities to teaching staff (faculty members, post-graduate students), extending them to students and research staff as well.

Concerning the thematic areas of the services provided, most of them offer training programmes and consultation/support, while some other interesting areas of activities include the production of educational materials, events organizing, and support for the use of ICT. As for the content of the courses provided to teaching staff, we can conclude that the main sectors are those of course design, teaching strategies, and feedback and assessment. For the courses and support provided to students, the main sectors of activities are those of studying strategies, academic success, and academic writing.

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Comparing Pre- and Intra-Covid-19 students' perception of the digitalization of higher education institutions

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Abstract

Higher education institutions (HEIs) are significantly progressing, especially to external affordances caused by Covid-19. Digital assets are an opportunity during the pandemic to secure social distance and enhance the students' learning experience at the same time. Also, student administration might benefit from new digitally-enhanced opportunities. There is no uniform procedure for the use of digital media in teaching and student services. Thus, HEIs need to ascertain students' attitudes toward the technologies used. To compare attitudes before and during the pandemic, we surveyed students about their perceptions. The first round of surveys was completed in a blended learning setting in fall 2019 before the global pandemic of Covid-19. The second round was conducted in an online learning setting in February 2021 after nearly one year of higher education under Covid-19. Our results show that students' perceptions toward digitalization at HEIs differ in many aspects due to the Covid-19 pandemic. Students during the pandemic are more critical of the effects on their learning success. The study indicates that the adoption has taken place more quickly in services. Still, teaching concepts and the learning culture are lagging.

Keywords: *Higher education; organization; digitalization; learning; technology; Covid-19.*

1. Introduction

Pandemic and digitalization are changing our daily lives. Already before the pandemic, teaching and learning at higher education institutions (HEIs) were changed by digital means (Castro, 2019). Student assistance, administration processes, knowledge transfer, and assessment become more digitalized. Digital infrastructure enhances constructive learning approaches, access to learning materials, communication, and cooperation between different interest groups. For many HEIs, digitalization is a trend to follow. Nevertheless, it became imperative during the pandemic. HEIs are having difficulties in adopting technologies (Carver, 2016; Reid, 2014). Now, they are forced to implement them. As different stakeholder groups have very different demands, their complex entanglements hinder the digitalization of the HEIs (Reid, 2014).

This paper contributes to research aiming to explore existing issues in digitalization. From the students' point of view, we survey their perception of their HEI's digitalization before and during Covid-19. Our working hypothesis is that there is a difference in the perception due to the enforced acceleration of digitalization. Thus, our research question is: How differently do students perceive their HEI's digitalization in 2019 and 2021? We examine their perception by employing dimensions such as trust, learning, and organizational culture.

In our study, students experience digitalization as users. As they grew up as digital natives (Crittenden, Biel, & Lovely, 2019), they are particularly critical of the digitalization of HEIs. Moreover, they will experience the effects of digitalization in their professional careers (Friga, Bettis, & Sullivan, 2003).

In the next section, we present the theoretical background of our work. After, we introduce our research approach, followed by a description of the results. We close the paper with short conclusions and explain the implications and limitations of our work.

2. Digitalization of Higher Education Institutions

Digital technologies in education support lecturers in enriching learning resources and evaluating learning goals (Vogelsang, Droit, & Liere-Netheler, 2019). Further, digitalized processes accelerate service support. Digital technologies converge teaching and administration. Thus, students' results become more transparent and transferrable. Also, convergence has the potential to lead to more efficient processes. As HEIs operate in a more and more competitive environment, efficiency and competitive advantage become imperative (Adler & Harzing, 2017). With the ubiquitously digital availability, faculty and administrative staff issues arise (Proserpio & Gioia, 2007).

Digital assets have been used very heterogeneously in higher education. Now, the pandemic forces HEIs into usage and adoption (Mittal, Mantri, Tandon, & Dwivedi, 2021). Often,

research has focused on the evaluation of learning settings (Lapitan, Tiangco, Sumalinog, Sabarillo, & Diaz, 2021), effects of students' individual learning success (Janson, Söllner, Bitzer, & Leimeister, 2014), or measurement of systems' acceptance and success (Tselios, Daskalakis, & Papadopoulou, 2011; Ouajdouni, Chafik, & Boubker, 2021). Besides drivers and barriers (Gregory & Lodge, 2015), studies provide suggestions for the didactic design of learning elements (Talley & Scherer, 2013; Tejedor, Cervi, Pérez-Escoda, Tusa, & Parola, 2021). A smaller branch of research deals with organizational anchoring and adoption (Porter & Graham, 2016). Even the pandemic did not trigger strong operational responses in HEIs (Miller, 2021). In HEIs, some resistance to change exists and is a source for issues with organizational integration of digital technologies (Al-Senaidi, Lin, & Poirot, 2009). Especially, teaching scenarios play a significant role in research in higher education. Thus, generalizations of results are only possible to a limited extent. A generally accepted instrument that addresses challenges and shows solution paths is still lacking.

3. Research Method and Sample

To measure the impact of the Covid-19 pandemic and associated constraints, we collected data at two different time points. The pre-pandemic data collection was conducted to analyze the general view of students on the digitalization of their HEIs (Brink, Packmohr, & Vogelsang, 2020). An intra-pandemic data collection was added with the same instrument in the same courses to compare results. Thus, the respondents changed because we surveyed different cohorts of students. Nevertheless, the two groups follow the same study plans and have the same profiles.

The questionnaire comprises 16 different statements that refer to various potential areas of concern in digitalization. The students rated statements on a five-point Likert scale ranging from "I do not agree at all" (1) to "I strongly agree" (5).

The pre-pandemic sample was surveyed during August/September 2019, consisting of students from elective management courses: a) Business Process Management and (b) Digital Transformation. The students were asked in class to fill out a paper-based questionnaire. Additionally, we contacted students from earlier terms of these courses and included former participants of the course "Project Management" (Master's in Management/Information Systems) to participate in an online survey. We selected these courses because they instruct with a blended-learning approach of digital components and a supplementary attendance part. Furthermore, they included digitalized administrative processes such as course subscriptions, exam registrations, and communication supported by technology. From this sample, we received 97 completed questionnaires.

The intra-pandemic sample was surveyed during February 2021 in the same courses. In total, we were able to collect 113 completed questionnaires that were filled out online. Due to the

global Covid-19 pandemic, the course designs have massively changed due to contact restrictions and hygiene regulations. The courses went from a blended design to digitally only. Even the supplementary attendance part was conducted online. Besides, exams were taken online, and the administrative processes were converted into contactless and digital services. As a result, student life has taken place solely at home. Thus, students were likely to be confronted more with the issue of digitalization at their HEI.

Currently, the digitalization at HEIs is provoked through an externality. Comparing the pre- and intra-pandemic samples offers the chance to examine the change in students' perceptions.

4. Results and Discussion

In the following, the results from both time points are compared to understand the impact of the Covid-19 pandemic on students' attitudes in greater detail. We compare the means and standard deviations (std. dev.) of both samples' statements. Also, we calculate the deviation (delta) between these two time points to demonstrate the differences. Table 1 shows the results.

Regarding the pre-pandemic results, the mean values for the changed learning characteristic show no felt disadvantage from the blended learning design. However, the students do not emphasize a clear digital progression within the teaching by their HEI. Results from the intra-pandemic sample look much differently. The students see more disadvantages in their learning with the online courses. Also, the digital progression is judged more critically. This characteristic shows the highest deltas of the study. Even the std. dev. shows higher results. The students realize a small change in the digitalization of services. A greater change is registered within the digitalization of processes. The std. dev. raised a bit for the services. Thus, the opinions of the students have a greater variation. Students perceive a positive effect of enforced digitalization within the HEI's processes, e.g., making tasks such as registrations easier. Although students are more critical of the HEI's culture, they have a more positive perception than before towards constant development and new teaching ideas. Especially in this characteristic, there might be a clash between long-term and short-term effects. New teaching ideas, such as setting up break-out rooms for small group discussion, can be organized easily. Cultural changes take a longer time. Especially concerning fast-moving technologies, the culture at HEIs might be perceived as more and more traditional. The smallest changes are visible in the resources. At the same time, both means are rather high, showing a limiting factor in digitalization. Likewise, students do not perceive an increase in projects and positions related to digitalization. As digitalization became an imperative during the pandemic, HEIs are forced to adapt their strategies. Students recognize the efforts made during the pandemic.

Table 1. Mean Values and Standard Deviation.

Characteristic	Statements in keywords related to students' HEI perception	Pre-Covid		Intra-Covid		Delta Mean
		Mean	Std. Dev.	Mean	Std. Dev.	
Changed Learning	Changed course form harms learning success	1,05	1,05	3,31	1,29	2,26
	No advantages of technical support by the digital learning platform	1,87	1,02	2,84	1,13	0,97
	Existing methods for teaching & services	2,04	0,72	3,51	1,22	1,47
Changed Services	Digital services offered to support studies	3,40	1,04	3,62	1,27	0,22
	Internal processes digitized	2,92	1,07	3,77	1,04	0,85
Cultural	No change in learning culture	2,10	1,02	3,03	1,30	0,93
Change	Constant learning to get better in how to transform digitally	3,26	0,95	3,77	0,96	0,51
	Openness to new ideas in teaching	3,36	1,01	3,85	1,06	0,49
Resources	Specific jobs/projects for digitalization	3,29	0,79	3,44	0,89	0,15
	Not enough resources for the digital learning platform	2,51	1,09	2,84	1,28	0,33
Strategy	HEI's digitalization moves forward	3,33	0,94	3,87	1,02	0,54
	Management supports digital transformation	3,25	0,83	3,92	1,09	0,67
	HEI has clear vision or DT strategy	2,94	0,84	3,48	1,07	0,54
Trust	Own control of data storage	2,55	1,16	3,18	1,04	0,63
	Trust in HEI in handling generated data	3,86	0,99	3,41	1,24	-0,45
	No effect of data transparency on digital learning platform use	3,66	1,02	3,56	1,01	-0,1

Source: Cf. (Brink, Packmohr, & Vogelsang, 2020) for exact wordings of the items.

The commitment of the HEI's management to digitalization is perceived more clearly. The last characteristic shows a further negative impact. Due to the Covid-19 pandemic, teaching is increasingly handled via digital learning platforms. Data from the platforms that lectures

can access does not change the platform's use. Although, students show lower trust in the HEI in handling their data in general. Especially at the beginning of the pandemic, not every HEI could rely on privacy-compliant systems and had to use, e.g., video conferencing systems with questionable data protection.

Comparing the pre-pandemic and the intra-pandemic sample clearly shows a negative trend in the characteristic changed learning. Students emphasize that the changed form of the courses in the pandemic harms their learning success. The study's greatest delta (2,26) is observed here. The standard deviation also increased for almost all statements, indicating that attitudes are more divergent among students. As a pandemic is a complex experience, it is not affecting all students equally. This effect was also demonstrated in a study by Aucejo et al. (2020). In particular, low-income students were more negatively affected. Although other studies found an improvement in students' performance during the pandemic (Gonzalez et al., 2020), the perceived learning success doesn't seem to indicate the same result. Generally, there seems to be despair between young people's perception and their real knowledge (Sommer 2014). In this case, students' performance might be better than they would expect it due to the changing environment.

5. Conclusions and Limitations

This study focuses on students' perception of higher education institutions' digitalization at different time points of the Covid-19 pandemic. We surveyed a group of management students in different courses with a blended (pre-pandemic) and complete online design (intra-pandemic).

Our results show that students' perceptions toward digitalization at HEIs differ in many aspects due to the pandemic. Students during the pandemic are much more critical of the HEIs' digitalization in terms of their own learning success. They perceive the blended course design as superior to the online design. However, the increasing standard deviation suggests that not all students are affected equally.

The pandemic had caused a need to change the course designs in a short time. Also, the HEI was forced to offer its services digitally immediately. For the students and all other stakeholders, this development was an exceptional change. Our study indicates that the adaptation has taken place more quickly in services and that teaching concept and the learning culture lag development. Adjusting to the new status quo takes time. Further monitoring is needed to evaluate how student attitudes change over time. Moving away from traditional teaching methods, such as transforming lectures to an online format, might require more lead time. Also, transforming the culture of learning is a long-term task.

The research presented is not without limitations. The results are based on a survey of management students in some of their elective courses. This group could have a positive relationship to digitalization, leading to a bias. Furthermore, a longitudinal study of the same cohort of students can be expected to generate more reliable results as the perception of the same respondents would be collected over time. Unfortunately, it is hardly possible to control such a study as students fluctuate. The students surveyed show some affinity to technology. The courses they studied are electives loosely connected to the topic of Information Systems. Thus, we aim to further examine the topic in a larger survey with a more diversified group of students from other less and more technology affine programs and other levels of education. Also, an additional collection of demographic data, such as income or living situation, could lead to a better explanation of the higher std. devs. Generally, a pandemic is an extensive experience leading to stress in a lot of different aspects of life. In our study, students experience differences in the course design as a proxy for a pandemic experience. Thus, we do not directly measure the influence of the pandemic. Currently, a greater negativity regarding pandemic restrictions could have an impact on our results. A post-pandemic follow-up might lead to more clarification.

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Do proctored online University exams in Covid-19 era affect final grades respect face-to-face exams?

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Abstract

The Covid-19 pandemic forced universities to convert their traditional face-to-face exams to online exams with doubts as to whether student cheating or technical difficulties would affect their final grades. After taking three of these exams online, we considered comparing their grades with those of previous years on traditional exams. The average mark of the traditional exams before the pandemic was 6.95 over 10, while the average mark of the three exams carried out in the Covid-19 era is 6.64. The student's t test indicated that there are no significant differences between the two types of exams in the mean ($p = 0.408$), the median ($p = 0.378$), the range ($p = 0.307$), the minimum ($p = 0.410$) and the maximum ($p = 0.072$). Taking online exams did not modify the exam grades compared to previous years. There is a lot of variability in similar studies in the literature due to cheating that can be performed in online exams. A proctoring system, good question design, and limited exam time can minimize these differences.

Keywords: *Proctoring; online; exams; cheating; tests; grades.*

1. Introduction

The quarantines and lockdowns decreed by practically all governments during the spring of 2020 due to the Covid-19 pandemic forced universities around the world to quickly transform their teaching, practices, and exams to online training due to the impossibility of performing them face-to-face. One of the most difficult decisions was regarding exams: not holding them in classrooms with the supervision of professors would lead to cheating, fraud and copying between students using the multiple possibilities of information technologies. One of the possible solutions was the oral exams by videoconference, but they ran into many difficulties: impossibility of solving problems that require autonomous work or writing, finding questions of homogeneous difficulty or excessive examination time to evaluate hundreds of students (Haus *et al*., 2020).

Many Universities chose online exams, a technology that had been available for decades. As early as 2001, Alexander's team, realizing that many teachers were moving their exams to online platforms, warned about the need to maintain academic integrity through supervised online exams. (Alexander *et al*., 2001). It is easy with current technology to find the answers to the exam questions, and there are even companies that carry out the exam for the student (Daffin Jr & Jones, 2018). Academic dishonesty includes: conducting the exam by an expert instead of the student, several students taking an exam that should be individual, using prohibited sources such as books or Internet webpages (Reisenwitz, 2020), sheets with annotations, plagiarizing a work or copying exercises (Daffin Jr & Jones, 2018), waiting to take your own exam so you can get answers from other students, making false statements to be able to take the exam again (for example claiming that the connection failed), setting up two computers (one to perform the exam and another to find answers) or even buying the answers on the Internet (Moten Jr *et al*., 2013).

For this reason, numerous supervision software was developed based on the same principles: a camera on the student's computer that records its activity, allowing the professor (live or later) to observe if the student speaks, looks for information in books, or uses the mobile phone. Furthermore, these programs limit the functions of computers: they prevent opening the internet browser, calculator, copy and paste functions, etc. In this way, it is possible to control unethical behavior or cheating.

These programs do not always work well. Milone's team stopped using them due to ongoing technical problems experienced by students, the overall impact on the educational experience, excessive technical requirements, and additional costs for students (for example to buy a webcam), which to their judgment outweighed the benefits of avoiding cheating on exams (Milone *et al*., 2017).

One of the main doubts that online exams raise is whether they will impact students' grades, an issue on which our work will focus.

2. Objectives

Our goal is to check whether taking online exams has had an impact on students' grades. Although general research wishes to find differences between groups (alternative hypothesis), in this concrete case the good news would be that the implementation of online exams has not influenced students' grades, and therefore migration to online exams during the Covid-19 pandemic has not affected the performance of our students.

3. Material and methods

In the first place, we will carry out a retrospective search of the grades of the Anatomy III and Anatomy IV subjects taken by medical students at the Cardenal Herrera CEU University in Alfara del Patriarca (Spain). Both subjects are taught respectively in the first semester (autumn) and second semester (spring) by the same professor, which guarantees homogeneity in teaching and in the difficulty of the questions in the exam. In each subject, a midterm exam and a final exam are carried out and they are assessed on a total of 10 points. We collect the marks from the 2017-2018 academic year until the recent final exam held in January 2021 (the only exception is the Anatomy IV 2020 midterm exam which was canceled). The last three exams were taken online during the Covid-19 pandemic using proctoring tools, and the previous ten exams were taken in the classroom with teacher supervision. We will use the student's t test to compare the means between both groups of exams to check if there have been differences between both groups.

4. Results

Table 1 shows the main descriptive results of each of the 13 exams. The first three are the online exams while the next ten are traditional face-to-face exams. You may notice some small fluctuations between the number of students who take the midterm and final exam, they are exceptions based on several explanations: students who finally decide not to take the final exam, or who enroll the course late, or who cannot take the midterm for whatever justified cause.

At first glance, the average has oscillated in each course between values close to 6 or 7, every year there have been outstanding marks of 9 or even 10 and every year there have been failed students below 5. It is striking that in the last exam in January 2021 the range has decreased a lot, finding all the marks between 4.27 and 9.73.

Table 1. Measures of central tendency that describe the different exams.

	Delivered exams	Average	Median	Standard deviation	Variance	Range	Niminum	Maximum
Final Anatomy III 2021	59	6,98	6,93	1,46	2,14	5,47	4,27	9,73
Midterm Anatomy III 2020	58	6,28	6,71	2,06	4,25	8,40	1,35	9,75
Final Anatomy IV 2020	55	6,65	6,80	1,77	3,13	8,13	1,60	9,73
Final Anatomy III 2020	59	5,93	5,67	2,12	4,51	9,53	0,47	10,00
Midterm Anatomy III 2019	59	6,16	6,30	1,99	3,97	8,10	1,90	10,00
Final Anatomy IV 2019	47	7,14	7,47	2,03	4,12	7,07	2,93	10,00
Midterm Anatomy IV 2019	49	7,71	8,20	1,85	3,44	7,20	2,80	10,00
Final Anatomy III 2019	51	7,14	7,50	1,81	3,26	7,60	2,40	10,00
Midterm Anatomy III 2018	50	6,60	7,30	2,18	4,74	9,70	0,30	10,00
Final Anatomy IV 2018	61	7,03	7,33	1,88	3,54	8,13	1,60	9,73
Midterm Anatomy IV 2018	60	7,88	8,29	2,00	3,98	9,17	0,83	10,00
Final Anatomy III 2018	63	7,17	7,27	1,65	2,71	6,81	2,73	9,54
Midterm Anatomy III 2017	61	6,85	7,10	2,01	4,06	8,20	1,80	10,00
Total online tests	172	6,64	6,86	1,79	3,22	8,40	1,35	9,75
Total traditional tests	560	6,95	7,29	2,03	4,10	9,70	0,30	10,00

Source: self-made

Figure 1 represents in a boxplot the distribution of the exams for a quick easy visualization. At first glance, is not observed a great variability among the three tests of the Covid-19 era.

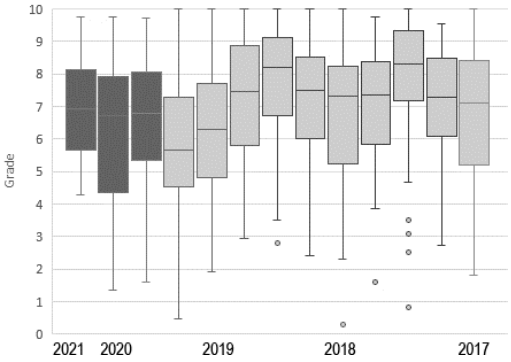

Figure 1. Boxplot of each one of the exams, showing retrospectively the range and median. The first three dark on the left are the on-line tests. Source: self-made.

We can group the grades of all students into two groups: online exams and traditional exams, thus obtaining the last two rows of Table 1 and graphically expressed in Figure 2.

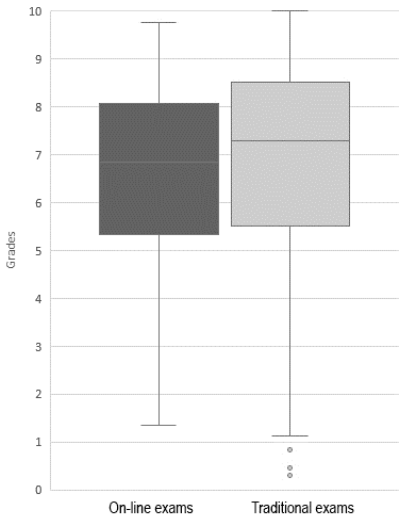

Figure 2. Boxplot of all exams grouped in two categories: On-line and traditional. Source: self-made.

The average mark of the traditional exams carried out before the pandemic was 6.95, while the average mark of the three exams carried out in the Covid-19 era is 6.64. To check if this difference is statistically significant, we have performed the student's t test to compare the different parameters using the categorical classification variable "online exam" or "traditional exam". In all the applied parameters, Levene's test indicated that equal variances were assumed, and the two-sided p-values for each of the parameters were not significant. That is, for 11 degrees of freedom, the mean ($t = -0.860$, $p = 0.408$), the median ($t = -0.919$, $p = 0.378$), the range ($t = -1.072$, $p = 0.307$), the minimum ($t = 0.857$, $p = 0.410$) and the maximum ($t = -1.993$, $p = 0.072$) do not represent a statistically significant difference between the two groups. This statement allows us to conclude as the main objective of the study, that the fact of conducting online examinations did not modify the exam parameters with respect to previous years.

5. Discussion

One strength of the study is to have compared it with exams given by the same teacher to different groups of students with a homogeneous level of difficulty and the same subject for all. One limitation is having done it on only three exams, so it is likely that as students are getting used to taking exams online, they may have better (or worse) results than with

traditional exams. When reviewing similar experiences in the bibliography we find two types of studies:

5.1. Studies that found differences

Some studies disagree with our findings and do find significant differences. Alessio *et al* indicate that the results with video-proctored exams were significantly lower (17% obtained an A grade) than the unsupervised ones (63% obtained an A grade). In addition, the unsupervised needed more time to complete the exam, which make them suspect that they were searching for the answers. They conclude by emphasizing the importance of using proctoring to combat academic dishonesty (Alessio *et al*., 2017). According to Goedl & Malla (2020), the average grades of students on unsupervised online exams are statistically higher than on proctored online exams, so the two types of exam are not equivalent.

We found the same results in Harmon & Lambrinos (2008), suggesting that differences were due to cheating. Hylton *et al*., (2016) also indicated that the unsupervised students needed more time to complete the exam, in a similar way to Prince, Fulton, & Garsombke, (2009), Richardson & North, (2013), Truszkowski, (2019), Weiner & Hurtz, (2017), and Wellman & Marcinkiewicz, (2004) that obtained same conclusions. Curiously, no one found better grades in the supervised group than in the unsupervised group.

5.2. Studies that found no differences

However, many other studies find results similar to ours, with no differences between groups. Mozes-Carmel & Gold (2009) conducted a large-scale study with 1,800 students, taking advantage of the fact that Nova Southeastern University decided in 2003 that all exams would be held online. They found no statistically significant difference between the average scores of the supervised and unsupervised exams and attributed this to the type of exam questions. Beck (2014). also found no differences between the two groups and attributed it to techniques to reduce cheating: randomizing the order of the questions, showing one question at a time, and not going backward through the questions. Other studies that do not find differences between groups are Howard, (2020), Ladyshewsky, (2015), Lee, (2020), Stack, (2015), Wibowo *et al*., (2016), Woldeab & Brothen, (2019) and Yates & Beaudrie, (2009).

5.3. What can we do to fight against academic dishonesty?

To consolidate the non-difference of results it is necessary to fight against academic dishonesty. Tips found in literature for minimizing cheating on exams include: do not allow going back on questions, show the questions randomly, show the different answers to the question randomly, reduce exam time, design questions based on learned knowledge and skills rather than identifying one answer among five options. If it is possible, include essay questions. Disciplinary sanctions and their consequences also have a dissuasive effect, as

well as including a clause of good repute at the beginning of the examination (Daffin Jr & Jones, 2018). It is also possible to use open book exams (Alessio *et al*., 2017), use comprehension, analysis, and practical application questions instead of simple memory questions (Howard, 2020). It also helps to take a practice test at the beginning of each course (Anderson & Gades, 2017).

6. Conclusion

We conclude that conducting online exams during the Covid-19 pandemic has not had an impact on the grades of students, and no grade differences were found respect those exams performed in a traditional face-to-face way. These conclusions allow us to encourage teachers and students who fear that online exams will alter the grades to have solid data that leads to reject that worry. There is a lot of variability in similar studies in the literature that can be explained by different cheating methods that can be performed in online exams. A proctoring system, good question design, and limited exam time can minimize these differences.

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Meeting diversity during the covid-19 pandemic in a fully online learning environment

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Abstract

Diversity among engineering students is growing more and more acknowledgeable in higher education – especially in first year classes where in applied universities students from many backgrounds form new classes. Differences in education (high school, job training, dual careers, etc.) are as common as various social aspects (family duties, etc.) that delay full time studying. This challenges students as well as lecturers especially in the covid-19 pandemic of 2020/2021. A standard based portfolio grading enables students to participate and place different skills in their cumulative assessment. The online course structure using Moodle as content management system is based on inverted classroom teaching scenarios. These are supported by peer-to-peer lecture films and micro-lectures along with various online teaching materials and online meeting sessions. The portfolio cumulatively grades lectures, presentations, forum discussions, written homework and glossary entries. Although benefits of present classes are obvious the course results improved over previous semester especially for students with language difficulties. This paper reflects on the possibility to meet diversity in the covid-19 pandemic and enable first year mechanical engineering students to grow more homogeneous regarding scholarly work.

Keywords: *Diversity; language skills; lecture film; inverted classroom; first year students.*

1. Introduction

Especially in first year classes where in applied universities students from many backgrounds form new heterogeneous classes diversity among engineering students is growing more and more acknowledgeable in higher education. Student backgrounds differ in education as well as social aspects hindering full time studying, e.g. they may enroll directly from high school, have had job training, or went for dual careers. Some are taking care of little children or supporting elderly family members. With the covid-19 pandemic more personal problems enter the study schedule. Generally, high school students had good education in math, physics and chemistry whereas students with job histories have advantages in applied subjects such as technical mechanics, design or material science: Pfennig (2020). Because as a future maker of things students should investigate and learn with a strong practical motive: Ashby *et al*. (2013), Pfennig (2016), Pfennig (2018). Therefore, at HTW-Berlin, Germany, Material Science is taught based via "design-led" teaching approach: Ashby *et al*. (2013) including inverted classroom teaching scenarios: Berret (2012), Brame (2015), Pfennig (2016), Pfennig (2018), Pfennig (2019). Here, students study the science on their own without time limit and then take time to raise questions and discuss details, solve hands-on problems, perform group work and master difficult problems in class. Setren *et al*. (2019) reports success for the "inverted classroom" teaching method only for MINT courses neglecting progress for economic related teaching. Still, it enables students to discuss early and communicate in a scientific related course such as Mat. Sci. in equal measure: Pfennig (2016), Pfennig (2018).

In general, grading and reporting on student learning continue to challenge educators especially in divers classes. The educational benefits of standards-based: Sadler (2005) versus the traditional score-based grading have been modelled quantitavely by: Marbouti *et al*. (2016) showing that standards-based grading is based on "the measurement of the quality of students proficiency towards achieving well defined course objectives": Heywood (2014). But, only if the grading provides quality information about student learning, is carefully planned and excellently communicated it is successful: Guskey and Pollio (2012). Standards-based assessments provide clear, meaningful, and personalized feedback for students related to learning objectives if the course objectives are well defined beforehand: Heywood (2014).

Especially time limited exams with strong focus on verbal expression not mathematically precise description penalize students with language or reading difficulties. Morover, presentations, answering questions and group discussions are also of disadvantage to students with language difficulties and to those insecure of presenting results – especially in a digital online environment. Students with outside of university duties, care of family relatives and personal problems will face difficulties turning in semester-homework on time. The cumulative assessment of the Material Science course introduced earlier: Pfennig (2018), Pfennig (2019), Pfennig (2020) offers a promising alternative to meet diversity – especially in a fully online teaching environment, such as summer and winter semester 2020/2021.

2. Course structure and assessment

The originally blended learning course approach: Pfennig (2018), Pfennig (2020) was restructured to meet the requirements of full online teaching and assessment in summer and winter semester 2020. Usually, face-to-face time is 4 hours/week accounting for 6 ECTS. To shift the focus towards the learning progress and at the same time acknowledge different learning skills and abilities the course assessment was decentralized: Pfennig (2020). Widely differing cumulatively adding activities were established over the 12 to 16 weeks of the semester with regard to the learning objectives (Figure 1). Scientific peer-to-peer lecture films: Pfennig (2018), Pfennig (2019) and micromodule lectures provided via the content management system Moodle are the main learning resources. In addition different teaching materials e.g.: worksheets and worked solution, mindmaps, glossaries, memory sheets, online tests and web-based-trainings WBT are available: Pfennig (2016), Pfennig (2018). Weekly online teaching sessions using big blue button and zoom were invariably used for clarifying, answering questions, role plays and hands-on tasks in break-out rooms. According to the inverted classroom teaching approach knowledge transfer was rigidly set for the guided self-study periods only. This concept refers and applies to different learning styles, possible language problems and different personal, social, scientific and ethnic backgrounds of most of the averagely 45 students per semester, as first introduced in: Pfennig (2020).

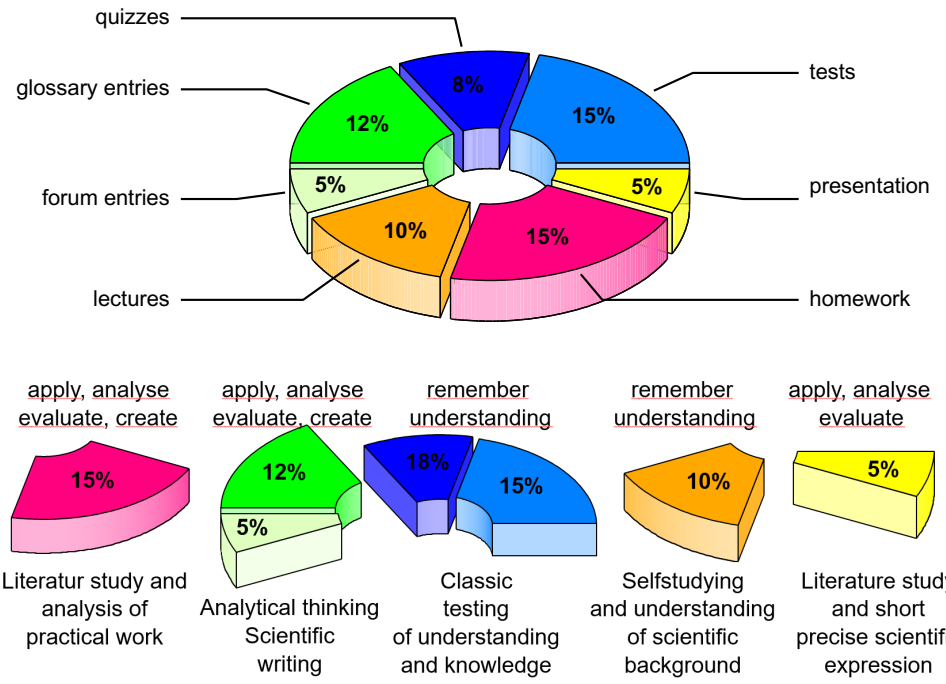

Figure 1. Grading Assignments (top) and main learning outcomes (bottom) in the Moodle based materials science course (5 ECTS).

Moodle provides an excellent basis to establish graded activities that are followed or accompany each lecture or theme: Pfennig (2018). All semester activities (50 points) were weighted appropriately and implemented as compulsory. The final Moodle exam based on tests during the semester counts for 10 points (in sum 60) with progressing credits towards the end of the semester to to prevent students from stopping to study after they reached the necessary 30 points to pass the course. Alternatively, up until the final week of the semester students could choose to take a final exam instead of the cumulative course assessment counting for all students transferring in the middle of the semester, repeating students and those coming from different study subjects.

3. Course results with regard to the online semester SS2020

Due to data restriction on students social background the diversity of the course is exemplary stated by the language background (Figure 2). Averagely students scored 40 (C+) out of 60 possible points in 2015/16, 49 (B) in SS2016, 54 (A-) in WS2016/17, 36 (C) in SS2017, 42 (B-) in SS2018, 39 (C+) in SS2019 and 43 (B-) in SS2020. The summative assessment of the course does not indicate significant improvement of learning outcome when students were requested to study during the entire semester. However, it is noteworthy and important to consider the grade distribution: The cumulative Moodle course assessment offers more students access to good grades, such as A- to A+ compared to the course assessment via final exam. It is very important to know about the special situation in Germany: since 2015. Refugees mainly from the Arabic peninsula, Syria, Libanon, and partly from the Maghreb, Tunisia, Marokko and Egypt are involved in asylum affairs and students with very little language skills enroll into applied Universities to start or finish studies. In summer semester 2018 these students were allowed to enter without the otherwise necessary DSL-2 language certificate (B2, C1 average): Pfennig (2020) and also in SS2019 students were allowed to postpone their language certificate until the third semester. Despite good engineering capabilities the missing language skills severely constrain learning progress and success (Figure 2). However, even in summer semester 2018 fewer students failed the class when their background was non-native German speaking which was not repeated in SS2019. The best course grade for GSL (german as a second language) students in SS2018 was B+ and in SS2019 B. In SS2020, however, even GSL-students scored A+ and non of these students failed the class. In SS2020 the Corona-Pandemic requested all courses to be taught fully online. Face-to-face time was exchanged for online sessions with hardly interactions of the first year students at all. Still, especially students with migration background were very eager to study and follow the course on an weekly basis. The grade average in SS2020 does not differ significantly from previous semester. However, GLS-students significantly score better in an online setting than blended learning setting This clearly indicates that the cumulatively

assessed Moodle course is successful even in a fully remote setting.

In the blended learning setting of SS2018 and SS2019 approximately 30% of the students with German as second language GSL did not attend the face-to-face time with exception of the explicit inverted classroom scenarios with lecture captures as mandatory preparation and small group work during class. They explained that they did not understand the lecture due to their lack in language understanding and had to look up many words and sentences in a dictionary and that is was much easier and successful in terms of learning outcome to study at home with their peers. During the online semester of the covid-19 pandemic students at home now had enough time to read, look up words, discuss, exercise and understand using the different learning materials provided in the Moodle course: Pfennig (2018). Feedback given during online-sessions was rated valuable and reflected the students` study progress.

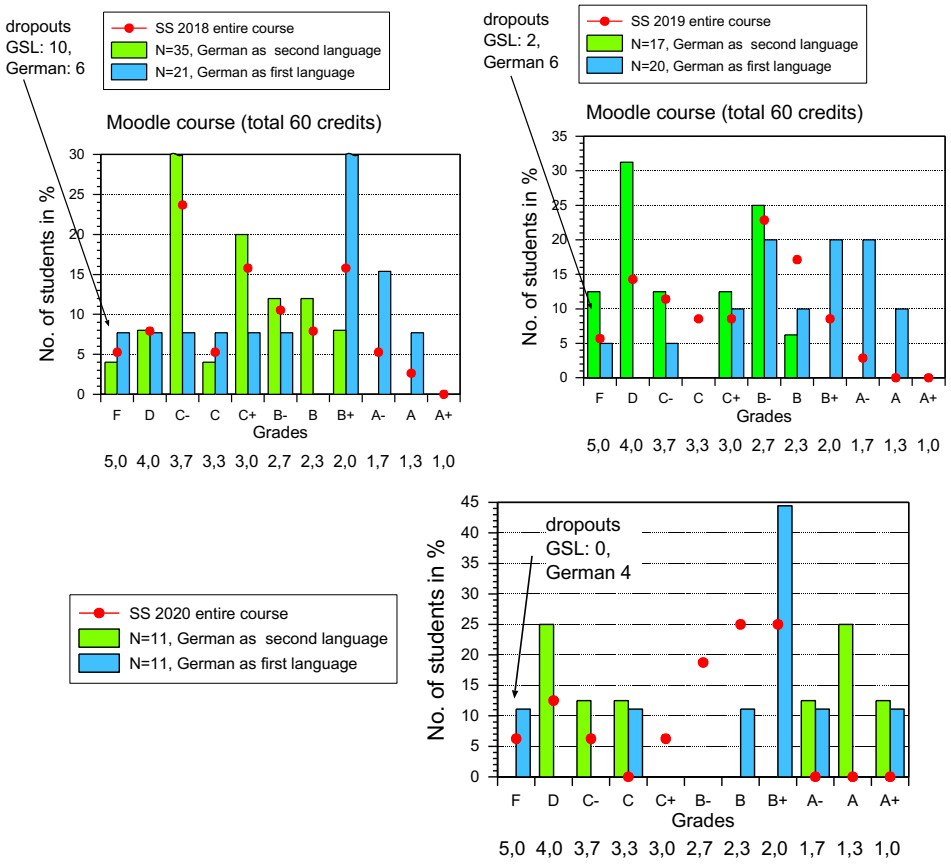

Figure 2. Material science course results SS2018 to SS2019 (blended learning) and SS2020 (full online course) accounted for German as a first and second language applying the cumulative Moodle-based assessment).

4. Evaluation

Despite all negative aspects of the covid-19 pandemic and required fully online-semester the possibility for students in a first year material science class to study in their own velocity and to work on projects in small groups with their peers seems to be beneficial for the diverse student group and especially for students with German as a foreign language. Also, the possibility of the lecturer explaining details according to the special needs allowed students to approach hands-on problems skillfully. Students who had to work or take care of family members could participate without knowledge loss, because the Moodle course offers time and place independent studying (learning materials are reusable and repeatable) and self-assessment. Students of the covid-19-semester SS2020 rate the course and its assessment in agreement to students who attended the blended learning classes (Figure 3). Although the course could be easily managed from a distance approximately 65% of the course attended the online sessions time regularly.

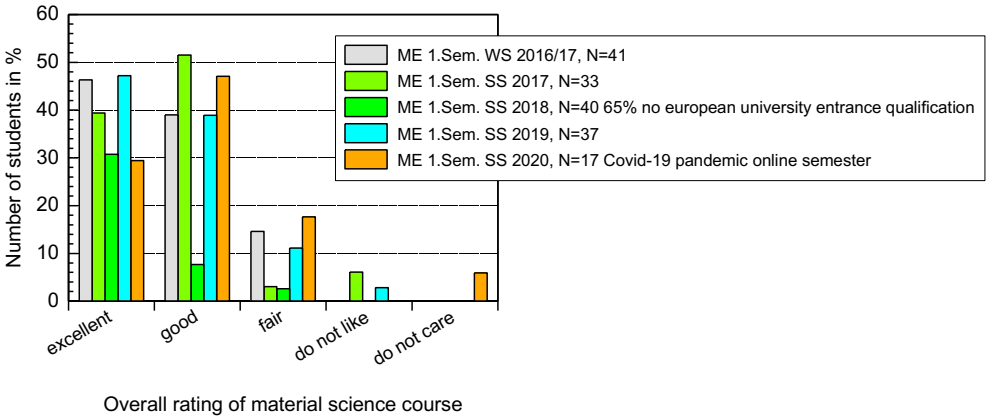

Figure 3. Evaluation of the material science course with regard to the cumulative assessment SS2016 to SS2020.

Indeed, students with migration background and language problems generally scored lower in tests due to time limits and difficulty in reading and understanding questions without using a dictionary. But, because the different activities offered enough possibilities to pass the class and even score high, they put a lot of effort into their studies – and in SS2020 even scored A+ (Figure 2). In the pandemic online semester of SS2020 the diversity in learning outcome was reduced and homogeneity regarding language background enhanced. It seems that with all students forced to study self-directed with no classroom interaction and forced teaching situations language problems were overcome. Note, students with the same language background formed rather homogeneous study groups with speaking French or Arabic during group work. Usually these language problems are a big obstacle for the homogeneity of a class but did not account for the pandemic covid-19 semester 2020. Generally, students were

given more responsibility for their learning progress during the semester which was found to encourage critical thinking: CSU (2015), that results in deeper learning outcomes: Simon *et al*. (2010). The author wants to remind, that all the advantages may be lost when online-sessions are used for knowledge transfer only. It is highly recommended that online time is used for explanations and small group work in break-out sessions. In these more individual and hence safer environments students are more lively, ask questions and feel addressed in person which is directly related to good leraning outcome. Small groups, individual positive feedback and also phone calls on the well being and study progress seemed to be essential for students to reach the course learning objectives.

It is important to note, that the cumulative micro-grading assessment method (Figure 3) and inverted classroom micro lectures directly connects the course assessments to the course learning objectives without being only a series of separate course assignments: Carberry *et al*. (2012). Grades are weighed and summed anonymously offering the lecturer to be less biased therefore students grades are more substantial: CSU (2015). Advantageously, the grading offers transparency and does not push student work towards the end but is equally distributed throughout the semester. Despite the discussion on the value of teaching in present (which we fully agree with) here especially students with language difficulties felt reassured of their learning skills in the fully online environment without the pressure of the presence in course, perform orally, understand during class and a single final exam.

5. Conclusion

Because the diversity of first year students at applied universities is high such as: different educational backgrounds, languages spoken and various social duties next to studying the (online) course concept is of interest to lecturers in higher education. To reduce diversity in material science for mechanical engineering the former blended learning concept was redirected to a fully online concept in the covid-19 semester of SS2020. Inverted classroom scenarios based on micro lectures and peer-to-peer lecture films, glossary and forum entries, group and single homework and traditional quizzes offer a portfolio of various standards. Cumulatively micro grades sum to a total over the entire semester as an alternative to traditional final-test grading. Knowledge transfer was achieved in self-study periods facilitated by the lecturer. Online-teaching sessions were strictly used for feedback, answering questions, group projects and soving hand-on problems. The learning-outcome was enhanced meeting certain boundary conditions, such as alignment of teaching material, especially lecture films and micro lectures, with the course objective. Without the pressure to understand or perform during present class especially students with language difficulties benefitted from the teaching and assessment method. The possibility to achieve high showing different skills, feedback on the learning progress and a transparent grading system during

the semester enhanced homogeneity of the class with special respect to language difficulties.

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Advancing higher-education practice by analyzing and training students' vocal charisma: Evidence from a Danish field study

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Abstract

Charismatic speaking skills, particularly those of the voice, are known to be an important asset of managers, politicians, and even teachers. Students have so far been less in the limelight in this regard, although modern collaborative-learning and oral-examination concepts suggest that vocal charisma can already be a decisive factor for study success as well. The present paper examines this question based on 82 electrical-engineering students. Their initial self-introductions in front of the other fellow students were analyzed using a new acoustic technology that translates 16 voice features into a total vocal charisma (PASCAL) score[*]. Results show that these PASCAL scores are overall low (i.e. improvable) and positively correlated with the oral exam grades of both individual students and student teams. Moreover, the teams' PASCAL scores positively correlate with the performance in the "Marshmallow Challenge", i.e. a creative teamwork task. Additional in-depth analyses show that teams without any above-average charismatic student performed worst, but that teams with more than one above-average charismatic student struggled with leadership conflicts and solo actions. We interpret our findings as a strong plea for (vocal) charisma analysis to be integrated in higher-education practice both for managing team dynamics and performance and for increasing individual study success.

Keywords: *Charisma; prosody; acoustic voice profiling; teamwork;oral exam; Marshmallow Challenge.*

[*] Visit https://www.allgoodspeakers.com/coi for a conflict-of-interest statement of the author.

1. Introduction

Charisma is a term that one would not primarily associate with students, but with the political and economic decision-makers of our society. In fact, most studies on charismatic signals and their effects address precisely these two groups of high-profile persons (Rosenberg & Hirschberg 2009; Niebuhr *et al*. 2016). The few studies in the field of education also concern teachers rather than students and show, for example, how more charismatic teachers can positively influence the motivation, satisfaction, and learning performance of students (Towler *et al*. 2015; Bolkan & Goodboy 2009, see also Fox Cabane 2012, pp.91-93).

Why should charisma be relevant for students or, to put it differently, why should students learn to be more charismatic? Firstly, simply because charisma can be learned. Charisma is (with a few exceptions such as age or body height) a signaling system based on verbal and, in particular, non-verbal communication elements (Chen *et al*. 2014; Caspi *et al*. 2019). Strong speaker charisma can play an important role in the students' later professional lives. Experimental and empirical (field) studies show, for example, that it is easier for more charismatic speakers to be promoted, to achieve higher salaries, to acquire (more) customers and investor funds (e.g. in entrepreneurship contexts) and to lead more motivated, conflict-free groups, see the summary in Niebuhr *et al*. (2017).

A second reason is that charisma is not just about persuasion. In particular, the non-verbal, voice-related features of speaker charisma, which are also among the most powerful ones (Chen *et al*. 2014), express competence, self-confidence and passion (Michalsky & Niebuhr 2019). This, in turn, creates trust, motivation, and commitment on the part of the listener, even if the speaker is not a human. Talking robots or cars whose speech synthesis was enhanced for vocal charisma can make human interaction partners eat healthier food and take detours in their own city (Fischer *et al*. 2019; Niebuhr & Michalsky 2019). A stronger speaker charisma among human team members can increase the cohesion, interactiveness, and output of a team as well as its creativity (Stashevsky *et al*. 2006; Amabile *et al*. 2004).

Crucially, since collaborative (i.e. team) learning is nowadays at the heart of modern pedagogy and comprises a multitude of techniques and approaches (Laal & Ghodsi 2012), students would not only benefit from charismatic speech training after they have graduated. Rather, it is reasonable to assume that charismatic speech training would already pay off for them during their education. With this assumption as point of departure, the author and his team at the University of Southern Denmark (SDU) have developed a new technology for measuring, assessing, and training charismatic speech: Acoustic Voice Profiling® (AVP) and the associated scoring system PASCAL (Prosodic Analysis of Speaker Charisma: Assessment and Learning). This article introduces this new technology and uses SDU student data from the years 2018-2020 to show that speaker charisma plays a significant role in the performance of individual students and teams in terms of both output and grades.

2. Acoustic Voice Profiling® (AVP) and PASCAL

The AVP technology was developed against the background that the speaker's voice is one of the key triggers of perceived speaker charisma (Chen *et al*. 2014; Caspi *et al*. 2019). Replicating and extending the results of previous studies (e.g., Rosenberg & Hirsch-berg 2009), the author and his team conducted several hundred contrastive acoustic analys-es of more and less charismatic speakers in order to determine which acoustic parameters in the tone of voice correlate with perceived speaker charisma and how. Based on that, large-scale perception experiments were carried out in which voice parameters of speech stimuli were manipulated (incremenatally increased or decreased) both individually and in combi-nation. The latter was required to determine, for example, how much of a change in pitch range would be necessary to level out a charisma-enhancing or -reducing effect of tempo or loudness; or to determine, if certain pitch ranges prevent tempo/loudness from affecting perceived charisma at all. More than 500,000 listener ratings were collected in these experiments, see Niebuhr *et al*. (2017) The final step was to research how the individual parameters can be reliably measured from the acoustic speech signal (Niebuhr & Skarnitzl 2019).

The result was a patentable algorithm that breaks down a speaker's tone of voice into those 16 acoustic parameters that are mainly involved in creating the perceived vocal charisma of a speaker. The values measured for all parameters are separately evaluated on gender-specific scales in terms of to how much they enhance or reduce speaker charisma. Then, each of these positive or negative contributions is weighted according to its relevance for charisma perception and integrated into a total performance value.

PASCAL includes software tools that visualize charisma-relevant vocal parameters in real time and give learners color-coded feedback on their performance (cf. Niebuhr & Neitsch 2020). First and foremost, however, PASCAL is a scoring system based on a (growing) database in which almost 2,500 AVP performance values are stored in combination with key metadata about the speakers. On this basis, PASCAL draws a precise (and successively more detailed) picture of how the charismatic tone-of-voice performances are distributed in a specific population like, for example, speakers of German (or in peer groups such as men and women, or teachers, bankers, engineers and students). Furthermore, by means of this distribution, PASCAL shows how the current performance of a speaker is to be rated. A PASCAL score of 35 means, for example, that the speaker in question outperformed 35 % of all other speakers in his/her population or peer group with the current AVP value.

AVP-based PASCAL scores proved to be a powerful predictor for perceived speaker charisma. For instance, in a small study on German, professional actors all read the same excerpt of Goethe's Faust and were ranked on this basis from more to less charismatic by media professionals. With only a single error, the actors' PASCAL scores resulted in the in the same ranking as that of the human listeners (Michalsky & Niebuhr 2019).

3. How AVP-based PASCAL scores predict student performance

Denmark attaches great importance to innovation and always achieves top positions in international innovation rankings (https://www.theglobaleconomy.com/rankings/GII_Index/). Danish universities support this agenda by giving students a lot of self-determined creative and creation time as well as by placing a special emphasis on soft-skill modules, especially in technical and natural-science courses. AVP and PASCAL were developed in and for this academic ecosystem. Today, AVP-based speaker charisma training is a compulsory mod-ule, for example, in engineering courses at SDU Sønderborg.

The first semester of the electrical-engineering education at SDU Sonderborg includes a 12-week semester project. In this project, teams of 3-4 students manufacture a predefined electronic product, such as a weather station. The 12-week project is concluded by an oral exam, which consists of a presentation followed by a Q&A session, first with the team as a whole and then with each individual team member based on his/her specific contribution to the project. In this way, the following evaluations are made by the examiners: (i) per-formance of the team, (ii) performance of the individual, (iii) quality and functionality of the manufactured product (e.g., the weather station), and (iv) effectiveness of the work, i.e. to what degree the self-imposed plans and milestones were achieved throughout the project. Moreover, (v) the students themselves assess of how well time management and teamwork worked in their team. All evaluations (i)-(v) are made in percentages. The percentages (i)-(iv) result in individual overall grades for the semester project. Percentage (v) is only intended as a point-of-orientation for examiners and as feedback for the own team members.

The soft-skill modules take place in parallel to the semester project and in addition to the actual electrical-engineering lectures. The first module is on team building and begins with a short speech in which all student introduce themselves individually to the class (e.g., in terms of their interests, origin, language background, goals). These speeches are acoustical-ly analyzed in terms of AVP and result in a baseline PASCAL score for each student. The team-building module is continued in the following week by the Marshmallow Challenge (Suzuki *et al*. 2016). Each team receives about 100 spaghetti, a meter of sticky tape, 1 meter of cord, and a marshmallow. Then, the teams have 18 minutes to use these materials to build a tower. The tower must be as high as possible and strong enough to carry the marshmellow at its top. In the end, the total height of the tower is measured (in cm), and the team with the highest tower wins (the tower must remain standing during the measurement, but at least for one minute). Note that this Marshmallow Challenge is conducted in the same team constellations as the semester project.

In the years 2018-2020, 82 students completed the first semester of electrical engineering at SDU Sonderborg. The corresponding 82 baseline PASCAL scores from the students' introductory speeches serve as the data basis of this study. In the results sections below, the scores

are projected onto the performance indicators (i)-(v) of the semester project (3.1) as well as onto the teams' performances in the Marshmallow Challenge (3.2).

3.1. PASCAL scores and semester-project performance

Figures 1(a)-(b) show significant positive corrlations between PASCAL scores and the oral-exam evaluations (i) and (ii) of the semester project. In other words, higher PASCAL scores meant better results in the project presentations and examinations of the 2018-2020 classes. Note that this relationship is slightly stronger at the team level ($r = 0.59$, $p < 0.01$) than at the individual student level ($r = 0.51$, $p < 0.01$). At the team level, the basis for the correlation was the mean PASCAL score across all 3-4 team members. Assuming that the examiners considered all individual contributions equally, the stronger correlation at the team level speaks for the inter-individual validity and precision of the PASCAL scores. In addition, the difference in correlation strength could mean that an audience gets a clearer impression of the charismatic impact of a presentation for teams than for individuals and/or that team presentations with different voices make an audience focus (even) more on the vocal features of perceived speaker charisma.

In addition, we see in Figure 1(b) that the AVP-based charismatic speaker training is indeed a useful module in the electrical engineering education of the SDU, since the average PASCAL score of all 82 students is just 27.9 (on a scale of 0-100). Such a low score is typical for engineers (Michalsky & Niebuhr 2019).

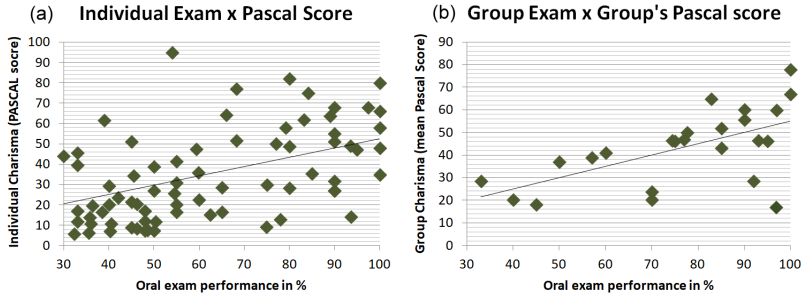
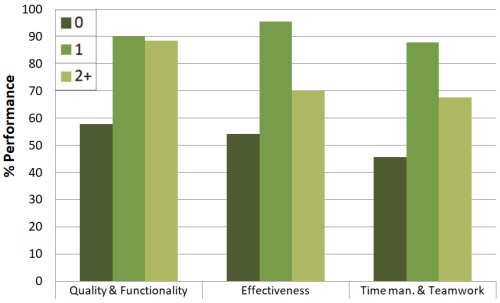


Figure 1. Correlation of Pascal scores with the oral-exam performance of (a) students and (b) student groups.

Regarding the evaluation measures (iii)-(v) of the semester project, an interesting pattern emerges if the students are split up along the mean PASCAL score of 27.9 into two groups, i.e. students with above-average and below-average vocal charisma. What Figure 2 shows in on this basis is as follows: If a team did not include any above-average charismatic student, then it performed relatively poorly. This was true not only for the two external criteria 'effective work' and 'quality and functionality of the product'. It also applied to the team's internal self-assessment regarding 'time management and teamwork'. In contrast, if one team member (and only one) had above-average vocal charisma, then the whole team performed

significantly better along all three performance criteria. If, on the other hand, a team consisted of two or more above-average charismatic students, then the performance remained high in terms of the delivered product ('quality & functionality'), but decreased with respect to the effectiveness of the work and the self-assessed time management and teamwork quality. In other words: things didn't go as smoothly as in those teams with only one above-average charismatic student. One-way ANOVAs show significant main effects of this charismatic-student factor for each performance indicator (quality & functionality of the product: $F[2,24] = 9.91$, $p < 0.01$; effective work: $F[2,24] = 7.35$, $p < 0.01$; time man-agement & teamwork: $F[2,24] = 4.88$, $p < 0.05$). According to post-hoc Tukey HSD tests, these significant main effects rely on all between-group differences observable in Figure 2.



	Quality & Function.	Effectiveness	Time & Teamwork
0	57.9	54.2	45.6
1	90.3	95.6	87.8
2+	88.5	70.0	67.7

Figure 2. Team's performance depending on number of above-average charismatic students (0,1,2+).

3.2. PASCAL scores and Marshmellow-Challenge performance

The results of the Marshmellow Challenge match well with those of the semester project. We see in Figure 3(a) a clearly positive correlation ($r = 0.70$, $p < 0.001$) between the teams' mean PASCAL scores and measured tower height, i.e. the level of success of the creative teamwork task. Figure 3(b) shows that the winning tower was almost 140 cm high. More-over, similar to the pattern in Figure 2, we found in a one-way ANOVA a significant main effect of the number of above/below-average charismatic students in a team on tower height ($F[2.24] = 6.09$, $p< 0.01$). Additional Tukey HSD tests show that, compared to those teams with one or more above-average charismatic students, the teams without any above-average charismatic student built towers that were either significantly less high or collapsed before the measurement (height = 0). Unlike in 3.1, however, the best performances (i.e. heighest towers) come from those teams in which all students had above-average vocal charisma.

4. Discussion

Being charismatic means creating trust through competence, motivation through self-confidence, and inspiration or commitment through passion. Charisma is primarily a communicative signaling system, and the voice is one of the most important factors herein. AVP and PASCAL boil down the vocal charisma impact of speakers to single performance scores that already proved to be robust and precise in previous tests. The present study provides supporting evidence for both the significance of a charismatic voice and the robustness and precision of the AVP-based PASCAL scores. This holds true not least because further post-hoc analyses showed that the correlations and differences in Figures 1-3 are not contaminated by potential confounding factors such as the age or origin of the students.

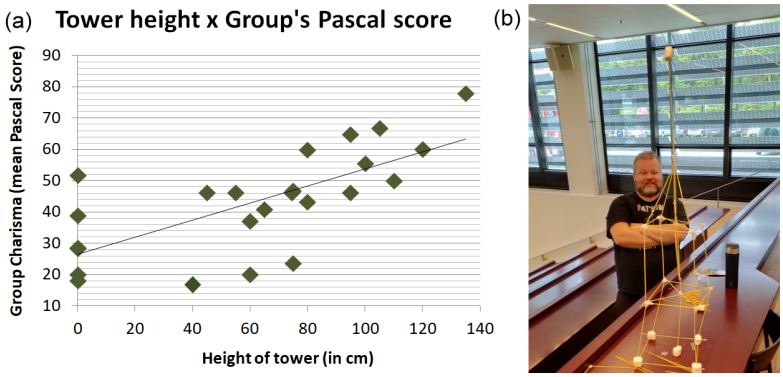


Figure 3. Results of (a) the Marshmallow Challenge and (b) its winning 137 cm high tower (photo: ON).

Furthermore, our findings are consistent with the previously stressed relevance of charisma for the performance and creativity of teams (e.g., Amabile *et al*. 2004). They additionally refine the associated previous findings in two respects. Firstly, they show that the overall vocal charisma of a team can be properly represented by the team's mean PASCAL score. Second, they suggest that focusing on output/performance alone gives a distorted im-pression of the charisma effect in teams. More than one above-average charismatic speaker per team does not increase the team's output; rather, such a composition can reduce the team's effectiveness/ productivity as well as its time management and team spirit. This is probably because the above-average charismatic speakers take on the leadership role within their team, so that two or more above-average charismatic speakers create leadership conflicts, interfering processes and less team cohesion (i.e. solo actions). The consequence of this conclusion for academic practice would be to use PASCAL scores in order to either control the composition of teams or anticipate their potential inner conflicts and counteract them with educational or pedagogical measures.

A third aspect, in which the present findings supplement the known links between charisma and performace is that, beyond teams, individual students can also benefit from a higher PASCAL score (i.e. from a stronger vocal charisma) in their presentations and examina-tions. Note that this correlation (like that of the teams) need not mean that the examiners were manipulated by the students charisma and, thus, gave biased evaluations. According to our observations, a higher charisma has a positive effect on students' own motivation to learn and leads to clearer, more understandable, better organized presentations and answers.

All in all, our findings are a strong plea for integrating and expanding (vocal) charisma trainings and analyzes in academic education; not only because charisma is basically learnable and can be of use to the students in their later professional life, but also because it already has a positive effect on performances and grades during the course of studies, presumably even more so in connection with modern collaborative learning approaches.

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Promoting Inclusive Practice: Video CVs as a Teaching & Learning Tool in the Language Classroom

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Abstract

This paper considers the benefits and results of the introduction of a video CV assessment into an intermediate, mixed-ability undergraduate Spanish-language class. This task was designed both to modernize an existing written task and to provide students with dyslexia and other language-processing difficulties with the opportunity to best display their capabilities in the second language (L2).

Dyslexia is a Specific Learning Difference (SpLD) whose characteristics can vary in form and severity, but which particularly affect language-processing. Dyslexic individuals often display a "paradoxical co-existence of special abilities and disabilities" (West, 1991, p.32): Abilities which include verbal acuity, visuospatial faculties, flexible problem-solving and creative skills which can all be used to advantage when designing activities to help students achieve success in learning a second language. A multisensory approach is now widely recognised as benefiting dyslexic individuals while other suggested adjustments include: oral recordings rather than written performance; multimedia presentations; and the incorporation of tasks that activate kinaesthetic-tactile components of learning, all elements mobilized within the video CV task.

The video CVs produced by students were multisensory and creative while effectively mobilisiing the L2, showing the benefits of inclusive practice for all students, helping to create a diverse and engaging learning experience.

Keywords: *Dyslexia; language-processing; multisensory; kinaesthetic; assessment; inclusive practice.*

1. Introduction

Dyslexia is a Specific Learning Difference (SpLD) which has a range of common characteristics that can vary in form and severity. Current research suggests that dyslexia is a neurological or neurobiological disorder with a genetic origin (Hudson *et al*, 2011; Kast *et al*, 2007), though the exact causes remain enigmatic (Kormos & Smith, 2012). There is no single coherent theoretical framework for approaching dyslexia (Ramus & Ahissar, 2012), rather there are several theories that focus on the differing impairments experienced by dyslexic individuals, though most include specific differences in cognitive and neuro-psychological functioning (Kormos & Smith, 2012, p.23). The most accepted theory, or majority subtype, is the phonological processing deficit hypothesis which manifests itself in reduced phoneme-to-grapheme mapping skills, plus minority subtypes characterised by visual/ attentional deficits, though these are by no means the only impairments experienced (see Kormos & Smith, 2012; Tambour *et al*, 2016). As dyslexia is a dimensional disorder, it affects people in different ways, while dyslexic individuals often develop both conscious and unconscious compensatory strategies which can mask impairments, problematising diagnoses. Nevertheless, the general consensus is that dyslexia mostly affects individuals with regard to language-related activities or verbal and information processing, engendering difficulties with grammatical and/or lexical pattern recognition, phonological-orthographic processing, visual and auditory processing, and sequencing and organisation which can impact all four linguistic competencies (reading, writing, listening and speaking) while poor working and short-term memory can further impede learning and the development of automacity (Crombie, 2013; Schneider & Crombie, 2004; Kormos & Smith, 2012).

This has clear implications for second language learning where standard classroom practices are not always helpful: This is particularly true of natural or communicative methodologies, in which students are expected to infer meaning from the context and receive less instruction in sound-system and syntactical or grammatical rules (Nijakowska, 2010, p.127; Schneider & Crombie, 2004, p.16). Various studies have shown instead that multisensory approaches or "the simultaneous presentation of linguistic material with the use of as many sensory channels as possible" (Nijakowska, 2010, p.125) are of much more benefit to dyslexic students (see Kast *et al*, 2011; Wang *et al*, 2018). Other beneficial approaches include: direct and explicit instruction in the sound-symbol, grammatical, lexical, semantic and socio-pragmatic systems of the language (metacognitive strategies); increased exposure to print in the L2, combined with listening and speaking work on the same text (multisensory input); usage of the L2 as the language of instruction in the classroom, keeping the native language for clarification of areas of special difficulty; increased usage of repetition developed across structured stages; the use of mnemonics; and frequent review of elements, since dyslexics "rely on long-term memory, requiring practice and concrete examples for understanding" (Waterfield, 2002, p.22).

Anxiety, motivation and self-confidence are also strong inhibitory factors for dyslexic students in the language classroom so taking efforts to minimise anxiety-provoking situations, particularly those that have the potential to emphasise any learning difference, and making an effort to improve self-confidence can also have a positive effect. The literature also suggests other beneficial adjustments, such as oral recordings rather than written performance/assessment, multimedia presentations and the incorporation of tasks that involve movable or visual aids and a variety of materials, in order to activate kinaesthetic-tactile elements of learning, visuospatial faculties, and creative and flexible problem-solving abilities. These kinds of approaches often seek to emphasise the positives of students' learning differences with a focus on students' abilities, not dis-abilities, or on what they can do rather than what they can't, specifically taking into account that individuals with dyslexia often display a seemingly "paradoxical co-existence of special abilities and disabilities" (West, 1991, p.32). These abilities can include verbal acuity, a talent for visuospatial processing, flexible problem-solving abilities, creative/imaginative abilities and an "aptitude for making connections and visualizing global ideas" (Waterfield, 2002, p.22) all of which can be used to advantage when designing activities and assessments to help dyslexic students achieve their full potential in the language classroom. Moreover, the use of such inclusive practices can be of benefit to all students, not just those with dyslexia (Conti, 2017; Crombie, 2013; Kast *et al*, 2011; Schneider & Crombie, 2004).

2. Video CVs

Video CVs, or video résumés, first appeared in the 1980s but have gained in popularity as a recruitment tool in recent years as the multimedia technology to enable the creation and dissemination of good quality material has become more widely accessible. Video CVs are short recorded audio-visual presentations, normally no more than 3-5 minutes in length, in which applicants can present themselves to a prospective employer. A video CV can be used to replace or supplement a traditional paper CV, but they offer much more scope as they allow applicants to differentiate themselves from others, highlight a particular skill-set or simply showcase their abilities, particularly those that may be difficult to convey via more traditional formats, such as linguistic, communicative or interpersonal competencies. A video CV can be more creative, individuated and competence-based as "more personalized information is visible through visual and auditory cues" (Hiemstra et al, 2012, p.431). For applicants with language-processing or other impairments a multimedia presentation may also offer the opportunity to circumvent the issues inherent in preparing a paper CV since "video resumes allow [candidates] to compensate for limited language skills or to show acquired skills that are not formalized in education and may remain unnoticed in paper resume screening" (Hiemstra et al, 2012, p.431) and hence to demonstrate their abilities and potential more clearly.

The format of a video CV can be designed to meet certain specified criteria or be more unstructured, and can vary from a basic recorded message to a polished multimedia presentation including such elements as subtitles, text/graphic inserts, stop-motion animation, voiceovers and soundtracks. Fundamentally, though, the usage of auditory and visual information is what differentiates the video CV from a paper one.

3. The Assessment

The rationale for re-thinking the traditional assessment regime for this intermediate mixed-ability undergraduate Spanish-language module was as a response to the growing number of students presenting with information and language-processing issues or SpLDs in these classes (dyslexia, dyspraxia, autism, etc.), as well as from a desire to diversify assessment practices to promote a wider range of linguistic, transferable and employability skills. This task was thus initially designed both to modernize an existing written task – to create a paper CV with accompanying cover letter – and to provide students with dyslexia and other language-processing difficulties with the opportunity to best display their capabilities in the L2.

This task was initially introduced in the first semester of the 2019-20 academic year to a group of 32 undergraduate students (19 female, 13 male), aged 19-32 years, 6 of whom (2 male, 4 female) presented with SpLDs, including dyslexia, a figure slightly above the 5-10% average (Drabble, 2013, p.7). The class was predominantly L1 English speakers (16 students), plus 11 Polish L1 speakers, 2 French L1 and 1 Spanish, Dutch and Italian L1 speaker respectively. All students presenting with SpLDs were L1 English speakers.

3.1. Underlying principles

The task of creating a video CV allowed the students to engage with the L2 in new, multisensory ways and to mobilise different skills and abilities to the ones they would in a standard written assessment, while the nature of the task mirrored the strategies and adjustments suggested for dyslexic students in the literature. Schneider and Crombie (2004), for example, recommend that activities should be designed to "integrate multi-sensory practice" (p.79), emphasizing "learning channels that utilize the dyslexic students' strengths" (p.49), especially by mobilizing "kinaesthetic-tactile components" (p.79). Activities that provide these elements are those that can engage the student through: visual cues and gestures, where auditory input is supported by kinaesthetic, visual and/or textual clues; colour and shape coding, that is the mapping out of structures in visual/graphic ways; the verbalization of and/or the connection of bodily movements with linguistic and semantic concepts; metacognitive strategies; and the staged introduction of concepts. Videos, as teaching input, activate many of these learning channels. They provide multisensory input with audio presentation of the L2 supported by visual clues, where images, actions, gestures

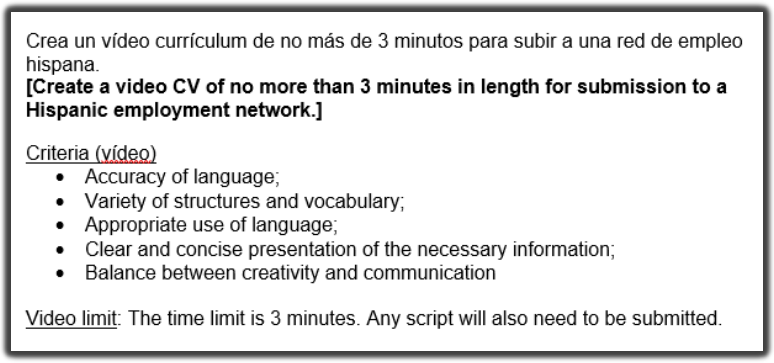
and behaviours reinforce or translate linguistic expression, alongside textual elements such as subtitles, signage, and so on. Students thus receive "multisensory written and oral, as well as non-verbal, foreign-language and culture input" (Schneider & Crombie, 2004, p.87). Furthermore, when used as output, with students producing their own videos in the L2, this activates and supports further learning components, such as kinaesthetic-tactile elements and problem-solving skills. Students can submit an oral/visual piece rather than a written text, another of the recommendations for students who struggle with written tasks, and one which allows them to be creative in their response, showcasing their abilities in other areas, such as verbal acuity. Such a task also helps to foster creativity and engage visuospatial faculties, as well as promoting independent learning and improving students' self-confidence, while removing the anxiety of having to perform on the spot, as well as encouraging a more personal engagement with the material.

3.2. How the assessment worked

The video CV assessment was embedded within the course syllabus topic of employment, linked to preparation for the Year Abroad. Students were introduced to paper CVs, cover letters and formal letter-writing structures, as well as authentic audiovisual material in the L2 exploring interviews and interview techniques. As an introduction to this assessment, in class students viewed and discussed examples of video CVs in the L2 from Méndez (2020), a blogpost which also includes useful tools and guidance on 'How to create a great video CV'. Students were shown a selection of video CVs which mobilized different approaches and techniques including examples with short interviews, multilingual elements, stop-motion animation, graphics and textual elements, subtitles, humour, etc. Examples which offered cultural input as well as those that highlighted the importance of visual clues and of accessibility, focusing on ability, not dis-ability, were also included. Students were encouraged to analyse the different examples via guided discussion to increase comprehension and point them towards relevant cultural, linguistic, topic-based and assessment-related information, building on previous material and providing a staged introduction to the necessary concepts to complete the task succesfully. This was supplemented by the provision of further resources via the VLE, which also allowed students to reinforce their learning via the opportunity to review material as many times as they wished, an invaluable *aide memoire* for dyslexic students (Kormos & Smith, 2012; Wang *et al*, 2018).

The video CV assessment was not explicitly highlighted as designed for students with SpLDs, rather it was framed as being an assignment to allow students to use multimedia technology in the L2, to activate other skills and to engage with an interesting aspect of the Hispanic recruitment scene. Students were also offered a choice between three assessment tasks, two of which were more traditional written pieces (a paper CV and cover letter, or an opinion

piece), the other being the video CV, as detailed below (Fig.1), with more extensive instructions provided via the VLE.


Crea un vídeo currículum de no más de 3 minutos para subir a una red de empleo hispana.
[Create a video CV of no more than 3 minutes in length for submission to a Hispanic employment network.]

Criteria (vídeo)

- Accuracy of language;
- Variety of structures and vocabulary;
- Appropriate use of language;
- Clear and concise presentation of the necessary information;
- Balance between creativity and communication

Video limit: The time limit is 3 minutes. Any script will also need to be submitted.

Figure 1. Assessment instructions.

These instructions also explicitly drew on student feedback and analysis of the video CVs discussed in class via the inclusion of the balance between creativity and communication as well as clarity of presentation, providing a greater sense of ownership and more personal engagement with the material.

4. Discussion

Only 6 of the 32 students chose the video CV, but those who did were predominantly those who presented with SpLDs (4 to 2) and they had clearly taken a great deal from both the preparatory process and the completion of the task itself. They had evidently engaged with and applied the concepts discussed in class, choosing particular approaches and building certain ideas into their own work. Each video CV was creative, individualized and focused on competencies beyond formalized educational and employment achievements, offering an insight into each student's particular abilities, skills, interests and potential. Their videos also showed off their language skills to great effect with the inclusion of new grammatical and semantic concepts, the mobilization of appropriate topic-related vocabulary and attention paid to pronunciation, fluidity, register and tone. Students also used a variety of approaches, with some presenting themselves more formally on screen while others preferred to use strong visuals accompanied by a voice-over. One student with musical abilities chose to use a sound-track of themselves playing classical guitar to highlight these skills while others chose to use no musical accompaniment but did include graphics to emphasise their points, demonstrating their particular personality and emphasizing communicative and interpersonal skills. Accessibility was another area that students referenced with the choice to use subtitles and also to demonstrate their knowledge of sign-language. Others chose to use strong visual elements, influenced by stop-motion animation techniques transferred to a more technologically manageable format via sequencing the placing of items in front of the camera

lens at appropriate moments to illustrate their script or the positioning of elements within shot, which showed creativity, problem-solving skills and visuospatial awareness.

Student feedback on this assessment was very positive with comments focusing on the non-traditional format, which allowed them to be creative and to employ audio-visual and multimedia competencies, which reflected the nature and needs of the modern world. Students also appreciated the transferrable and employability skills embedded within the format, of particular use in finding work placements as part of their preparation for the Year Abroad. Those students with SpLDs performed above expectations on this task, achieving an average upward mark-band shift (e.g. 2:1. to 1st) and showcasing their creative and problem-solving abilities alongside their fluency and verbal acuity in the L2, leading to a subsequent gain in self-confidence.

5. Conclusions

The whole class group were able to benefit from engagement with the preparatory process for this assessment and those who completed the video CV produced work that was multisensory, accessible and creative, while mobilising the L2 to good effect. The task also had a broad appeal as students with declared SpLDs as well as students without completed this assessment showing it to be an effective multisensory teaching and learning tool.

Beyond inclusive practice, there are other benefits to such an assessment. Video CVs offer a diversification of assessment format while also assessing more than one linguistic competency or skill-set, which can also mitigate against reliance on such tools as machine translation software or the likes of Google Translate. As Sager (2020) notes, in designing to guard against such usage, particularly when students are studying at home or online, one strategy "is to diversify assessment formats, relying less on essays and written exams and instead embracing oral exams using Zoom or Skype, or having students produce podcasts, YouTube videos, posters or Prezi presentations that can be shared online" (para.12).

For students, such assessments allow them to display and develop other skills, beyond their linguistic skills, and in the process they also produce something concrete that they can build on, develop and use in the future. Video CVs are an increasing trend in the recruitment marketplace (Hiemstra *et al,* 2012; Waung *et al*, 2015) so having the opportunity to work with such material might help students to make an impression on the jobs market.

As this experience shows, ensuring the active participation of students with SpLDs in the language classroom can be successfully achieved by adjusting teaching and assessment practices. Making such accommodations doesn't have to mean lowering requirements or creating multiple, individually-tailored assessments, but rather creating conditions that allow all students to develop and demonstrate their skills and achieve their full potential.

Adjustments made for learning differences can and do benefit all students and help to create a diverse, creative and engaging learning experience.

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Assuring the Quality of the Course Learning Outcomes Assessment Process

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Abstract

Learning Outcomes Assessment (LOA) provide educators with a practical instrument to review and enhance the alignment between the planned, delivered and experienced curriculum. Effective LOA processes help educators decide on the proper actions to take and the strategies to implement in order to ensure the continuous improvement of the student learning experience, and the attainment of the intended learning outcomes. Nonetheless, the adoption of LOA in higher education is still lagging and the assessment loop is rarely closed. This is mainly due to the indigent implementation of the assessment processes, and the vague definition of the responsibilities and quality assurance measures. This paper introduces a committee infrastructure to foster accountability and responsibility and assure the quality of the implemented assessment processes. The infrastructure has been established syccessfully over the last few years, and a noticeable improve in the execution of the assessment process has been detected.

Keywords: *Learning outcomes assessment; quality assurance; committee; continuous improvement.*

1. Introduction

The last few decades witnessed a paradigm shift in higher education as more and more institutions have adopted the outcome-based education (OBE) model instead of the traditional curriculum-based one (Harden, 2007). The OBE model relies on the articulation of a set of learning outcomes that defines the knowledge, skills, and dispositions that students will have and able to demonstrate after successfully completing a learning experience (e.g., program, course, module, etc.). The defined learning outcomes are then used as guidelines for content development, instruction, and evaluation. They are also used to define the type and depth of learning students are expected to achieve, and provide a point of reference to assess the effectiveness of the learning experience. Moreover, they clearly communicate expectations to learners and prospective employers. This shift to the OBE model allows educators to focus more on what students know and are able to do by the time of graduation rather than the quality of the offered curriculum (i.e., output instead of input based).

To foster continuous improvements, the OBE model relies on assessing the learning outcomes defined for offered courses and programs through a periodic assessment cycle (Jankowski et al., 2018; Kuh et al., 2015). A typical learning outcomes assessment (LOA) process is shown in Figure 1. In order to have an effective assessment process, assessment tools should be selected carefully to collect data that represent the true students' attainment level (Keshavarz, 2011). Collected data from multiple tools across several semesters should be analysed thoroughly to identify positive and negative developing trends. The analysis possess should also identify deficiencies and areas for improvement, as well as the impact of implemented recommended actions from previous assessment cycles. Appropriate actions with implementation timeline should be recommended to remedy identified deficiencies. To close the assessment loop, the recommended actions are implemented during the subsequent offering and their impact is measured.

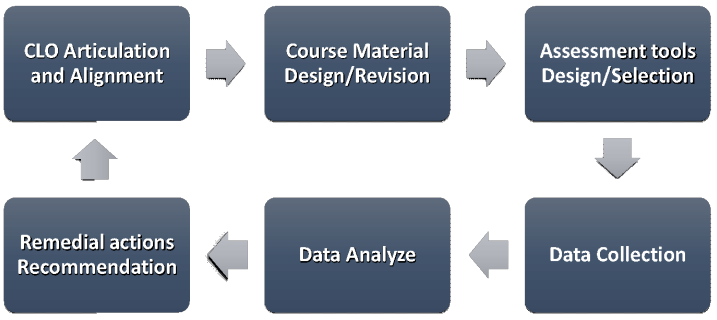

Figure 1. A Typical Course Learning Outcomes Assessment Process

Despite the promising features of the outcomes-based model and its integrated assessment and continuous improvement cycle, its adoption in higher education is still lagging and the assessment loop is rarely closed (Kinzie et al., 2015; Kuh & Ewell, 2010). This is mainly due to the indigent implementation of the assessment processes, and the vague definition of the responsibilities and quality assurance measures. This paper introduces the committee infrastructure established at (the University name is removed for blind review) to foster accountability and responsibility and assure the quality of the implemented assessment processes. The remaining of the paper is organized as follows. Potential LOA quality issues are discussed in Section 2, followed by the proposed quality assurance infrastrtute in Section 3, and discussion remarks in Section 4.

2. Potential issues that could affect the quality of the assessment process

Although the typical LOA process shown in Figure 1 looks simple and straightforward to implement, in reality, the process is often lengthy and error prone. Therefore, having an integrated quality assurance framework that clearly defines the responsibility and accountability of each assessment task is essential for the successful implementation and closure of the assessment loop. For instance, the assessment process could define a task to thoroughly analyse the collected assessment data without clearly specifying who is responsible for completing the task and submitting the analysis remarks. In such a case, there is a considerable probability that no one will take the responsibility of getting the task done, which will cause the assessment process to terminate prematurely. Even if the task is eventually completed, it will be completed on voluntarily basis, which lacks the responsibility and accountability aspects necessary for quality assurance. The following subsections highlight some of the potential mistakes that could occur during the execution of the course assessment process and lead to the premature termination of the assessment loop.

2.1. CLO Articulation and Alignment

As shown in Figure 1, the course assessment process starts by articulating the intended course learning outcomes (CLOs) and aligning them with program learning outcomes and course objectives. Articulating appropriate CLOs is essential as they define the breadth and depth of the learning students are expected to achieve, and serve as guideline for content, instruction, and evaluation. The defined CLOs should be Specific, Measurable, Attainable, Relevant, and Time-bound (SMART). Each CLO must be articulated using specific language, and should start with appropriate Blooms Taxonomy action verb (Anderson et al., 2000) that defines its expected cognitive level.

Articulating appropriate CLOs is the initial step towards a successful execution of the assessment process. On the other hand, defining unmeasurable CLOs, or having a cognitive level mismatch between the CLOs and the course or the program level will cause the

assessment process to fail. For instance, starting the CLO with vague action verbs such as "to know", "to appreciate", "to understand", "to be familiar with", etc. will make the CLO unmeasurable, as it does not clearly and explicitly define what is expected from students. The cognitive level of the CLO must be carfully selected to match the course and the program levels. For instance, the CLOs articulated for undergraduate freshmen courses should not have the same depth and breadth as a CLO of senior level courses, or CLOs articulated for Master or Doctorate level courses. Failing to articulate the CLO at the proper cognitive level is usually manifsated by the shortage of covering material and activities, which renders the CLO unmeasurable.

2.2. Course Material Design and Revision

The second task of the course assessment process is to define the course topics needed to cover the defined course learning outcomes. The aim of this task is to ensure that offered topics provide students with multiple opportunities to achieve the intended outcomes. It is also used to assure that the offered topics are aligned with the blooms cognitive level specified by the CLOs. Moreover, it is essential for closing the assessment loop, as it can be used to accurately identify the topics contributing to an unachieved CLO.

Failing to align the course topics and activities with the articulated CLOs is another cause of unmeaserable CLOs. In many cases, faculty are faced with a problem at the end of the semester that no assessment data is collected for one or more CLOs. This could be because the CLO was not covered at all; or it was covered, but was not assessed by any of the course activities. For instance, a course may define a CLO for students to communicate effectively in both oral and written format, however the course fails to define any topic or have any activity that covers communication skills. Failing to align course topics and activities with the cognitive level of the articulated CLOs will render the CLOs unmeasurable as well. For exmaple, a CLO could be articulated at the "Create" cognitive level (the highest level of Bloom's congnitive taxonomy), but the covered topics stops only at the "Apply" level.

2.3. Assessment Tools Design and Selection

The third task of the assessment process is to define the direct and indirect assessment tools that will be used to collect assessment data for each CLO. The aim is to select assessment tools that requires little extra time and effort, and do not overwhelm faculty and students with new tasks. Assessment data could be easily collected from regular learning activities (e.g. exams, portfolios, capstone projects, lab assignments, etc.) rather than additional tasks for students. The better the integration of the assessment tools into existing student work, the greater the probability that the assessment plans will succeed.

Collecting assessment data that does not truly represent the students' attainment level will lead to wrong analysis remarks and ineffective remedial actions. For instance, a final exam

question might not be an appropriate tool to assess the student's ability to implement a design. Similarly, MCQs are not appropriate tools to measure the students' communication or information literacy skills. Therefore, the first step in the assessment plan is to identify the most appropriate assessment tools that will be used to assess each outcome. An appropriate assessment tool should be able to measure the competency addressed by the outcome effectively and accurately from multiple sections of the same course.

2.4. Analyzing the Collected Data and Closing the Assessment loop

Although closing the assessment loop is essential for continuous quality improvement, it is typically where the assessment efforts are disrupted (Hutchings et al., 2015). For instance, course instructors may terminate the assessment process after reporting the collected assessment results without providing any analysis remarks or recommend remedial actions. They could happen because they do not fully understand their role in the assessment process, and belive the assessment contribution ends after reporting the assessment data. It could also occur because they do not have enough information or the tools to analyse the students performance across multiple assessment cycles.

Even when remedial actions are recommended, there is usually no follow up to ensure that the recommended actions are implemented during the following course offering, especially when remedial actions are documented hard course portfolios (paper format) or in a soft format that is difficult to look up and extract. Consequently, the continuous improvement cycle is interrupted and no noticeable improvement is usually detected in the students' performance during the following assessment cycles. This usually led to faculty frustration and reluctance to participate in the assessment effort, as they do not see the benefit of the extra effort of collecting and reporting assessment data.

3. Defining Responsibility and Accountability

In a process that involves many contributors, clearly defining the entities responsible for each task or activity is essential for accountability and quality assurance. For instance, when the process assigns a general responsibility for faculty member to analyse the collected assessment data, there is a chance that no one will take responsibility for getting that task done. Therefore, effective assessment processes should clearly define the entities responsible for each assessment task, and the task timeline. This will allow the quality assurance team to follow up with the entities responsible for missing or incomplete tasks.

To assure proper implementation of the assessment process and the effective closure of the assessment loop, the role of the following entities are defined in the assessment process:

- Course Coordinator
- Course Committee

- Department Assessment Committee (DAC)
- Department Curriculum Committee (DCC)

3.1. Course Committee

A course committee is routinely formed at the beginning of the semester for each courses offered by multiple instructors for multiple sections. The committee is chaired by the course coordinator and comprised of all instructors teaching the course that semester or taught the course recently. The course committee is responsible for developing and implementing the course assessment plan. The committee meets at the beginning of the semester to:

1. discuss and approve any modification to the course syllabus proposed by the course coordinator,
2. review the teaching materials, and decide on the delivery timeline and milestones including common midterm and final exams, if needed,
3. select the summative assessment tools to be used for each learning outcome, and
4. discuss the remedial actions recommended from previous offering, and decide on their implementation plans.

Member of the course committees are responsible for collecting the assessment data using the selected assessment tools, and implementing the approved remedial actions. They also collect evidence on the effectiveness of the implemented actions. At the end of the semester, the course committee meets again to analyse the learning outcomes attainment results, discuss the impact of the implemented remedial actions, and decide on the recommended actions for subsequent offering.

3.2. Course Coordinator

To strengthen course ownership, a course coordinator is appointed by the department chair for each offered course. The term of appointment of the course coordinator is four academic years. The performance of course coordinator is reviewed by the department chair in due time for a renewal or a replacement decision. The course coordinator responsibilities include:

1. Act as a liaison for course-related material (e.g. course syllabus, assessment reports, etc.), and chair the course committee in the case of multiple sections course.
2. Maintain the official course material.
3. Prepare the course portfolio each time the course is offered and upload it to the online course repository.
4. Organize and lead the initial meeting with the course committee during the first week of the semester to discuss the course offering plan.
5. Setup periodic follow up meetings with members of the courses committee to ensure homogeneous and synchronized progress of the course delivery across all offered sections of the course (lectures and labs).

6. Coordinate the preparation of the unified midterm and final exams, and ensure their alignment with the course learning outcomes.
7. Oversee the implementation of the approved remedial actions
8. Follow up with the course committee on the implementation of the approved assessment tools and collection of the assessment data.
9. Organize and lead the end of the semester meeting with the course committee
10. Upload the course analysis remarks and new recommended actions to the LOA management system along with the implementation details and impact of the remedial actions implemented during the semester.

The appointed course coordinator should assume the responsibilities of the course committee if the course committee is not formed (e.g., a new course).

3.3. Department Assessment Committee

Department Assessment Committee (DAC) is a standing committee appointed by the department chair at the beginning of each academic year. The DLOAC oversees the execution of the course assessment process and ensures that the assessment data are collected and analysed as per the approved assessment timeline.

The DAC also plays a crucial role in closing the assessment loop. The scope of the course remedial actions could vary from a simple action that does not require any approval or the approval of the course committee, to more complex actions that might require the approval of the department, college, and university assessment committees. Some actions such as changing the course modality (e.g., face-to-face, blended, online) might also require the approval of the accrediting agency. Therefore, the role of the DAC is instrumental in following up with the involved entities to ensure that the remedial actions are implemented and the assessment loop is closed effectively.

3.4. Department Curriculum Committee

The department curriculum committee (DCC) is another standing committee appointed by the department chair at the beginning of each academic year. The curriculum committee is responsible for reviewing and approving any modification to the offered courses proposed by the course committee. The modifications include course description, topics, modality, and learning outcomes.

4. Discussions

To address the requirement of national and international accreditation agencies, a unified course learning outcomes assessment process was developed and implemented across the (University name is removed for blind review) since 2013. Although assessment data was

regularly collected from all offered courses, the University quality assurance unit was deeply concerned that the assessment process usually stops after the assessment data is collected and the assessment loop is hardly closed. To address this issue, the terms of reference of the course coordinator and course committee were created and added to the University's Quality Assurance Framework. The terms of reference DAC was also revised to add a new responsibility to oversee the the execution of the course assessment process.

An online LOA management system was also designed and developed in house to streamline the developed assessment process. The system provides the department chairs, chairs of DLOAC, and course coordinators with detailed information regarding the status of the course assessment process, as well as executive dashboards to track the submission of the assessment data and the associated analysis remarks, the progress in the implementation of the recommended remedial actions, as well as the impact of the implemented actions.

A significant improvement in the execution of the assessment process and the closure of the assessment loop is evident since the introduction of the new quality assurance measures and the deployment of the online management system. Assessment statistics show that more than 5000 CLO were assessed during Spring 2020 in 1010 offered courses. Around 2000 remedial actions were also recommended by the course committees, out of which 378 are already implemented and closed in Fall 2020.

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Towards a transdisciplinary approach in the training of teachers: Creating procedures in learning and teaching in higher education

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Abstract

For decades we have been immersed in a constant change in our society, registered together with an increase in its degree of complexity. This greatly affects the currently prevailing educational axioms, making them obsolete, which implies, according to our hypothesis, the need for a process of revision and innovation of existing models. Our proposal starts from a bibliographic review of some existing proposals in innovation, to create a new pedagogical model based on polyhedral and transdisciplinary methodologies. At the same time, we offer a case study in a core subject of the first teacher training course at the Autonomous University of Barcelona. After the practical application of our transdisciplinary methodological theories, it has been possible to successfully collect evidence of a balanced interaction between disciplinary areas by students. The application of the innovations can become a frame of reference for higher education institutions interested in following this very important process of adaptation to social reality.

Keywords: *Transdisciplinary methodologies; teaching; strategies; knowledge; complexity; innovation.*

1. Introduction

The increasing social complexity, the environmental conflicts and the uncertainties generated by the global economic crisis are bringing new demands and so, new answers to multiple variables. Consequently, a need for the repositioning of academic learning and teaching has appeared: our world requires new ways of understanding while ensuring an integrated perspective on reality. Future teachers should be aware of their role as educators of future citizens of a complex world and so, their training should be orientated to manage a diverse and often conflictive real and virtual public space. The universities are faced to generate and transmit knowledge that promotes innovation, quality and equity while ensuring congruence in the means and methods used. The European regulations promoted in 2001 have been the turning point towards a new curriculum able to re-design the traditional paradigms from a model in which the transmission of knowledge had predominantly been in teacher's hands, towards a new one based on the graduate's competences profile. It was assumed that the training of teachers should be re-oriented towards innovative solutions to prepare them with new methodologies and pedagogical applications able to make them work in an interrelated instead of juxtaposed way. To this objective, the Faculty of Education at the Autonomous University of Barcelona (UAB), Spain, introduced in 2009 a new subject addressed to the first-year students, regardless of their speciality (childhood, primary, social education, pedagogical studies) aiming to reflect about the main ideas and findings that have been shaping the contemporary world. Natural sciences, humanities and social sciences were committed to overlap in an integrated view of reality to promote interest for the natural, social and cultural spheres through critical thinking and to help students to face real problems through a complex approach. The planning of this new subject though, aimed to be a teaching experience where different professional profiles should find a way to orientate the first-year students into a guided reflection about the contemporary world: social and natural sciences as well as other cultural aspects (anthropology, philology, philosophy, biology, sociology, economy, art, and literature) were organised in three multidisciplinary clusters: Society, Science and Culture (SSC). There was a general assumption that traditional disciplinary boundaries were fast eroding and that the kind of disciplinary knowledge that the students needed to develop were changing as well.

Western science is explicitly reductionist, we can learn about the whole by studying its parts, we disassemble and fractionate, as assuming a lego-like world. At this point, the main idea was afforded by the transdisciplinary methodology and the theory of complexity. The qualitative results of the experience presented in this paper have to be analysed in the framework of this subject, Society, Science and Culture, that has been offered to 640 students per year, and carried out by a total of 21 teachers along 10 years. Main objective of this paper is to give evidence of multidisciplinary pedagogical experiences with the aim of constructing a transdisciplinary learning. Concretely, the objectives are: a) a bibliographic review of some

existing proposals in innovation; b) to present pedagogical methodologies to achieve transdisciplinary learning; c) the results of a case study in a core subject of the first teacher training course at the UAB.

2. Findings: New tools to achieve transdisciplinarity education

In order to create the new procedures, the research has been divided into different focuses: transdisciplinarity in education, design of classroom activities (into practice), data collection and organizational aspects and self-training of the teaching team.

2.1. Transdisciplinarity in education

Transdisciplinarity, a concept first used by Edgar Morin, Jean Piaget and Erich Jantsh that meant to 'celebrate the transgression of disciplinary boundaries, an act that far surpassed the multidisciplinary and the interdisciplinary approaches' (cited by Nicolescu, 2002, pp 1) appeared to be the most challenging direction. At the same time, Klein (2001, pg. 246), defined transdisciplinarity as a crossed disciplinary methodology that 'organizes mutual learning and joint problem solving between science and society' and so, transdisciplinary research becomes not antagonistic but complementary to multidisciplinarity and interdisciplinarity research.

Transdisciplinarity connotes a strategy that crosses disciplinary boundaries to create a holistic approach and it is also used to signify a unity beyond disciplines, struggling for a different way of thinking and a different way of organizing knowledge (Max-Neef, 2005; McGregor, 2014). Transdisciplinarity is the result of a coordination between hierarchical levels settled in a pyramid graph. As Max-Neef (2005) suggests, the disciplines at the base of the pyramid describe the world as it is, and it relates the question: what exists? from the natural sciences which explain the basic of the nature to sociology and economics which attempt to explain human behavior. The next level is about what we have learned from the empirical level and what are we able to do and answers the question of what we want to do? The third level is questioning: what should we do? and goes beyond the present and the immediate. It aims at generations yet to come, at the planet.

Placing the debate within the educational context, the teacher is the person who emits and develops a transdisciplinary methodology and the student is expected to achieve a transdisciplinary learning. Transdisciplinary learning should be the exploration of a relevant issue or problem that integrates the perspectives of multiple disciplines in order to connect new knowledge and deeper understanding to real life experiences. Integration is the keyword to increase understanding and constitutes the theoretical background of a 'transdisciplinary dimension', the intellectual space where the links among isolated issues can be explored, the space where alternatives are reconsidered and interrelations revealed (UNESCO, 1998). The

student must be the protagonist of an effective transdisciplinary learning being able to combine and articulate the knowledge provided by the teaching activity. Transdisciplinary methodology concerns which is at once, between the disciplines, across the different disciplines, and beyond all disciplines. The advent and development of transdisciplinarity demonstrate emerging ways not only of organizing but thinking about knowledge and inquiry in a world that has become 'too big to know' (Weinberger, 2011).

In our experience we tried to clearly differentiate between transdisciplinarity, interdisciplinarity and multidisciplinarity while redefining these concepts from the specialized literature and from our experience in their application in education (Klein, 2008). These redefinitions have been done from the point of view of the involved disciplines and from the point of view of the problem to be analyzed and discussed. In order to define our epistemological approach, we have established a clear distinction between the subject/s with a unique point of view towards the problem –disciplinarity-, subjects of different disciplines come together to treat the same problem -multidisciplinarity-, the subject/s with a disciplinary point of view that enriches knowledge resulting from looking at other disciplines –interdisciplinarity-, the subject/s have a global look that goes beyond the boundaries between disciplines, including all the knowledge involved and their relationships–transdisciplinarity- (Saura-Mas et al., 2021).

Working and using transdisciplinary methodology does not mean rejecting a disciplinary perspective, but rather enhancing the understanding of reality by means of a new conceptual framework. For this reason, the transdisciplinary methodology can also include multidisciplinary and interdisciplinary perspectives.

2.2. Into practice: the macro-concept and the polyhedral systems

To achieve this transdisciplinary teaching-learning process, the first step was to agree a consensus within the teacher's team, concerning the setting of the macro-concept (Morin, 2000), which had to be the main learning objective, as well as the polyhedral systems (also called constellations).

The macro-concept: In our experience, the term macro-concept has been used as an integration of order, disorder, interaction and organization, according to Morin's (2000) description and the idea of 'non-belonging' to any discipline was assumed. As a result, the macro-concept allowed all the possible scenarios instead of being kidnapped by a concrete discipline. All the teachers participated in a brainstorming session suggesting, at least, three potential macro-concepts each one, and after debate, the group chooses one by consensus. The agreed macro-concept was 'change', that belongs to a transdisciplinary space of non belonging to any unique field of knowledge. Concerning the learning process, when there is a holistic comprehension of a phenomenon (Kerne, 2005; Choi and Pak, 2006), that it is only prioritized by the macro-concept, the agent of change, then, there is the demonstration of the

understanding of a complexity and a net of knowledge and problems. The setting of a macro-concept since the beginning of the course was a meeting point for the different disciplines involved in the transdisciplinary methodology and learning, to occur more naturally (Figure 1).

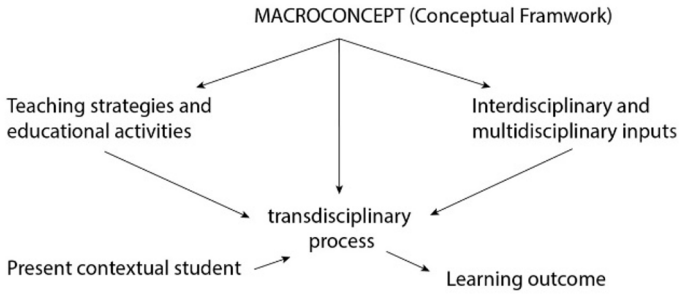

Figure 1. Pedagogical strategy from the macro- concept to learning outcomes. Source: own elaboration

The polyhedral system or 'constellation': This is an activity that consists in the dissemination of 'anchor words/concepts' derived from the macro-concept settled as a central point and from there, particular paths can be defined according to the constellation of concepts/words. Thus, the student constructs the constellation from the main macro-concept and the universe of concepts from the disciplinary cluster sessions (Figure 2). The basic contents and materials afforded by the teaching team from different areas of expertise have determined the elaboration of the constellation by the students.

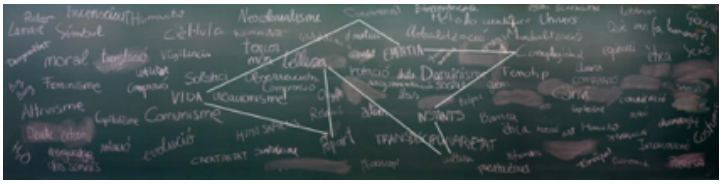

Figure 2. Picture of the result of the polyhedral system activity. Source: own elaboration

2.3. Data collection and analyses of classroom activity: the macro-concept and the polyhedral system

This educational experience has been analyzed in a mixed system of qualitative and quantitative data collection, with the main goal of verifying the efficacy of the transdisciplinary methodology on the student's learning processes. The last class of the course, data from a whole group of 77 students, at the end of the four year of studies, was collected and analyzed. Concretely, we analyzed the sentences written for each student during

the activity of construction ofa polyhedral system around the macro-concept of 'change'. For each sentence, we calculated the number of mentioned disciplines' clusters (DCn) (Figure 3) as a quantitative value to measure the transdisciplinarity learning achieved by the students. The Academic Coding System (JACS) version 3.0 defined by HESA (Higher education statistics agency) was used to classify disciplines. Each cluster consists of three blocks of knowledge: society, science and culture, and each one of these blocks contain many different disciplines, organized in three clusters.

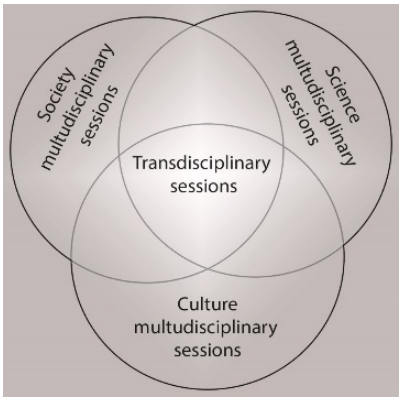

Figure 3. Clusters of disciplines in transdisciplinary SCC course experience. Source: own elaboration

Statistical results indicate a DCn mean of 2.4 +/- 0.11 s.e.. The 36.36 % of students mentioned three clusters of disciplines, and 33.77 % mentioned two (Figure 4). Only 19.48% of them stayed in a single disciplinary point of view. The most mentioned clusters of disciplines were history and philosophy (27.3%), in the second position there was social studies (26.2 %) and in the third site (24.6%) biological sciences.

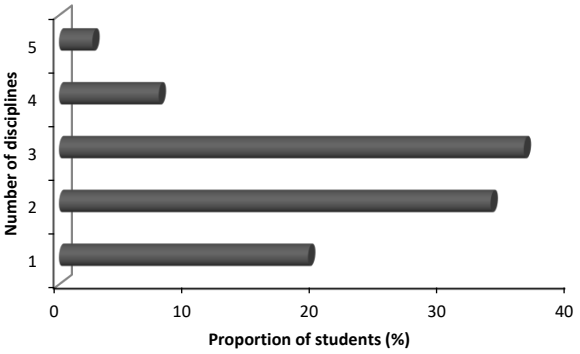

Figure 4. Number of disciplines mentioned by the students in the polyhedral system. Source: own elaboration

2.4. Organization and training of the teaching team

An integrative strategy has been established (Klein, 1996; Lenoir, 2016), for all the 21 university teachers, from 10 different disciplines (ecology, anthropology, geology, plant physiology, human geography, philology, literature, didactic of arts, ethics, and history). They were involved in this subject, based on systematic meetings to define common objectives centered on the macro-concept and the transdisciplinary learning-teaching process.

To set the working planning of the teacher's team, to organize their training and to define the contents for a one-year course has been as important as to set the transdisciplinary theoretical framework and the activities. The traditional lectures had to be substituted by a more flexible organization of learning activities focusing more on the students' improvement rather than on the teachers' timetables.

Then, we organized the course through the year so that there were three blocks, society, science and culture multidisciplinary sessions (10.5h of practical seminars and 15h of theoretical contents, for each block). Moreover, some of the sessions were transdisciplinary (13.5h), with the macro-concept of 'Change' as the main topic, and obtaining as a result, a cluster of disciplines in the subject SSC (Saura-Mas et al., 2021). There was a teacher with a professional area of expertise belonging to each one of the three blocks. In the transdisciplinary sessions, the three teachers worked together before, during and after the sessions.

Constant self-analyses and restructuration have been promoted among the teaching team, so that it has been very important that teachers adapted to conditions that required specific knowledge as well as a holistic comprehension of the world.

3. Conclusions

Concretely, we have established a new theoretical framework of transdisciplinarity in an educational context, and an adaptation of methodologies creating what we call the polyhedral systems methodology. Nowadays, many educational institutions are interested in transdisciplinary education, but often, educators and education managers are confused in the terms, and methodologies. The literature review and proposals of this research can be very useful for future application of transdisciplinarity in educational contexts.

In our experience, it is possible to validate the starting hypothesis in which we propose the need for a process of revision and innovation of the existing models. This objective has been specified in the practical application in the classroom of activities designed in an appropriate way, through tools such as the macro-concept and polyhedral systems.

At the same time, adaptation has been possible thanks to the collection of data and organizational aspects, as well as the coordination and training of the teaching team.

Here we propose theoretical and practical evidence of the effectiveness of this transdisciplinary system success during our learning-teaching processes so that we must reach to apply it in the future as a part of the pedagogical system. There are results of one of our transdisciplinary methodologies, so that we have evidence of the success of it. Most of the students of the case study, 66%, mixed clusters of disciplines on their learning results. One of the main problems of these results is that we already cannot evidence that the student gets from the interdisciplinary to the global view or transdisciplinary thinking. Nowadays, our research group is working in developing some indexes to evaluate transdisciplinary thinking reached by the student after a transdisciplinary learning-teaching process.

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Building an interactive platform for practical design projects between students and industries

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Abstract

The advancement of information media and the convenience of the Internet have fostered the growth of web-based instruction, interactive functions, and resources available for participants to engage, interact, learn, discuss, and access without time and space constraints. This paper aims to provide an introduction on an interactive online platform which is beneficial for university-enterprise cooperation. Enterprises and students have more online and offline opportunities to gain a better mutual understanding and actively collaborate. Combined with the "learning to learn" theory, this sustainable platform can enhance the learning of students so that they learn capabilities over time through guidance and practical projects exercise.

Keywords: *Design education; online platform; learning to learn; practical design.*

1. Introduction

Nurturing the ability of students to learn has been widely regarded as one of the important objectives of Hong Kong's education reform. The Curriculum Development Council (2001) also pointed out the crucial role of "learning to learn: the direction of curriculum development" in a conference document. Hence, in order to equip students so that they can face the challenges of the 21st century, school curriculum must help students to establish positive values and attitudes, and encourage the spirit of lifelong learning, so as to learn how to learn, and cultivate a variety of general abilities to acquire and construct knowledge and lay the foundations for the advancement of humankind.

To achieve this goal, it is necessary to impart knowledge on "learning to learn" and the skills to do so. In an era that continuously innovates knowledge, students not only need to gain knowledge, but also master learning skills, so that they can guide themselves through continuous learning and become lifelong learners after leaving school.

Universities lack a platform to integrate and sustain enterprise resources, while students and teachers lack the channels to directly access enterprise resources. Opportunities for students to contact enterprises are still limited, and they may lack the skills for effective communication and cooperation with enterprises, as well as the ability to implement practical work. For enterprises, the school lacks a platform through which they can actively seek cooperation and understand students, as the lack of trust can be problematic when they are in a cooperation situation. The current school-enterprise cooperation model faces numerous limitations in resources, coverage and globalization. Thus, a platform for schools and enterprises is timely and needed. Effective communication is expected to be carried out in real time and increase production efficiency. Moreover, students need a "learning to learn" type of guidance for working with enterprises, so that they can inspire to aspire and develop a sense of purpose in cooperating with the industry through guidance, which can improve their success and learning experiences.

Therefore, we build an interactive platform for students and enterprises to solve the problems mentioned above. In this project, we explore the entire project management process for students on the platform, which provides them with "learning to learn" guidelines to engage in this sustained process.

2. Aim of the Study

This project aims to build a sustainable interactive online platform to encourage students and enterprises to participate in a practical project collaboration in fashion and textile design, which can improve the "learning to learn" capabilities of students and provide global business cooperation resources, so that students can receive professional "learning to learn" guidelines

and have the opportunity to cooperate with enterprises to design products during their study period. This project can enhance "learning to learn" capabilities, and communication and cooperation skills with the industries. The knowledge that students gain will be truly in line with the needs of the enterprise and the market. Students could also gain the ability to learn in a new environment and adapt to it, which can encourage them to be a more autonomous, effective and adaptive learner.

Figure 1 shows that at the beginning, the motivation to learn is instilled in students, and then they develop a sense of purpose and make plans. Then, students are guided to combine metacognitive strategies in practice. In the end, students will gain knowledge, and new skills or competencies, showcase and build pride through "learning to learn" guidelines and practical design exercises.

Matching educational resources could facilitate learners to understand how to combine what they have learned from school and work, apply theoretical knowledge to actual practices, and then bring the challenges and insights encountered at work back to the learning environment. It can enhance teaching and learning in school, achieve the relative integration of supply of "subject" and demand of "subject" and improve the quality of educational products and market competitiveness.

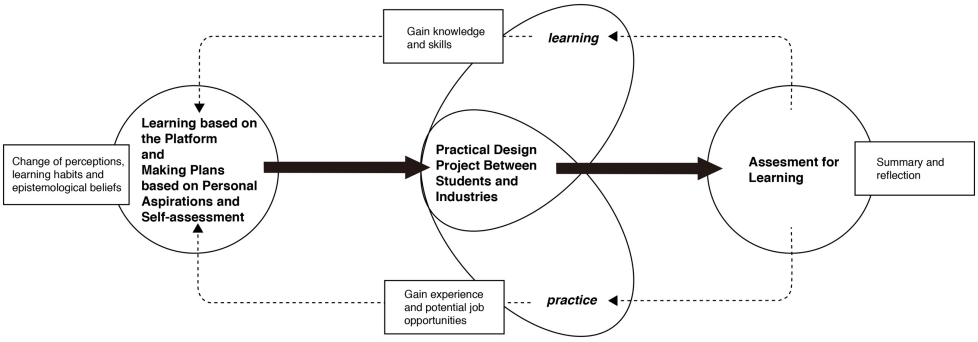

Figure 1. Proposed model for platform.

3. Interactive Platform Design

Building a sustainable interactive online platform for school-enterprise cooperation is about the integration and use of enterprise resources. On the other hand, students and teachers can also learn and practice on the platform during and beyond the project period. This platform consists of three components:

- a "learning to learn" component which facilitates students to learn, think, plan and so on and so forth;

- an interactive platform that integrates enterprise resources and displays the works of students as a collaborative effort; and
- measures to evaluate the progress of the students and facilitate self-reflection.

3.1. Learning to Learn

We established a learning workflow (Figure 2) which shows the important milestones for completing a project. It is a clear and useful resource for students to understand how to engage in a "learning to learn" process step-by-step and receive guidance. This resource for self-learning consists of three units: Unit 1. Motivation: What is it? (Why does motivation matter? Why is it hard to get motivated? What are some strategies for boosting motivation?) Unit 2. Cultivating Metacognition. (What is the metacognitive concept and theory? Metacognition vs. cognition. Metacognition in design. Metacognitive strategies.) Unit 3. Gain Knowledge of Practical Design. (Design methods. Know more about the industry. Recommendations). The platform also provides learning resources for teachers to co-learn and help their students.

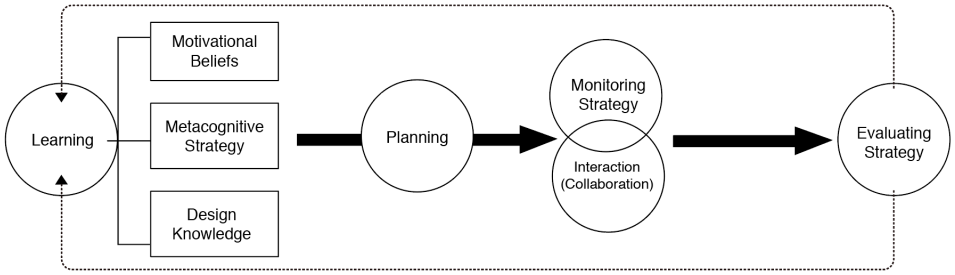

Figure 2. Learning workflow.

3.2. Interactive Platform

The interactive platform provides the opportunity for students to do real life design. They can communicate and work with the company on the online platform. It is not just practice, but actual design work for the industry. Students can provide personal details, such as a profile, their portfolio and résumé on the platform to promote themselves (see Figure 3). By participating in school-enterprise cooperation activities, a company can cultivate new talent and receive new ideas. The collaboration is also conducive to brand marketing and promotion, so this platform benefits companies too. Companies can distribute their information and design projects on the platform for students and teachers who are interested and further communicate with them (see Figure 4). Students can also carry out some background research on the company to accommodate their corporate climate.

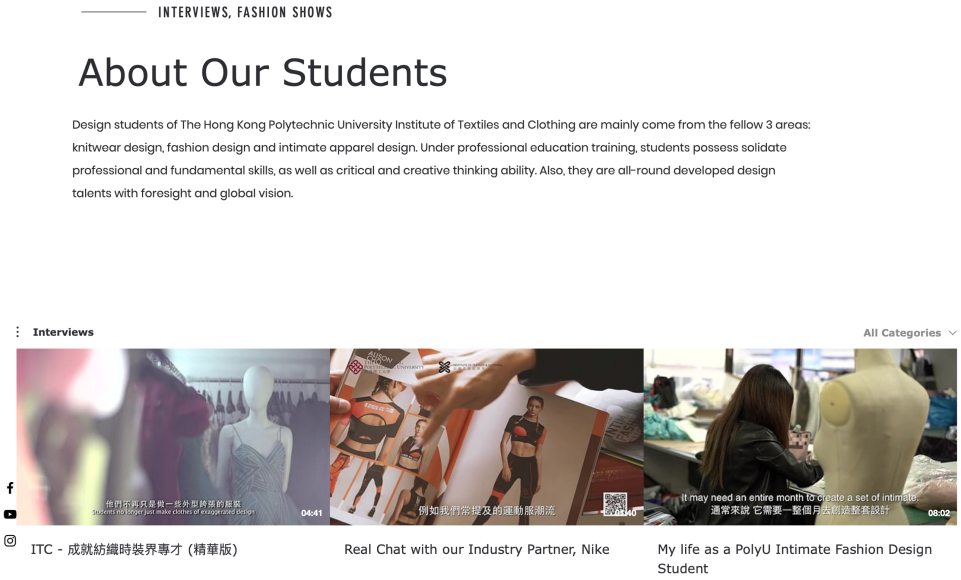

Figure 3. Student particulars on the platform.

Figure 4. Company information.

3.3. Evaluation

Metacognition defines evaluation as assessing the recent knowledge status of learners, which involves tracking their attention span as they study, and self-testing and enquiring, which are ongoing (before, within and after a task). Lawanto (2010), Choi (2006) indicated that "the purpose of metacognition evaluation is to encourage students to think about such problems

(e.g. poor performance) by reflecting upon themselves through self-evaluation." According to Hargrove (2007), the implementation of evaluation includes the following elements:

- Evaluating goal achievement
- Judging the results accurately and adequately
- Evaluating the appropriateness of procedures used
- Assessing how obstacles/errors are managed
- Evaluating the efficiency of a plan and its execution

Established data analysis strategies can be used to evaluate the progress of students, e.g. through surveys, interviews, observations, or reflective design portfolios. Not only do these confirm the effectiveness of this project, but also obtain feedback to improve the platform. Figure 5 shows the main evaluation scope of student learning in this stage.

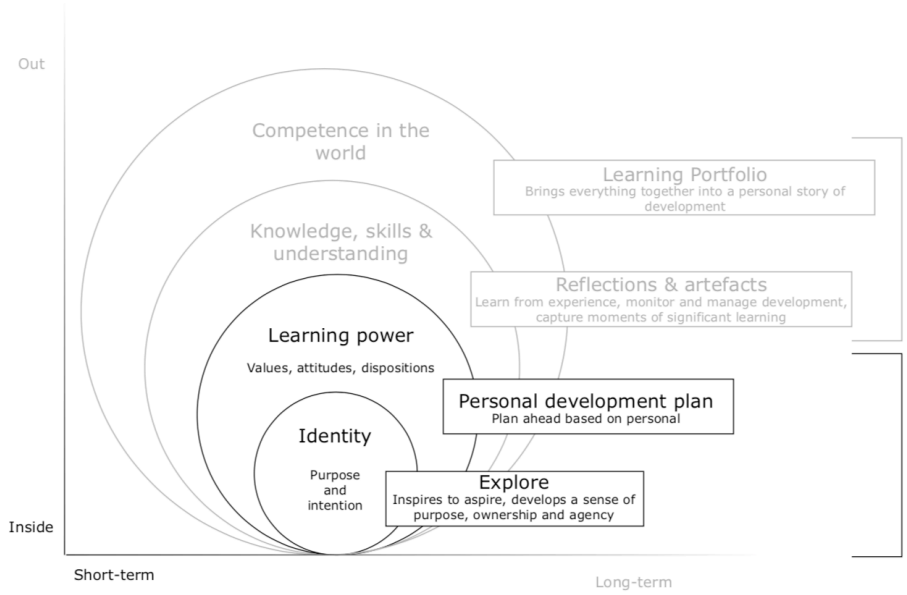

Figure 5. Main evaluation scope.

4. Conclusions

"Learning to learn" provides a much needed overview and international guide to the field of learning to learn from a multidisciplinary lifelong and lifewide perspective. A wealth of research has been flourishing on this key educational goal in recent years. Internationally, it is not only considered to be one of the key competencies needed to compete in the global economy, but also a crucial factor for individual and social well-being (Crick, Stringher & Ren, 2014) Encouraging learning to learn should thus be one of the primary objectives of today's education systems.

The world is changing rapidly nowadays, with the rapid development of computer network technology. Also, COVID-19 has changed lifestyle, work, learning, etc. The model of school-enterprise cooperation has also changed from offline to online. As such, an interactive platform would offer great convenience to enterprises and universities, and along with the application of the learning to learn theory, contribute to advancing practical design education.

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Born or made - Can interdisciplinary and intersectoral doctorate education create institutional entrepreneurs? A systematic review

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Abstract

Solving grand societal challenges such as equitable healthcare provision and climate change will require institutional entrepreneurs – people who can challenge prevailing regulations, behaviors, and ways of thinking. As the pinnacle of educational achievement, the doctoral degree should be the fire in which such fledgling institutional entrepreneurs are forged. Doctoral education has, however, been criticized as overspecialized and divorced from reality. We systematically review the doctoral education literature in our search for doctoral education programs that challenge institutional norms by bridging sectoral and disciplinary divides. We ask whether such programs can help to nurture institutionally entrepreneurial researchers. We find that students must manage ambiguous identities and wide networks but that such programs have the potential to equip them for both sense-making and sense-giving activities of institutional entrepreneurship.

Keywords: *Doctoral education; institutional entrepreneurship; intersectoral; interdisciplinary.*

1. Introduction

Institutional entrepreneurs are essential to the solving of many of modern society's grand challenges such as equitable healthcare provision or climate change as they "spearhead collective attempts to infuse new beliefs, norms, and values into social structures, thus creating discontinuities in the world of organizations." (Rao et al., 2000: 239). They view the world through various lenses and bring otherwise disconnected ideas and values together. Institutional entrepreneurs wield business knowledge alongside political sense and an ability to anticipate reception from multiple angles (Dorado, 2005). They deploy an array of skills: analytic, empathetic, framing, translational, organizational, tactical, and timing (Fohim, 2020). Understanding different perspectives results in credibility and trust, leading to strong social networks which can be merged to achieve their goals (Battilana and Casciaro, 2012).

Traditionally, universities have been hailed as the institutional center of education and research in society. Recently this perspective has shifted to include a new role of intersectoral collaboration and knowledge sharing (Cardoso et al., 2019) increasing pressure to contribute to innovation and industrial competitiveness (Haapakorpi, 2017). The doctorate, despite being the highest form of educational attainment, has faced criticism for its incompatibility with demands of the modern workplace (Celis and Acosta, 2016). Missing transferable skills, overspecialization and a lack of real-world experience and practical knowledge have all been identified as issues with traditional doctorate programs (Cui and Harshman, 2020).

Two approaches have been taken to reform doctorate education. The first is interdisciplinarity, where "scholars work jointly on a common problem with the intention of transferring knowledge from one discipline to another" (Kemp and Nurius, 2015: 134). This differs from the traditional isolation of the student within doctoral education, instead focusing on collaboration and boundary-spanning (Balleisen and Wisdom, 2018). The second approach is intersectorality, or industrial PhDs, encouraged by governmental innovation policies linking industry and education (Celis and Acosta, 2016). The student typically takes on dual roles of researcher and practitioner with research relevant to both academia and industry (Cardoso et al., 2019). The skills, knowledge, and boundary-spanning activities encouraged through such programs are key to institutional entrepreneurship. Thus, this review asks: Is it possible to train an institutional entrepreneur?

2. Methodology

We conducted a systematic review of interdisciplinary and intersectoral doctorate education literature following Aguinis et al.'s (2018) steps to ensure inferential reproducibility: (1) identification of sources, (2) screening to narrow results, (3) applying eligibility criteria and, (4) confirmation of sources to be reviewed in full. We applied four inclusion and exclusion criteria to further develop the standard for review (Rhaiem et al., 2019) (see table 1).

Table 1. Exclusion criteria for systematic review

Criteria	Inclusion	Exclusion	Rationale
Language	English	Not available in English	Authors' ability to analyse
Content	Relevant to doctoral education	Irrelevant to doctoral education	Relevancy to research question
Peer Review	Peer reviewed journal articles	Non-peer reviewed journal articles	Information is from a reliable source
Database Selection	Scopus and ProQuest	Databases not included in Scopus or ProQuest	Both databases provide wide disciplinary coverage

Two electronic databases were searched for this review: ProQuest and Scopus, using three searches between the end of October to the end of November 2020:

1. "interdisciplinary" AND "doctora* education": Abstract searches returned 107 (Scopus) and 199 (ProQuest) results. Language and source checks reduced this to 34 (Scopus) and 64 (ProQuest). Eligibility assessment through reading of abstracts and introductions eliminated 4 (Scopus) and 23 (ProQuest). 13 duplicates were removed. 7 articles were unavailable to access and further reading resulted in the removal of 3 further articles. This left 48 for review.
2. "intersectoral" AND "doctora* education": Abstract searches returned 9 (Scopus) and 0 (ProQuest). All failed to meet eligibility criteria.
3. "university industry collaboration" and "doctora* education": Abstract searches returned 22 articles. 5 duplicates were removed, leaving 17. 1 article was removed due to lack of access and a second lacked useful information upon reading. 15 articles were therefore added to the previous list giving 63 articles for review.

Approximately 57% of the articles were published in education journals, though there were also publications in healthcare (14.3%), STEM (14.3%), management (9.5%) and other/multidisciplinary journals (6.35%). We used the Gioia method (Gioia et al., 2013), to inductively analyze the articles using NVivo qualitative data analysis software.

3. Findings

We identify those elements of intersectoral and interdisciplinary doctoral education that a) map onto characteristics of institutional entrepreneurs as identified in that literature; and b) challenge existing institutions – cognitive, normative and regulatory.

3.1. Skills & networks for institutional entrepreneurship

Although 'soft skills' are highly sought after, little attention is given to their development within traditional doctorate programmes. Employers demands to address the mismatch between industry needs and doctoral skills (Cardoso et al., 2019) mean, however, that many programs now addressing the issue of transferable skills (Santos et al., 2020). Since transferable skills apply across disciplinary and professional boundaries (Haapakorpi, 2017) they are crucial to the development of institutional entrepreneurs enabling communication, flexibility, leadership, teamwork, planning, organization, management, and problem solving (Cui and Harshman, 2020).

Owen Smith & Powell (2008) describe how ambiguous identities and multiple networks create conditions conducive to institutional entrepreneurship. While mentors and supervisors may provide access to sectoral or disciplinary networks (Caliskan and Holley, 2017), networking outside the home discipline can lead to an appreciation of different epistemologies (Bosque Pérez et al., 2016). Such interactions may also extend strong ties beyond disciplinary boundaries with access to different perspectives (Mountford et al., 2019).

3.2. Challenges to existing institutions

3.2.1. Cognitive challanges

Research cultures are the set of beliefs, norms, and values that exist within a particular discipline or research institution (Kunttu et al., 2018). Humility and respect are key to breaking down the barriers of research cultures (Carr et al., 2018). It can be easy to misinterpret others with whom we do not share a common goal or value, so a broad understanding of other disciplines and understanding their viewpoints is important (Bosque Pérez et al., 2016; Cui and Harshman, 2020). A shared vision brings interdisciplinary team members closer together and broadens researchers' perspectives (Bosque Pérez et al., 2016). Individual students can then see how their own work can benefit other disciplines and begin to identify their own opportunities for collaboration (Kiley and Halliday, 2019).

Curricular activities that break down such cognitive barriers include seminars and mini presentations to share research ideas and methods (Kiley and Halliday, 2019). Asking students to discuss the strengths and weaknesses of their main research discipline as a class activity, fosters appreciation of the uses of various epistemologies and methodologies (Carr et al., 2018). Self-reflective surveys were issued during a seminar titled 'Philosophical Issues in Interdisciplinary Research' to challenge students to think critically about their assumptions going into the course (Bosque-Pérez et al., 2016). Another example includes a workshop titled 'Finding our way: interprofessional connected health education' that directly asked students to think ahead about what barriers or misunderstandings may occur in their interdisciplinary work and how might they overcome them (Chouvarda et al., 2019).

Less formal efforts include low stakes interactions such as group meals (Balleisen and Wisdom., 2018). The relaxed nature of such interactions opens up discussion without fear of judgement (Kiley and Halliday, 2019), building trust and respect (Carr et al., 2018). Relaxed students are more creative and open-minded (Chouvarda et al., 2019). Ideally, a program wishing to foster collaboration would prioritize both formal and informal interaction opportunities to develop personal and collective skills (Caliskan and Holley, 2017).

Mentors and supervisors can either question or reinforce cognitive norms. They influence how students see their work and the world around them (Hammel et al., 2015). Interdisciplinary or intersectoral students may have two or more supervisors, scrutinizing their research from multiple perspectives (Bosque Pérez et al., 2016; Carr et al., 2018). Intersectoral programs may have a professional supervisor in addition to a peer mentor (Caliskan and Holley, 2017) where mentors hold a more informal type of relationship with the student that can facilitate further questioning of norms.

3.2.2. Normative challenges

Dorado (2005) defines the agency required for institutional entrepreneurship as "the motivation and the creativity that drive actors to break away from scripted patterns of behaviour" (p. 388). Such scripted patterns include communication preferences across sectors e.g. academics prefer written communication while industry favors oral communication (Cui and Harshman, 2020). Efforts to move beyond such norms can, however, incur costs. Digital communication, for example, is consistent in its reception by interdisciplinary students regardless of background with blogs and social media allowing students to keep in touch and share information (Balleisen and Wisdom., 2018; Mountford et al., 2019). However, a lack of physical presence in collaboration has led to decreasing quality of relationships and trust, alongside reduced networking opportunities (Carr et al., 2018).

Supervisors can struggle where students deviate from their own norms often worrying whether they can handle a student that takes a direction unfamiliar to them. Busy schedules and lack of personal fit can exacerbate such difficulties (Caliskan and Holley, 2017). A faculty training program may better prepare supervisors for working with others in interdisciplinary or intersectoral contexts (Bosque-Pérez et al., 2016). Ideal supervisory traits to deal with challenges to behavioural and cognitive norms include open-mindedness, curiosity and being receptive to having one's biases challenged (Kiley and Halliday, 2019).

3.2.3. Regulatory challenges

The organizational and professional institutions of academic life may regulate against those who challenge them. Organizational structures in universities typically separate disciplines into different departments with little encouragement or effort made to develop communication across departments, leading to knowledge separation and segregation rather

than integration (Donina et al., 2017). Universities give quicker graduation and promotion to disciplinary, rather than interdisciplinary work (Golembiewskih et al., 2018).

4. Discussion

Identity directly influences a student's sense of belonging (Caliskan and Holley, 2017). When identity is unclear, students can struggle to identify and market their own capabilities (Holley, 2018). In an interdisciplinary environment where boundaries are broken down, this is especially important as: "identity development and socialization … enable emergent interdisciplinary scholars to develop strong connections with multiple communities that align with their emergent professional identities" (Holley, 2018: 124). Building a strong research community within interdisciplinary programs is key, as it can improve student confidence and sense of belonging (Caliskan and Holley, 2017; Kiley and Halliday, 2018). This may allow students to become institutional entrepreneurs as they combine a level of ambiguity of identity with strong ties in wide networks (Owen Smith & Powell, 2008) to make sense of multiple inputs and give sense to multiple communities.

4.1. Sensemaking versus Sensegiving

Institutional entrepreneurs adopt one of three forms of agency: routine, strategic or sensemaking (Dorado, 2005). Past studies have focused on the sensemaking abilities of institutional entrepreneurs (Dorado, 2005), however, Santos and Eisenhardt (2009) suggest that institutional entrepreneurs also play a role in 'sensegiving' or claiming, that is the act of taking familiar information and presenting it with new meaning. Storytelling is particularly useful at conveying meaning to these audiences (Santos and Eisenhardt, 2009). This concept of sensegiving and storytelling echoes interdisciplinary programs' focus on teaching new methodologies and promoting qualitative research, particularly to STEM students.

Intersectoral or interdisciplinary social networks may be more or less accessible, depending on how structured or "opportunity hazy" the field is (Dorado, 2005; 397). Doctoral students who work with others from varying disciplines learn how to spot opportunities for later collaboration and value the opportunities to build social networks beyond their home discipline, department and institution (Balleisen and Wisdom, 2018). Social capital accumulated through participation can potentially aid in later boundary-spanning (Mountford et al., 2019) and improve ability to give sense to a variety of audiences.

Our review indicates that intersectoral and interdisciplinary doctorate programs may have the potential to forge institutional entrepreneurs who can overcome the cognitive, normative and regulatory barriers to solving some of society's greatest challenges. There is, however, an imbalance in the academic literature on interdisciplinarity and intersectorality. Despite the increasing involvement of stakeholders in collaborative programs, the concept of

intersectorality at doctorate level is still lacking. Future research may require looking beyond academic literature to other documents from grey literature, given the involvement from industry and potential policy-makers in shaping these doctoral programs.

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Assessment of Environmental Literacy

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Abstract

Nowadays, the issues related with environment preservation assume an increasing importance. Progressively, more sustainable solutions/techniques are being developed to combat environmental destruction. The decision to include themes related to the environment in the curriculum of technological courses in higher education aims to promote more sustainable behaviors and in an indirect way, increase the environmental literacy of the population. Thus, this study aims to evaluate the environmental literacy focusing on four topics, i.e., air pollution, water pollution, global warming, and energy resources. For this purpose, a questionnaire was developed and applied to a convenience sample, formed by individuals of both genders, aged between 20 and 81 years old. The questionnaire intended to collect data to characterize the sample and assess the literacy regarding environmental issues. In order to carry out the environmental literacy assessment, the respondents were asked to express their degree of agreement with some statements related with the environmental themes mentioned above. The data collected was analyzed using data mining tools. The results suggest that the population's literacy is satisfactory in relation to some issues, but insufficient in relation to others, equally important, but less disseminated.

Keywords: *Environmental literacy; sustainability; biotechnology; artificial neural networks.*

1. Introduction

Since the mid-eighties of the 20th century, mankind has repeatedly failed to achieve the goal of sustainability. Indeed, in the past few decades, highly developed human societies have consumed more resources than those the planet can produce, creating amounts of pollution far beyond the Earth's ability to absorb and purify (Wackernagel & Rees, 1996). Despite the efforts of governments and various non-governmental organizations, the evidence shows that human efforts are not enough to prevent serious climate change or global warming. The efforts made are important, but they will not be enough if the population is not aware of the importance of being greener and kinder. This awareness requires an appropriate environmental education policy that mobilizes the population for a common goal – the sustainability of the Planet.

About 30 years ago, Dising & Roth (1992) suggested that environmental literacy is the ability to understand and to interpret the relative balance of environmental systems and to take appropriate actions to maintain, restore or improve the health of those systems. Currently, the term *environmental literacy* comprises the knowledge and understanding of environmental concepts, problems and issues, affective and cognitive dispositions, as well as a set of competencies and skills, together with appropriate behavioral strategies to adopt relevant decisions in a wide range of environmental contexts (Hollweg *et al.*, 2011). In simple terms, environmental literacy can be understood as the domain of four interrelated components: knowledge, attitudes, skills, and environmentally friendly behaviors (Hungerford & Volk, 1990). Given that biotechnology is an emerging scientific field with extraordinary potential for creating innovative and environmentally friendly products and solutions that can make a vital contribution to global sustainability, it is particularly important to examine the level of population literacy on these issues.

Indeed, to ensure the success of any environmental policy, the population must adhere to it. For this it is necessary that the population knows and understands the underlying concepts and practices. Thus, this work intends to evaluate the environmental literacy in a small sample of the Portuguese population regarding to four main themes – air pollution, water pollution, global warming, and energy resources.

This paper comprises four sections. Following the introduction to the theme, the methodology for problem solving is presented (section 2), whereas the results are presented and discussed in section 3. Finally, in section 4, conclusions are drawn, and future work is outlined.

2. Methods

The data collection was carried out using the questionnaire survey technique. The questionnaire was evaluated by a set of specialists. After specialist analysis, the questionnaire

was modified and applied to a restrict group of participants, not included in the sample. Due to the pandemic of the new coronavirus (COVID-19) and all associated changes in society's daily life, the questionnaire was distributed randomly in digital form.

The questionnaire consists of two parts, the first referring to the collection of sociodemographic data (e.g., age, gender, educational qualifications, and place of residence) and the second containing a set of statements on which respondents were asked to give their opinion on the four topics covered (i.e., air pollution, water pollution, global warming, and energy resources). In the first section, the answers are descriptive while the second used a Likert scale with five levels (i.e., *strongly agree*, *agree*, *disagree*, *strongly disagree* and *I don't know*).

The former topic comprises the statements, viz.

S1 Reducing the use of combustion engines helps to reduce air pollution;
S2 The use of activated carbon contributes to the retention of polluting gases; and
S3 The use of pesticides/fertilizers contributes to the air contamination.

The second topic encompasses the statements, viz.

S4 In oil spills in the oceans, the use of microorganisms accelerates the water purification;
S5 The use of specific plants along the watercourses helps the decontamination process; and
S6 The direct discharge of industrial waste into water courses causes the death of living organisms.

The topic regarding *global warming* includes the statements, viz.

S7 The use of fossil fuels as energy source is the main cause of global warming;
S8 The rapid glaciers melt is caused by the planet warming; and
S9 The use of large amounts of CFCs causes an increase in the ozone hole.

Finally, the topic concerning *energy resources* contains the statements, viz.

S10 The use of renewable energies contributes to the environment protection;
S11 Biogas is increasingly used as an energy source; and
S12 Renewable energies are inexhaustible.

With the aim of converting the qualitative data (collected via the questionnaire) into quantitative one, the method proposed by Fernandes *et al.* (2016) was applied. Thus, the set of n statements relating to a particular topic is divided into a circle with an area of 1 (one) which is divided into n slots, with the marks in the axis relating to each of the possible scale's options. The quantitative value corresponds to the total area according to Section 3.3.

The Waikato Environment for Knowledge Analysis (WEKA) was used to set Artificial Neural Networks (ANNs) (Haykin, 2009) while maintaining the standard software parameters (Frank *et al*., 2016). In each simulation, the database was randomly divided into two mutually exclusive partitions, leading to the training test sets.

3. Results and Discussion

3.1. Sample Characterization

This study was carried out using a convenience sample that included 147 participants between 20 and 81 years of age, with an average of 35. The gender distribution was 40.2% and 59.8% for male and female, respectively. In terms of academic qualifications, 14.3% of the cohort said they had a basic education, 51.0% said they had completed secondary education, and 34.7% said they had a degree or postgraduate education. In terms of place of residence, 19.7%, 30.6% and 49.7% are from the northern, central, and southern regions of Portugal, correspondingly.

3.2. Answer Frequency Analysis

Figure 1 shows the frequency of answer to the second part of the questionnaire, where participants chosen the alternative that best express their opinion regarding each statement.

The statements S1 to S3 refer to the *air pollution*, S4 to S6 are related to *water pollution*, S7 to S9 are about *global warming*, and S10 to S12 are relative to *energy resources*. Regarding the statements included in the topic *air pollution*, 36.7% and 67.3% of respondents ticked the option *agree*, in statements 2 (related with the use of activated carbon) and 3 (concerning contamination by pesticides/fertilizers), respectively.

With regard to statement 1 (about the use of combustion engines), the majority of participants ticked the options *strongly agree* (52.3%) and *agree* (44.9%). The option *disagree* was chosen by 12.9%, 10.9% and 1.4% of participants in statements 2, 3 and 1, respectively. Regarding the option *strongly disagree*, it was not selected by the participants.

With regard to the topic *water pollution* all the participants chosen the options *strongly agree* (67.3%) and *agree* (32.7%) in statement 6 (related with direct discharge of industrial waste). Concerning statements 4 (related to the use of microorganisms for decontamination) and 5 (regarding the use of plants for decontamination) the option *agree* was the most marked (43.6% and 51.0% respectively) followed by the option *strongly agree* (18.4% and 19.7% respectively). The option *disagree* was chosen by 10.9% and 1.4% of participants in statements 5 and 4, respectively. As before, the option *strongly disagree* was not selected.

Concerning the statements comprised in the topic *global warming* (i.e., statements S7 to S9), the option *agree* was the most chosen (63.3%, 59.9% and 40.1% respectively) followed by

the option *strongly agree* (23.8%, 37.3% and 29.3% respectively). The option *disagree* was ticked only in statement 8 (related with glaciers melt), by 1.4% of participants. The option *strongly disagree* was not marked. Finally, with respect to the topic *energy resources*, 54.4% of participants ticked the option *agree* to statement 10 (related with the use of renewable energies), whereas 44.2% marked the option *strongly agree*.

Regarding statement 11 (about the use of biogas), 47.6% of participants chose the option *agree*, whereas only 5.5% marked the option *strongly agree*. In statement 12 (on the inexhaustibility of renewable energies), 47.6% of participants chose the option *agree*, 15.0% ticked the option disagree, whereas the option *strongly agree* was marked by 12.9%. It should be noted that 4.1% of respondents ticked the option *strongly disagree*.

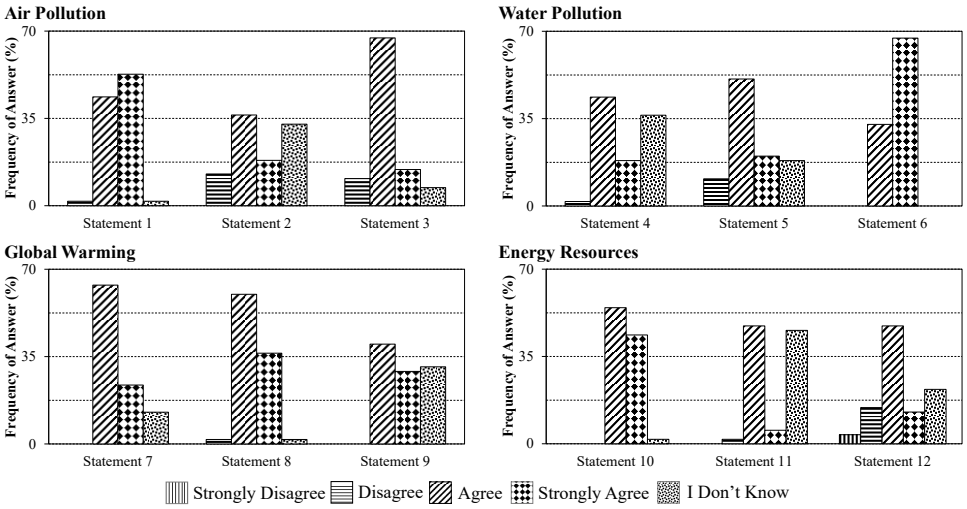

Figure 1. Frequency of answer to the statements included in the second part of the questionnaire.

Regarding the option *I don't know*, the analysis of Figure 1 allows to identify 3 different situations, corresponding to frequencies of answer lesser than 2%, ranging between 7% and 22%, and higher than 30%. The former group includes the statements 1 (about the use of combustion engines), 6 (related with direct discharge of industrial waste), 8 (related with glaciers melt) and 10 (related with the use of renewable energies).

The issues related with activated carbon (S2), microorganisms for decontamination (S4), CFCs (S9), and biogas (S11) integrate the third group, exhibiting frequencies of the answer *I don't know* higher than 30%. This evidence can be justified considering that these issues are less disseminated through the media, with the population less informed about their importance.

3.3. Environmental Literacy Assessment

To develop a decision support system for assessing the environmental literacy, ANNs were trained and tested on the basis of the results obtained in the second section of the questionnaire. Since the data collected is qualitative, it had to be quantified, being the method suggested by Fernandes *et al*. (2016) the one that was adopted. To illustrate the process, Table 1 presents the answers of participant 1.

Table 1. The answers of participant 1 to the statements included in questionnaire (2nd section).

Topic	Statements	Strongly Disagree	Disagree	Agree	Strongly Agree	I Don't Know
Air Pollution	S1				×	
	S2		×			
	S3			×		
Water Pollution	S4			×		
	S5			×		
	S6				×	
Global Warming	S7			×		
	S8				×	
	S9					×
Energy Resources	S10			×		
	S11					×
	S12		×			

For each topic (i.e., *air pollution*, *water pollution*, *global warming*, and *energy resources*) the answers were summarized in a unitary area circle. The marks in the axis correspond to each possible answer, i.e., *strongly disagree*, *disagree*, *agree*, *strongly agree*, and *I don't know*.

Exemplifying with the statements of the topic *air pollution*, the answer to S1 was *strongly agree* and the correspondent area is given by $\frac{1}{3} \times \pi \times \left(\frac{1}{\sqrt{\pi}}\right)^2 = 0.33$, in S2 was chosen the option *disagree* and the correspondent area is $\frac{1}{3} \times \pi \times \left(\frac{2}{4} \times \frac{1}{\sqrt{\pi}}\right)^2 = 0.08$. Finally, for S3 the answer was *agree* and the area is $\frac{1}{3} \times \pi \times \left(\frac{3}{4} \times \frac{1}{\sqrt{\pi}}\right)^2 = 0.19$. The total area (i.e., 0.60) is the sum of the partial ones, being the quantitative value regarding the statements of the topic *air pollution* for participant 1 (Figure 2). The values presented in Table 2 were computed in a similar way, for the remaining topics and for each participant.

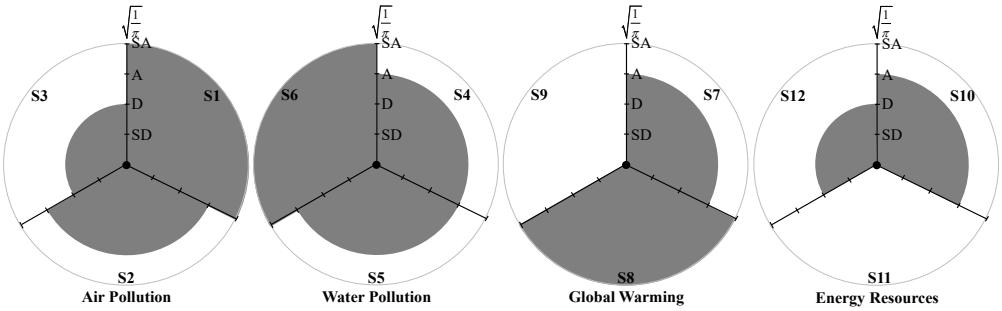

Figure 2. The quantification process of the qualitative information collected in the second section of the questionnaire for respondent 1. SD – Strongly Disagree, D – Disagree, A – Agree, SA – Strongly Agree.

Table 2. A fragment of the knowledge base for the environmental literacy assessment.

Participant	Air Pollution	Water Pollution	Global Warming	Energy Resources
1	0.60	0.71	0.52	0.27
…	…	…	…	…
147	0.56	0.85	0.56	0.08

The values presented in Table 2 were used as inputs of the ANNs models, whereas the output was the assessment of environmental literacy. To achieve the best ANN to assess the environmental literacy several network structures have been elaborated and evaluated (Haykin, 2009).

The performance of ANN models was compared using the confusion matrixes (Fernandes *et al*., 2020). Among the various topologies tested, the one with the best performance (i.e., higher accuracy) was the 4-3-1 topology (Figure 3).

The respective confusion matrix is displayed in Table 3 (the values displayed correspond to the average of 30 experiments). Based on Table 3, it is possible to compute the model accuracy for training set (88.1%, i.e., 89 correctly labeled in 101) and for test set (86.9%, i.e., 40 correctly labeled in 46). Thus, the assessment of environmental literacy through the proposed ANN can be considered satisfactory, exhibiting accuracies higher than 85%.

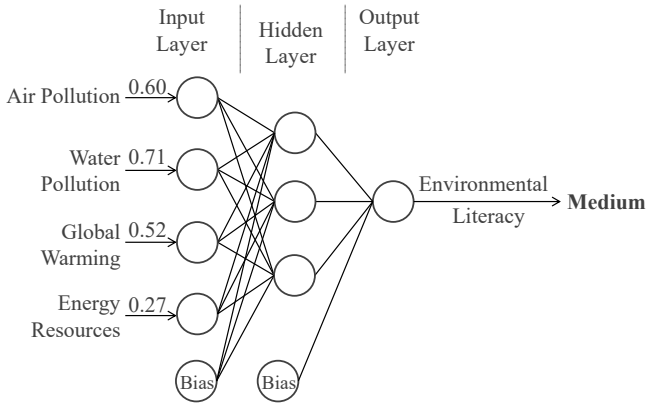

Figure 3. A schematic view of the ANN selected for environmental literacy assessment.

Table 3. Confusion matrix regarding ANN selected for environmental literacy assessment.

Target	**Predictive**					
	Training Set			Test Set		
	Reduced	*Medium*	*High*	*Reduced*	*Medium*	*High*
Reduced	28	4	0	12	2	0
Medium	5	50	1	3	22	
High	0	2	11	0	1	6

4. Conclusions and Future Work

Encouraging environmentally friendly behaviors and developing actions that guarantee the planet's sustainability are mandatory. The population's adhesion can make the actions more effective, and this depends to a great extent on their knowledge on these themes.

This work proposes a methodology to assess the environmental literacy. The results obtained show that the degree of literacy is quite high in relation to the most popular topics in the media, but very low in relation to other topics related to more recent technological solutions, such as the use of biofuels, activated carbon, microorganisms, and biogas. This fact was revealed by the high percentage of answers *I don't know* obtained in the statements related with those topics. This approach exhibits a satisfactory effectiveness, showing an accuracy higher than 85%.

Furthermore, it allows to recognize the less well-known topics of the population and help the decision makers to promote future dissemination actions as well as their inclusion in the curricula of the various higher education courses. Future work will consider new environmental topics and the use of a cohort of higher education students to study the impact of the scientific area of courses on environmental literacy.

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Impact of Text Discussions on the Professional Identity of Higher Education Students

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Abstract

Comprehension of academic literature is a key element in the immersion of university students in the academic subcultures of each discipline (Chanock, 2001; Estienne & Carlino, 2004; Gottschalk & Hjortshoj, 2004). To do so, universities opt for the implementation of text discussion such as book clubs (Hartley, 2002; Long, 2003), dialogic literary gatherings (Flecha, 2000; Mirceva & Larena, 2010) or literary circles (Daniels, 2002; Duncan, 2012).

This case study, essentially qualitative, seeks to know the impact of text discussions on the professional identity of the students of Teacher Education and Computer Science at the University of Andorra (UdA). Results are obtained by student focus groups, the Likert test Motivational Survey on Academic Reading (Muñoz et al., 2012), teacher interviews and taking notes in situ throughout the discussions.

The main results indicate that the text discussions have a positive impact on students as (1) it increases the reflection, understanding and critique of the professional world, (2) they apply evidence-based content in professional contexts and (3) it improves the justification of informed professional decisions.

Keywords: *Higher education, text discussions, professional identity.*

1. Research goal

The main aim of this study is to analyze the contributions of text discussions on the professional identity of UdA students.

2. Framework

In an increasingly dialogical society (Habermas, 2001; Beck, 1998; Flecha, et al., 2001), it is not possible to ignore the relevance of the university as an actor of the society as it becomes one of the main institutions that trains future professionals involved in the transformation of the Europe of the new century (European Commission, 2010). In the midst of this dialogicty (Bakthin, 1981), text discussions grow in university contexts: learners read a text and then meet to share interpretations and negotiate meanings. In this collective process of interthinking (Mercer & Littleton, 2007), reading comprehension becomes a key factor in the formation of critical people with the ability to participate in the construction of a diverse and plural community (Cassany, 2006).

In this dialogical reading, students debate theoretical questions, share points of view and connect the ideas of theory with professional practice (Fernández et al., 2012). In these connections between theoretical concepts and professional actions, students critically reflect on professional practice (Freire, 1994) and, in addition, theory and practice reciprocally feed into each other (Fernández et al., 2012). Accordingly, the international scientific literature reflects the impact of text discussions on the configuration of the professional identity of the participants.

One of the contributions is the improvement of understanding of the professional world (Macoun & Miller, 2014) as students reflect and take a critical position towards professional real context (Aguilar, 2017). In this sense, several studies whose participants are Teacher Education students collect results on how they reflect on the teaching practice and the role of the educator in classrooms (Flood et al., 1994; Finke & Edwards, 1997; Aguilar, 2017). For example, they reflect and dialogue about the impact the educator has on student participation in the classroom (Chocarro de Luis, 2013).

On the other hand, readers are also questioning values and principles that will guide their actions in the professional context. As an example, Bixler and colleagues (2013) collect how students become aware of the need to be readers in order to teach reading. In this reflective process, the awareness of the need for informed and justified professional decision-making based on scientific evidence raises (Aguilar, 2017) and the ability to argue upon scientific bases also improves (Bixler et al., 2013).

Moving from reflection to practice, HE students also apply the contents learned in classsroom. In this line, different studies developed in Teacher Education show how students

have transferred or intend to implement the reading groups as a teaching strategy in schools (Finke & Edwards, 1997; Bixler et al., 2013; Chocarro de Luis, 2013). Some arguments that motivate the transfer of this teaching strategy are that it is conceived as a way to expand ideas towards the same content through peer interactions or as a way to give learning opportunities to all students, including those who are shyer and less participatory (Flood et al., 1994).

3. Methodology

This research is an essentially qualitative case study (Yin, 2009). Quantitative data are also obtained in order to expand and delve into specific aspects (Hesse-Biber, 2010). This triangulation adds greater breadth, richness, and depth to the study (Flick, 2007, cited by Denzin, 2012).

On the one hand, qualitative data are obtained through the application of interviews and discussion groups with faculty and university students. On the other hand, we obtain quantitative data through the tool *Motivational Survey towards Academic Reading* (Muñoz et al., 2012) applied to the students. At the same time, we make observations of the text discussion sessions and on-site notes are collected.

4. Results

First, we note an improvement in the reflection, understanding and critique of the professional world. Students express how focus groups allow them to better understand their future profession. For example, a student expresses how the relationships between the content and other topics such as personal experiences or contextualized real cases favor a deeper understanding of the professional world in which they will enter once they have completed their training:

> *I understand more context for global world. This contextualization [in group discussions] helps me to understand better my task in the professional world.* (BAE1819_A4)

At the same time, participants reflect on the professional figure in their daily work. We observe it on the words of Teacher Education students when they reflect on the role of the teacher. These reflections are possible thanks to the internships that students do in schools:

> BCE1819_P: *The language is also important.*
> BCE1819_A9: *Is that what the author was saying, that talking about architecture with an architecture student is not the same as talking about a K-12 child, adapted!*
> BCE1819_A8: *adapted because there are parents who talk to their children as if they were a baby and it's not good either because the children talk fatally!*

> *And the teachers always try to say the sentences well and not say "woof, woof" and things like that.*

In this dialogic learning environment, students become involved in the process, work on the content in depth and try to understand it from multiple perspectives and, finally, implement somehow the contents learned in class. As we have seen, participants are able to more easily establish connections between theory and practice and, consequently, they transfer the content worked on together to a real professional context in an easier way. The following excerpt recounts the widespread perception among Teacher Education students:

> *Yes, I think so [that the reading groups have helped us in our professional action]. I think it helps you because you remember it, it's something you've worked on, that you've understood and at the moment you say "okay, I'm watching it and I know how to apply it, I know what to do".* (BCE1819_A6)

This links between theory and practice are also recorded in the field notes. For example, we notice how some students make direct references to the assessment challenges they have to undertake and the theory that they have adressed in class:

> *I liked the text, I find it very interesting. Overall, the reading is great, especially the part of our challenge that says the teacher needs to stimulate dialogue which is very important for children's cognitive and moral development.* (BCE1920_A6)

In addition, we observe how students discuss and help each other by expressing ideas, modifications and innovations that they would make in the written work of their classmates:

> BCE1920_A6: *My activity is about I cooking, right? They make the recipe, when they have the recipe they give it to the teacher and the teacher cheats them, that is, the teacher puts them in liters and they have to convert [to another unit].*
> BCE1920_A5: *if it is for the measures, with conversion of units. For example, to put a problem could be "we have this meter in ml and I have the recipe with l".*
> BCE1920_A3: *or do what he [partner] just told you, for example "this is for seven children, how much would it be if it were for more?*

On the other hand, some participants confirm that they have directly applied certain strategies worked on in the classroom based on reading and group discussion. We see some cases related to mathematical or teamwork strategies:

> *Yes. For example, teamwork, group strategies, yes I did it in the first cycle, they do a lot of group strategies!* (BCE1920_A3)

> *The other day [at school] we had a literary gathering and... about maths, they did fruit series. Then, the students ended up eating fruit skewers while doing the literary gathering.* (BCE1819_A3)

These student accounts are in line with the ratings scored in the survey. When students are asked about whether reading academic literature will help them become a good professional, we see an increase in students' perception of the usefulness of academic texts in their development as a professional (Table 1).

Table 1. Criteria of *Motivational Survey on Academic Reading* related to the *usefulness* of academic reading.

	Average		Var.
Reading academic literature will help me to be a good professional	3,654	3,99	+9.2%

Source: Prepared by the author on the basis of data compiled.

At the same time, an improvement in the justification of informed professional decisions is identified. The use of scientific evidence in informed professional decisions becomes a key factor in achieving excellence in professional contexts. In this sense, we identify several experiences of both Computer Science and Teacher Education students who use or in the future will use a scientific basis for the development of their professional tasks:

> BCE1819_A5: *about separating groups, it is true that we have seen that it is much better to separate them with some criteria, these criteria we have seen in scientific sources.*
> BCE1819_A6: *Yes, they are things we have already seen and we could work with what we know.*

We note several samples of how students include scientific evidence in the design and planning of activities which are going to be implemented in the school as well as in their future professional work. In the following example, the student uses theories from classical authors such as Piaget and Vygotsky in order to justify his decisions. As he says, the knowledge built in the group discussions "helps you to develop your daily work":

> *What I have seen is that perhaps, with Vygotsky's ZPD, we should always take into account elements that are close to children or that are not something completely decontextualized from their environment, but something that is from their daily lives. And I do try to apply that, for example, if I have to bring them a material of whatever, then I try to bring materials that they can find at home or with examples that are in their everyday or things like that. I always try to apply that.* (BCE1819_A5)

At the same time, students exemplify the usefulness of using scientific evidence for the development of professional work. The following excerpt summarizes how Computer

Science students attach importance to research as it provides reliable knowledge regarding the comparison of new systems and technologies, useful information for scientifically supported job performance:

> *The third reading we saw one method against the other, it was clearly more powerful. Based on that article you discover that and, perhaps, you can find an article where you compare two technologies that you are interested in implementing in your company or whatever and you see that one is better than the other, more like a benchmark, a comparison between two or more.* (BI1819_A2)

Finally, students also consider the use of primary sources important because it brings them closer to real professional contexts: they know what difficulties researchers have faced and allow them to learn the theory applied to real professional situations, with its limitations and difficulties. We retrieve the following fragment as an example:

> BI1819_A4: *yes [the seminars have helped us to better contextualize the theory in the real world], because we see a real case of someone who has applied… it is not just to say: "look, this protocol works like this", but you can say "look at the protocol, it is implemented with this technology, these servers have been needed."*
> BI1819_A3*: When you learn is when you are working and you find yourself in trouble and the university does not give you that… you learn it by working! And here, in the readings, we have seen difficulties that have come out that have helped us to analyze things, which is obviously much more extensive and infinite, but look, you already have things in mind that you don't have to do.*

5. Discussion of research outcomes

As we have seen, text discussions directly affects the configuration of the professional identity of the HE students. First, there is a greater reflection, understanding and critique of the professional world. On the one hand, the relationships between the content and other topics such as personal experiences or contextualized real cases favor a deeper understanding of the professional world, in line with previous studies (Flood et al., 1994; Finke & Edwards, 1997; Bixler et al., 2013; Chocarro de Luis, 2013; Macoun & Miller, 2014; Aguilar, 2017).

On the other hand, the dialogic scenario of the discussion groups contribute very favorably to the motivation of the students to consider and finally incorporate the new contents and the new teaching strategies learned in the framework of the reading activity. Similarly, other researchers have identified how students have transferred group text discussion as a teaching strategy during internship programs (Flood et al., 1994; Finke & Edwards, 1997; Bixler et al., 2013; Chocarro de Luis, 2013).

In addition, students show an increase in awareness of informed and justified decision-making based on scientific evidence (Aguilar, 2017) when, for example, they discuss what the teacher's daily work at school would be according to the theory. But beyond this increased awareness, participants show a clear interest in using primary academic literature and including this scientific basis in their early professional actions. As part of this study, students are already considering scientific evidence in the design and planning of activities to be implemented in the school.

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An Example of Innovative University Teaching and Learning: the Fashion-Tech Model of Integration

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Abstract

The aim of the paper is to investigate the relationship between higher education institutions and companies in the field of Fashion-Tech educational system, in order to test the effectiveness of the integration of heterogeneous skills and disciplines. The paper firstly analyses how design, pervaded by the results of technological progress, has become over time an increasingly complex and multidisciplinary field, determining the need and development of new professional figures. Secondly, it focuses on the fashion-tech sector, the resulting area obtained from the intersection of fashion design and digital technologies, highlighting the need for a reviewed educational approach to form hybrid professional figures. To this aim the paper examines data obtained through interviews and desk research conducted within the framework of "Education for Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era" European project, outlining the state of the art in fashion-tech and investigating the transversal dynamics between the academic world and companies. Next, a case study is reported: an international and multidisciplinary workshop carried out in the field of academic training with the collaboration of a company. What emerged from the experience is that in the Fashion-Tech, the close and continuous relationship with companies acquires a fundamental role.

Keywords: *Fashion-tech; design; hybrid professionals; multidisciplinary workshop.*

1. Introduction

The field of design is becoming more and more complex. Today's context challenges young designers to perform in an increasingly interdisciplinary and cross-fertilized environment, characterized by fluid and constantly changing methodologies (Testa, 2019). Especially with the advent of digital technologies and with the increase in design experiments around them, the act of hybridizing with different contexts is increasingly required in design research, education and practice. This would lead to outline a professional figure that can mediate within the design process, serving as a middle ground between art, engineering, design and critical thinking. Speaking of hybrid design implies confirming that the same boundaries among the different types of design are continuously dissolving (Bremner & Rodgers, 2013).

The growing hybridization of contexts does not only involve the definition of a professional figure, but also competes with the educational methodologies that can be constructed to define this new type of designer (Bremner & Rodgers, 2013). We can affirm the need for a urgency in redefining the patterns that make up design education.

The multidisciplinary that the Fashion-Tech environment constitutes forces the need to encourage an integration among different disciplines. This would create a fertile and cross-fertilized ground for design. Furthermore, it is also clear that, in this hybridized field, research and training should consequently have a practical and applicative feedback, to test its effectiveness and the interest that companies may have in specific design research.

Therefore, in the market application as well as in teaching, theory and practice of design cannot be split, but rather encouraged. To quote Boyer, "Theory surely leads to practice. But practice also leads to theory. And teaching, at its best, shapes both research and practice." (Boyer, 1990, p. 16) In detail, for Fashion-Tech, technologies have officially penetrated the mass market and are the result of a mixture of tools and methods from different sectors and disciplines (Tenuta, 2020). It is therefore necessary to revise the tools of investigation, not only for academic research, but also for applied research, through a redefinition of the design methodology that allows to connect and combine the processes of design with those of IT, thinning the boundaries between creativity and scientific method (Tenuta & Testa, 2018) as well as a definition of the characteristics of those professional figures that will populate the world of Fashion-Tech.

2. Fashion-Tech: from HEIs to Companies

In a changing landscape, the result of strictly enforced quarantines and social estrangement, fashion players have been forced to accelerate strategies that were at the testing stage only months ago into new operational realities. Some technologies that had been slow to catch on such as virtual catwalks and digital showrooms, sample signatures in sourcing offices,

livestream commerce and the latest 3D design tools, have accelerated dramatically (Business of Fashion, 2020).

The technologies and processes successfully implemented during the crisis will have a profound effect on the future of the industry, a future in which the grafts between fashion and technology have been around for the last years but have only recently taken hold.

The talents of the future have to be ready for all this, prepared to meet the needs of companies. It is precisely with a view to training professionals capable of handling the subject of fashion technologies that Politecnico di Milano has been investigating effective teaching and learning methodologies in the field of Fashion-Tech for years. In detail "Education for Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era", a three-year (2017-2020) Strategic Partnerships for higher education project co-founded by the Erasmus+ Programme of the European Union (GA 2017-1-SE01-KA203-034601), had the aim to bridge the fashion field with that of innovative technologies by creating new training pathways to improve the level of key competencies and skills of students and trainers and to break down barriers between technologists and creative communities and build meaningful collaborations.

A project that does not remain closed only in the academic culture but that, throughout its duration, has been enriched by dialogues with the market. From the outset, the project was oriented towards an observation that included not only research but also industry. Indeed, the initial desk research entailed researching higher education institutes (HEIs), research centres (RCs) and companies in Europe and worldwide in order to identify the ones active in the areas of wearables, smart textiles or digital manufacturing.

Additionally, the goal was to identify best practices and current and/or upcoming trends in the Fashion-Tech field. Thus, the structure, teams, products and methodologies of the identified practitioners were explored in order to understand educational and research approaches to the area of Fashion-Tech. The initial research concluded in 60 HEIs, 57 RCs and 171 companies (total of 288) globally, all working within the Fashion-Tech area. The state of art of higher education programmes was of interest, along with high-qualitative didactic experiences and applied research experiences by public or private research centres or companies. The institutions were contacted through email and personal contacts and 14 HEIs, 13 RCs and 27 companies globally showed interest in being involved with the project.

The results of this analysis were useful for two main points: there are many different fragmented realities that are defining a shared methodology, defining the features of a new hybrid figure that is able to control the different phases of the methodology and to connect the dots between the different professional figures that we will encompass later, by ensuring that shared tools for knowledge are defined; as for the collaborations, all the interviewed realities claim to be very attentive to collaborations or to have the intention to improve them

(12/14 universities, 21/26 companies and 12/13 research centres have collaborations in progress with companies).

2.1. "IAMlight" Experience

Starting from the results summarised in the previous chapter, the "IAMlight" workshop was designed with the aim of encouraging the meeting of different disciplines, testing a trans-disciplinary methodology based on a scientific method and a creative process for Fashion-Tech (Tenuta & Testa, 2018) and encouraging relationships with industries. "IAMlight" is one of five pilot workshops organized during the 3-years E4FT project with the aim to test and evaluate different approaches to Fashion-Tech. During the pilot workshops, the monitoring process was aimed to assess the overall quality and success of each delivered training program. Central to this process it was the use of evaluation forms and questionnaires that the participants completed before and/or after each workshop.

The methods were designed to provide accurate feedback and assessment relating to the depth and quality of the material delivered, the relevance of the subject matter, and the teaching practices employed throughout the intensive teaching and learning period. In addition, a peer observation process was adopted: it offers critical insights into an instructor's performance and complements the student ratings and feedback forms, combining both perspectives contributed toward a more comprehensive and accurate representation of the overall teaching quality.

Lastly, informal group discussions were held at the end of each workshop to openly discuss and collect any additional areas or matters that they wish to raise or express, which may not be best achieved using feedback forms or questionnaires. An in-depth analysis of the "IAMlight" workshop's learning, teaching and training experience follows.

2.2. "IAMlight", Experiencing Additive Manufacturing at Politecnico di Milano

The "IAMlight" workshop for higher education learners was organised by Politecnico di Milano (Project Leader) at Polifactory, the official makerspace and FabLab of Politecnico di Milano, from the 24th to 28th June 2019.

It aims to: test the designed curriculum's pedagogy and teachers' toolkit in real settings; engage learners in an intensive transnational, multicultural and interdisciplinary collaboration, to test not only their technical abilities but also their interpersonal skills; facilitate learners' ability to divergently personalise their learning within the fashion-tech fields thanks to the use of blended tools and on-field activities; prototype and evaluate the quality of possible outputs as Fashion-Tech artefacts too, then, approve methodology and promote it beyond the partnership and into the European communities of HEIs, companies and shareholders; highlight the further learning, teaching, and training opportunities based on the emerging needs of trainers and learners on the field.

In order to achieve these objectives, a specific brief was designed together with a company in order to break out of the academic dimension and design objects that would also consider the market and not only experimentation. The project brief was to design a jewellery piece for Maison203 using 3D printing technique. A design concept that starts from the perception of surfaces depending on the presence or absence of light.

As mentioned, the integration of different fields and competences was one of the main point of the project. That is why the actors involved were many and heterogeneous: 1 company: Orlando Fernandez Flores, Maison203; 5 Politecnico di Milano staff members from fashion and tech field, 2 (1 fashion 1 tech) with the role of trainers: Chiara Colombi, Patrizia Bolzan, Chiara di Lodovico, Livia Tenuta, Susanna Testa; 3 keynotes speakers with the role of expert trainers offering specialised contents to supporting trainers and learners' activities: Daria Casciani, Sara Colombo, Silvia Deborah Ferraris; 5 learners from London College of Fashion, 6 from Politecnico di Milano and 4 from the Swedish School of Textiles – University of Borås selected through a call for students, for a total of 15 students, grouped in 5 teams of 3 students, one student forms each partner, to maximise the benefits of an international collaborative experience.

2.3. Methodology

The project – organized in 5 days as shown in Figure 1 - envisaged a learning-by-doing part which was compounded by theoretical lessons imparted by experts in digital manufacturing and 3D printing, fashion and jewellery design, Fashion-Tech and communication design.

These supported the whole design process and guided the students through all of its stages. About the research methodology, a qualitative analysis from observation and a quantitative result through interviews and questionnaire were conducted during the different stages of the workshop. Below is an outline of the workshop meetings, with the specifications of the experts and the disciplines involved.

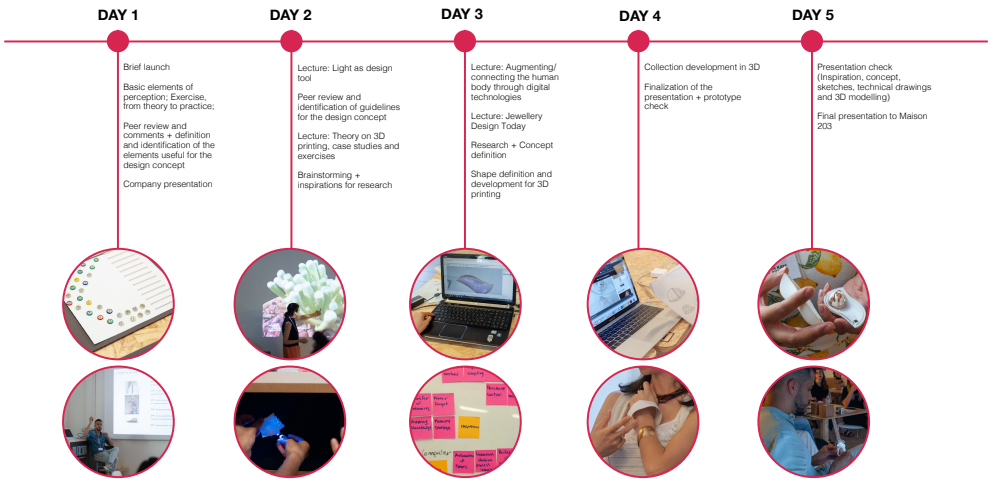

Figure 1. IAMlight Workshop Calendar. Source: Colombi & Tenuta (2020).

2.4. Results

As mentioned, a qualitative analysis from observation and a quantitative result through interviews and questionnaire were conducted during the different stages of the workshop. About the qualitative analysis, the intensive study programme produced 5 new Fashion-Tech product concepts, delivered with a physical prototype, addressing specific market opportunities in term of product-service, interaction with the users and supply chain management. The groups were asked to produce a presentation including research, concept, sketches, technical specifications and pictures of the prototype/mock-up. The products designed and prototyped by the various groups envisaged very diverse scenarios for the use of 3D printing and embedding light. Each group was able to develop the project brief taking into account the technical limitations that the applied technologies required. Furthermore, the collaboration with the company led the participants to develop a project suited to the aesthetic lines of the brand as well as to consider the industrial production of the object.

The initial exercises on the behavior of light applied to 3D printing had been used by the groups as a starting point for the project development. About the quantitative analysis, specific questions were included in the questionnaire, which were submitted to the students at the end of the course. The aim was to evaluate both the degree of satisfaction about the management and conduct of the workshop, both the improvement of the individual skills of each participant.

The program was considered coherent with the Fashion-Tech theme by 90% of the participants. This is demonstrated by the fact that the level of satisfaction for the entire programme, the structure and the organization was very high: 80% of the participants found

the information pack and programme extremely clear and 90% of them considered the FabLab a suitable place for the workshop.

The questionnaire also revealed the limits and opportunities that the participants described in relation to the teaching experience. In particular, among the opportunities identified, the importance of the union between theory and practice, the multidisciplinary of the experience and the possibility of working in a heterogeneous group in terms of knowledge, skills and cultural background was highlighted.

Furthermore, the opportunity was found to be able to collaborate on the one hand with experts of the Fashion-Tech sector, learning from their skills and challenging themselves with their knowledge inputs, and on the other hand to cooperate with a company thus having a real stimulus and feedback from a productive reality. Finally, the workshop was defined as a good simulation of a design reality.

The limitations that emerged from the questionnaire mainly concerned the time available, in particular that relating to the improvement of 3D modelling skills, the teaching of technicalities regarding light and practical experimentation with machines. In particular, the use of Rhinoceros 3D as a three-dimensional modelling software was described as essential, a skill that 60% of the participants stated they would have been able to develop more with more time at their disposal. In addition, 2 out of 5 groups have suffered from a lesser interdisciplinarity within the working group: they would have preferred a group built with a fashion/jewellery designer working together with a product designer/architect or even a (mechanical) engineering or electronic student etc.

The suggestions that emerged ranged from the implementation of the technical knowledge of 3D software to the desire to have further experimentation with experts in the field of electronics such as circuit integration as well as programming with a microcontroller.

Finally, it was asked what was the most important lesson learned from the workshop and it emerged that the 70% of the participants understood the contribution that the designer can make in the field of Fashion-Tech, the urgency to change the education curriculum, the importance of communication skills in group work and the need to capture and satisfy consumer's demand.

3. Conclusion

"IAMlight" workshop was useful to test the actual application of an innovative educational curriculum model in the field of Fashion-Tech, including a collaboration with a company. Participants were interested in learning and experimenting new approaches to the discipline.

The short course was structured in order to prepare students for the industry: the teaching aimed not only to address technical aspects but also to enable the development of

transferrable soft skills, such as teamwork, communication, critical thinking and problem formulation and solving, among others. Each module was well balanced between frontal lessons and learning-by-doing parts, giving a continuous stimulus to experimentation and learning of the discipline.

Although the overall evaluation of the experience is to be considered more than positive, the limited time available left some didactic gaps both for the technical part (understanding of 3D printing and electronic technologies) and for the material experimentation (printing tests and correction of the prototype). This underlines the importance of the designers' curricula being implemented with multidisciplinary collaborations to bridge any technical gaps.

Moreover what emerged from the experience, and in particular, from the learning by doing part, is that in the Fashion-Tech sector, the close and continuous relationship with companies acquires a fundamental role.

It allows universities to be aware of what the challenges are for the market. It is not a matter of knowing the technical challenges of a company, which are circumstantial and short-lived, but instead of entering into what are the most complex discourses, which invest different aspects of the world of design and involve various disciplines.

This synergy allows to find answers to bridge the gap between traditional design and new technologies that help make the industry more sustainable, forward-looking and effective. It allows universities to learn about the state of technological development.

This becomes a fundamental element to design according to available technologies, stimulating further developments, but starting from a certain basis. It allows to monitor the market and understand the actual demands of consumers. This is possible thanks to a constant comparison with the marketing areas of the companies that capture the requests and preferences of consumers. It allows to train professionals capable of responding to the challenges of the market, increase the employability and innovation potential of students.

Companies today are no longer interested only in internships or recruiting graduate talent, but want to develop relationships with students while they study, to be close to the talent pool.

The “Education for Fashion-Tech: Interdisciplinary Curriculum for Fashion in the Digital Era” project focused mainly on Higher Education Institutions, the following step is the one to create a stronger connection with industry. Precisely with the aim of increasing the link and dialogue between universities and companies, another European project has been launched: FTAlliance (GA 612662-EPP-1-2019-1-IT-EPPKA2-KA).

The consortium comprises 13 partners (12 full + 1 associate) including higher education institutions, research organisations and small, medium and large enterprises. To improve cooperation between industrial, research and educational institutions on a European scale,

multidisciplinary skills and resources are needed to implement innovative educational models. FTAlliance is an international industry-university educational alliance designed to enable mutual learning from different research, education and industry experiences, to exchange know-how and build an open innovation model to promote cooperation and fuel the competitive growth of the Fashion-Tech market.

The ambition of FTAlliance requires a major collaborative effort by pooling and sharing know-how and resources. Cooperation between universities and businesses at European level is needed to improve the skills and capabilities of fashion and textile designers to compete internationally.

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A case study on student perception of online lecturing

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Abstract

This case study looks at implications of transitioning live to recorded lectures, a subject that has acquired an acute importance given COVID19 and the unexpected need to move lectures online. Over a period of six years, from 2015 to 2020, a questionnaire was handed out at the end of a 'unit' on environmental geoscience; a 'unit' at Australian universities represents a 'course' in the European and American tertiary system. This is a 2nd semester, 3rd year core unit of an Applied Geology course meaning that (most of) the polled students were about to acquire a bachelor of science finishing their undergraduate studies. The students were asked multiple questions related to iLectures and their attitude towards this asynchronous content delivery approach as integral part of a flipped classroom. Provided that such a STEM unit with 40-120 students can be deemed representative of the wider student community, the findings indicate that students in general have come to terms with online lectures, way before COVID19 gave them no other choice. Acceptance rates for iLectures were over 50 % across all years, except for 2020, a clear indication that COVID19 marred the online experience, probably due to oversaturation and isolation. The majority of the students saw benefits in this asynchronous lecturing approach, irrespective of whether the rationale behind it had been explained in detail. Despite seeing benefits of the flipped classroom and recorded lectures, one out of three students preferred live lectures. This number has increased after COVID19 to 40 %, yet another sign of the negative impact of the pandemic on online lecturing. This inference is unrelated to the quality of the recordings which was deemed high. Finally, the importance of meaningful extended lecture notes to complement the recordings is highlighted.

Keywords: *Flipped classroom; online lectures; iLectures; COVID19, blended learning.*

1. Introduction

Before COVID19, one of the main rationales of desisting from live lecturing and offering online recordings instead (mind, for internal on-campus students) was the flipped classroom approach (FCA). The FCA and its pros and cons has been covered in detail in the literature (Akçayır & Akçayır, 2018; Bishop & Verleger, 2013; Milman, 2012; Tucker, 2012) and is *per se* no the subject of this study. It is understood (and applied) here as freeing up face-to-face time and using it for tutorials and laboratories where the recorded lecture material is put into practice via hands-on group as well as individual activities (e.g. case studies), discussions, and presentations. It is in these physical spaces where the students are prepared for the subsequent assessment of learning outcomes. As for the online lectures, these are normal 'off-the-shelf' slide-based recordings, nothing extra-ordinary or quirky whose novel and/or unusual format might have had any skewing effect on the polling outcome (more on their format in the text).

Because an integral part of any FCA is asynchronous content delivery, it is important to assess student acceptance (and adoption) of recorded vs. live lecturing, especially now in pandemic times when there is no real alternative to fully online or at least blended learning. There is an increasing amount of studies that have already looked at a comparison between the two techniques (Cardall, Krupat, & Ulrich, 2008; Gorissen, van Bruggen, & Jochems, 2012; Gupta & Saks, 2013; Milman, 2012; Tamm, Ernst, & Weems, 1999) but none of them has been carried out over several years. They provide a glimpse from a single cohort over a single term –and vary in their findings whether recorded lectures present a benefit over live ones. To help gauge student disposition towards iLectures before and after COVID19 and whether this attitude changes demographically and (somewhat) generationally over years, the introduction of the FCA was accompanied by rolling out a questionnaire. This ethics approved questionnaire enabled the compilation of empirical data on sundry aspects of recorded lectures that shed light on student behaviour, perception, and expectancy.

2. Results

Table 1 displays the ten questions administered to the students in the last week of the semester. They are part of a larger online questionnaire generated with Google Forms. The target group are 3rd year geology (and ecology, bioscience, and water technology) undergraduate students enrolled in a unit called 'Environmental Geoscience', taught during semester 2. This unit is one of the last four units that a prospective Bachelor of Science student takes before graduating. The students are a mix of overseas (15 %) and domestic students (85 %), from different countries and Australian States respectively, and from varying personal backgrounds; traditional as well as non-traditional students, most between 20 and 35 years of age. The considerably varying student numbers (increasing 1/3 from 2015 to 2017

and then slumping 2/3 until 2020, see Fig.1 caption) are due to the intimate coupling of employment prospects for geologists and the welfare of the mining industry in Western Australia. Figure 1 summarises the students' responses to the first eight questions. Figure 1a displays their response to the most important question, viz. whether they found recorded lectures better than live ones. The adjectives 'better' and 'worse' were not specified, so they may as well qualify as 'more entertaining-engaging' (rather than 'better') as well as less 'educating-informative-interesting' (rather than 'worse'). As can be seen, around a third of the students could not make up their minds (#3) while a similar percentage was favourable (#4). And those finding iLectures far better (#5) clearly outnumbered those who considered them worse (#2) or far worse (#1). What is striking, though, is that the student cohort who deemed iLectures better in 2019 (#4) precipitously dropped from 45 to 25 % in 2020 while at the same time the numbers of undecided students (#3) increased from 27 to 47 %. It is hard not to blame COVID19 for this patent trend against online lecturing. While the content of this particular unit was fine-tuned to online delivery over the years, in semester 1 of 2020 (an academic year in Australia follows a calendar year), other 3rd year units (and field excursions) had to change and adapt to a fully online environment practically overnight and this 'rush' may explain this huge decrease in favourable judgement from 2019 to 2020. It appears as though an increasing number of students have become disenchanted with iLectures as way of content delivery and less sure about their benefits.

Table 1. The full questions related to iLecture acceptance.

Did you find the iLecture format better than live lectures?
In this unit the stipulated time for the iLectures was max. 2h which I usually separated into shorter sound bites, sometimes less than 1h total. Do you think that time frame is reasonable? What is the number of iLectures that you listened to?
And for each iLecture, what was the percentage of completion? Did you listen to it all or did you skim through it? How important are the lecture notes, to what degree do you rely on them?
I provided Blenspace links to focus in far more detail on certain concepts that I cannot cover in the iLecture. Did you take advantage of this offer? Would you like to see more YouTube videos to illustrate certain concepts?
I am considering providing only lecture notes and YouTube and Blendspace links to convey the lecture material, rather than recorded lectures. The rationale behind is that lecturers are more curators than generators of information. What is your take on such an approach? Yes (I can imagine that this approach works fine because I primarily rely on the lecture notes and feel comfortable to complement that information with short YouTube videos rather than entire iLectures); Undecided (Sometimes the content is better presented by the lecturer, sometimes notes and YouTube links simply do); No (I want to listen to the lecturer) What about the learning effect from the iLectures, was there any in your opinion?
*Do you agree with the alleged benefits of online lecturing or are you critical and still favour live lectures?

*Question added after 2016

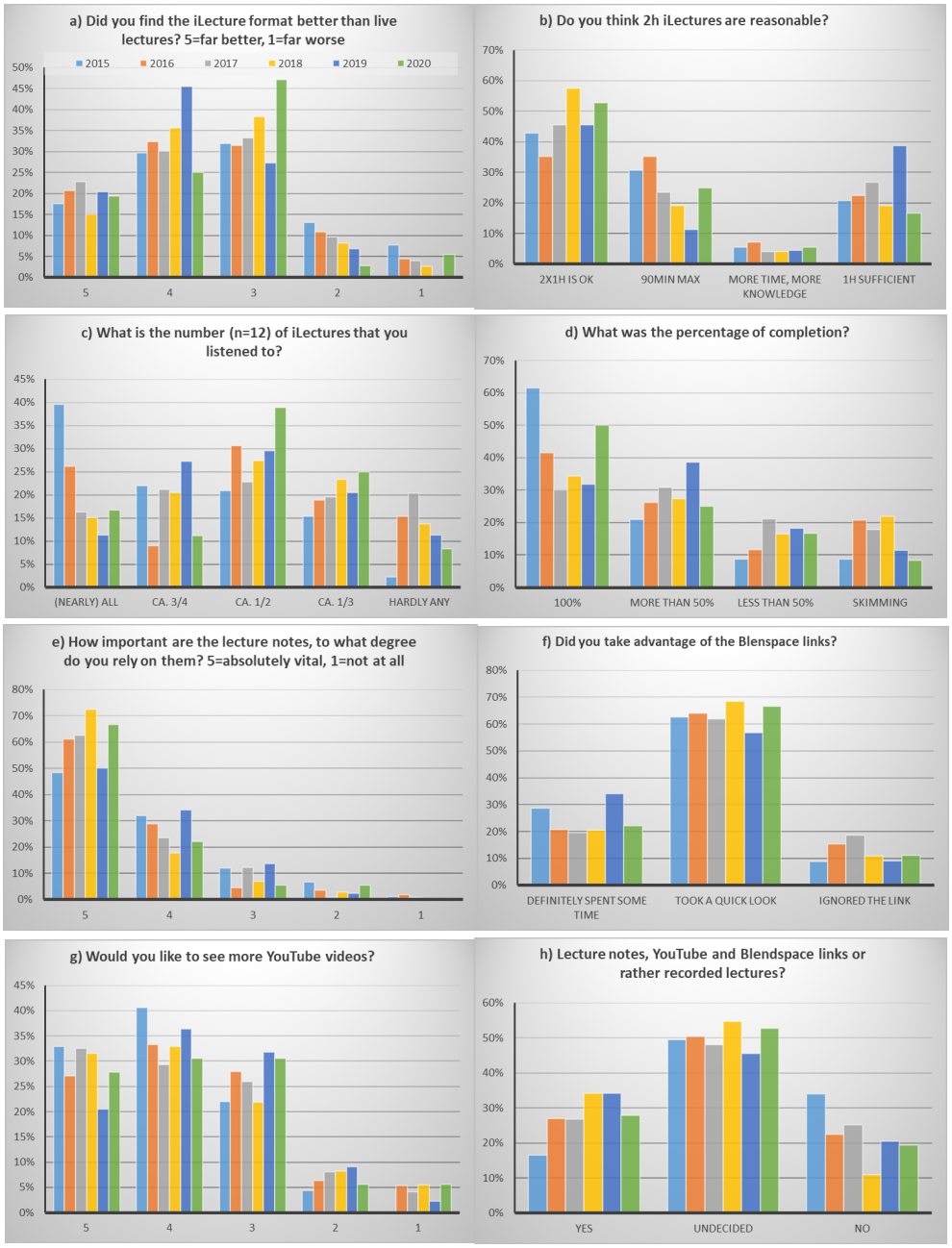

Figure 1. Eight questions and their respective student responses (a-h) to a questionnaire implemented over six years from 2015 to 2020, see legend in (a). The full questions have been tabulated in Table 1. The polling numbers for each year are as follows: n=91 (2015), n=111 (2016), n=123 (2017), n=73 (2018), n=44 (2019), n=36 (2020).

It is legitimate to ask if this change of mind is related to the iLecture format or quality or a change in the overall student behaviour for which the next graphs will provide information. Figure 1b displays student answers related to the length of recording, usually an important feature for acceptance. Mind that while the official tuition pattern called for lectures over two hours, none of the individual recordings were longer than 40 to 60 min. What surprises is that at least 40 % of the students do not find issue with a (ludicrously long) stipulated recording over two hours, irrespective of the year sampled. More perplexing is that this percentage went even over 50 % in 2020 (and sky-rocketed in 2018 to 58 %). Not surprisingly, there is a portion of the bulk thinking that one hour is more than sufficient but except for 2019, this fraction was around 20-25 %, well below the other end of the spectrum. It would, however, be premature to shout victory given these encouraging numbers. After all, Figure 1c demonstrates that the numbers of lectures the students listened to varied considerably across the years. From the twelve recordings (a regular teaching semester consists of twelve tuition weeks in Australia), many if not all lectures were listened to primarily in 2015 and 2019 while in 2017, 2018, and 2020 the sobering truth is that around 40 % of the students listened to hardly any or only around a third of the recordings. Equally revealing is the number of lectures that the students listened to completion (Fig. 1d). Only in 2015 did the majority of students (62 %) listen to completion whereas this number was between 30 and 40 % from 2016 to 2019. Roughly a third of the cohort did only skim through or digested less than 50 % of the recordings, irrespective of the year polled (except for the 'diligent' year 2015). As a sideline, many electronic learning management systems nowadays allow tracking and data collection of iLecture consumption to garner more accurate quantitative information to avoid such personal perceptions as 'nearly all' or 'skimming' but they only work when the online content is streamed, i.e. under constant internet connection. This was not feasible as basically all students insisted on the option of downloading recordings that enabled them to watch at their leisure, pace, and independent of the internet connection and location. The percentages from Figure 1c and 1d explain why students did not have a problem with the length of the recording. It seems they adjusted their weekly content intake by cutting down on the number of videos they watched and the time they spent on an iLecture. This assumption is corroborated by Figure 1e that displays the reliance on lecture notes. Across the board, the (vast) majority of students found the extensive notes either vital (#4) or absolutely vital (#5) and primarily relied on them rather than the spoken word. These notes (one student called them 'beautifully crafted') are not merely PowerPoint handouts but narratives in themselves in order to enhance rather than reproduce the lecture content; the latter has been shown not to aid on test performances (Noppe, Achterberg, Duquaine, Huebbe, & Williams, 2007) or in deeper learning (Kinchin, 2006). It is noteworthy that this utter reliance (#5) on lecture notes fluctuates over the years and cohort, ranging from 48 % (2015) to 73 % (2018). This scatter notwithstanding, it is patent that only a marginal fraction of students displayed (utter) indifference to this auxiliary medium. Speaking of which, the iLectures included links to

curated Blendspaces and YouTube videos to liven up the presentation and provide alternative ways of content delivery. Blendspaces are multimedia digital lessons finding their way into mainstream online teaching to enhance the self-directed flipped classroom experience (Devaki & Deivam, 2017; Zainuddin & Perera, 2018). The feedback to their implementation in this unit was tepid, at best. Over the years, 20 to 30 % of the students took up this offer (Fig. 1f) but a fairly homogeneous 60 % of the students had merely a peek, not really enough for any didactic effect to take hold. As for the offer of introducing more YouTube links, the bulk of students were favourable to this idea (#5 and 4 in Fig. 1g) but given the selective approach of what and for how long students are watching, it remains doubtful if more YouTube videos can win the day and displace recorded lectures as more favoured medium. To find the students' predilection, they were asked if they could imagine themselves relying solely on a mix of notes, Blendspaces, and YouTube videos for content delivery rather than recorded lectures (Fig. 1h). The answer was that it all depends ('undecided', see full text for meaning in Table 1). The student desired (not surprisingly) the best of all worlds which means notes and short Blendspace/Youtube gigs in some instances and entire two hour long recordings at other times. So far these observations have not considered the quality of the recording; after all no human can stomach a dry, droning-on recording of two hours or irrelevant or non-pertinent multi-media links. The easiest, albeit not necessarily most scientific, way to gauge the quality of the iLectures was to ask the students straight whether they thought they had actually learned something from them. This is clearly a subjective notion but unavoidable in any observational study involving student perception. Figure 2a illustrates that the majority of students across the years were indeed under the impression of having learned a lot while 40 % of them thought they had learned at least something. Only a negligible fraction below 5 % was not gaining anything (worthwhile) from them. It seems perplexing that, despite the apparent quality and variety of the digital multi-media material, the motivation to engage with it was lacking (see Fig. 1c, d). A possible explanation can be found in a study where students used recorded lectures primarily as a replacement for missed lectures or study tasks (preparing for an assessment) whereas the quality of the actual lectures appeared not to influence the use of the recorded lectures (Gorissen et al., 2012).

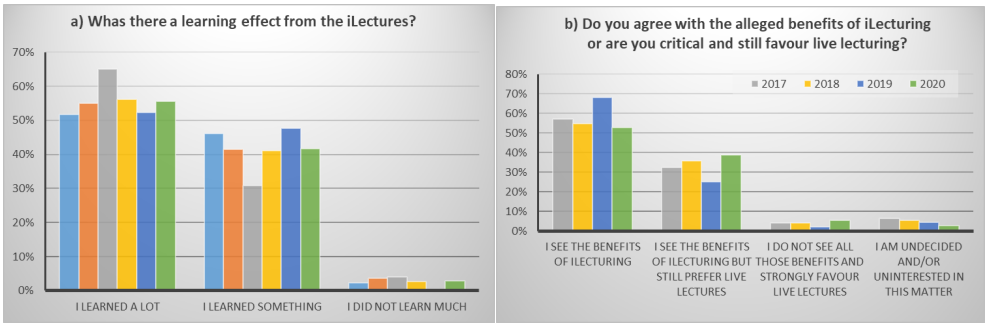

Figure 2. Two more questions and their respective student responses from the questionnaire.

If quality appears secondary in importance, what other intrinsic factors can prompt the students to confront the unit content? FCA relies heavily on self-directed learning and therefore the student needs to understand the rationale behind this switch from live to online lecturing. To foster such understanding, starting in 2017 the benefits of FCA (e.g. self-paced learning, pause button, maximum flexibility, no time constraints, class time dedicated to hands-on face-to-face activities etc.) were explicitly spelled out in a separate pdf file at the start of the unit. As can be seen in Figure 1a, this pro-active approach did not make a dent in approval rates before and after 2017. Also from 2017 onwards, the students were asked more specifically if they saw the benefits of iLecturing (as integral part of FCA). Depsite the observation that the majority clearly saw the benefits, a pernicious roughly 30 % of the cohort has, continuously over the years, still preferred live lectures (see Fig. 2b). How come students are aware of certain benefits but choose a more personal approach, even if that 'tentatively' means less learning? Admittedly, whether live or digital content delivery is a more efficient didactic tool remains undecided; Bahnson and Olejnikova (2017) for example found that student learning was not improved by substituting a self-paced, recorded module for live instruction. This said, the students of this unit are most likely not aware of the ongoing discussion and have been primed to think in positive terms about iLectures and FCA. Still, the desire for a physical experience trumps any touted FCA benefits. This sounds understandable but attendance rates of the same cohort in associated 3rd year units whose lectures were live (before 2020) consistently remained ≤ 20 %. So while a certain portion of the students claimed preference for live sessions, not all would *de facto* attend them. By the way, this preference for live lectures (Fig. 2b) jumped considerably from 25 % in 2019 to 39 % in 2020 while support for iLectures declined from 68 to 53 % in the same interval; an indication that COVID19 left the students saturated with digital learning. Fortunately, the fraction of students who were either indifferent to the entire issue or just did not see any advantages in asynchronous content delivery was consistently ≤ 7 % in the past four years.

3. Conclusions

Inasmuch as this STEM unit can be deemed reasonably representative of a wider student attitude on or rather off campus, at least at Australian universities, the following more general conclusions can be drawn:

- Most graphs show scatter, i.e. varied annual student responses/attitudes. There is no apparent trend for any particular question across the years (going consistently up or down) to suggest any trend or development towards one particular leaning. In the few instances where the annual answers are comparable (Fig. 1f, h), that may be an artefact because there were only three options with the middle ground taking up most votes.
- A couple of graphs show clear signs of student weariness or saturation vis-à-vis online lecturing from 2019 to 2020, i.e. after COVID19 struck (Figs. 1a, 2b). Before that year, however, acceptance rates for online delivery of unit content were over 50% (Fig. 1a, sum of #4 and #5), meaning that the bulk of students accepted iLectures as viable means of content delivery.
- Despite efforts to 'sell' the pedagogic advantages of online lectures as part of the FCA, roughly a third of the student bulk remained steadfast in their support for synchronous content delivery (Fig. 2b), especially but not exclusively in 2020. Face to face time is clearly appreciated and sought, more so during the period of isolation.
- Students managed the time spend on an iLecture, irrespective of the duration of the recording, which varied between 40 and 60 min. The students decided which iLectures and for how long they listened to. This discretion is likely a direct consequence of providing extended notes that enabled the students to rely solely on the written text to prepare adequately for the practical tutorials and laboratories.

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Digitising a Learning Activity: Challenges and Opportunities

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Abstract

As the world faces the new landcape in teaching and learning due to COVID-19, the pandemic, the strategies and approaches use for teaching and learning must ensure all students have access to digital resources. This paper explores the challenges and opportunities faced by the researcher and her students when a learning activity previously implemented in face-to-face sessions was transferred into an online learning environment. The learning activity, known as Work-the-Walk (WTW), is a transformative learning activity designed by the researcher, and the researcher owns the copyright of WTW. The objectives of this paper are to identify the challenges and opportunities raised by transferring WTW to a digital format, and ultimately to suggest the best ways to make the transition from a physical learning activity to a digital format effectively. Qualitative approach to research was used to obtain data for analysis and discussion. Preliminary findings suggest that the Digital WTW (D-WTW) present two main challenges and two main opportunities for both the researcher and students. Given this, the education providers must be willing to encourage the educators to provide various approaches to teaching and learning, as well as to promote experiments with various existing learning strategies used in face-to-face sessions, and to transfer them to be used in an online learning environment.

Keywords: *D-WTW; learning activity; online learning environment; teaching and learning; WTW.*

1. Introduction

The past one year has seen massive changes in the ways students learn, and the ways educators teach. Affected by COVID-19, education has been reported to be one of the distrupted sectors in the world (Demirbas, Bozkurt, & Yorgun, 2020). Despite the lack of physical schooling in 2020, educators struggle to complete the syllabi, and students struggle to learn fully online and score in assessments. From physical classes to blended learning, and now to fully online learning, education must continue to ensure all students get access to relevant resources to improve their life and those dependent upon them in the future.

This paper attempts to explore the challenges and opportunities in using a learning activity designed for face-to-face sessions in an online learning environment. The learning activity, known as Work-the-Walk (WTW), was designed by the researcher, and has been used in her face-to-face sessions for eight semesters, prior to the application for copyright of WTW. With the pandemic cancelling physical class and the associated class activities, the researcher has applied WTW online using existing platforms that are available. Therefore, data for this paper were collected at the National Defence University of Malaysia (NDUM), where the researcher teaches, and the users for her Digital WTW (D-WTW) were her students.

Given the paradigm shift in the process of teaching and learning, all education providers, including the NDUM must prepare a suitable online teaching and learning environment. This can start with the teaching and learning activities that could be adapted and transferred into an online learning environment. As mentioned earlier, the aim of this paper is to explore the challenges and opportunities to use a learning activity designed for face-to-face sessions in an online learning environmnet. Thus, there are two main objectives of this paper including, to identify the challenges and opportunities raised by transferring WTW to a digital format, and to recommend the best ways to adapt and transfer physical learning activities to an online format.

This paper has two main research questions that will achieve the aim and objectives of the study. These research questions include,

a. What are the challenges and opportunities when transferring WTW to a digital format?
b. How best to transfer the existing learning approaches used in face-to-face sessions into an online learning environment?

2. An Overview of WTW

This section explains the learning activity for face-to-face sessions, WTW, including the philosophy and practices (implementation). Since WTW was designed by the researcher about four years ago, and has been used in her physical classes, there are no formal

documentations and citations about the activity available. Thus, this section concentrates on its philosophy, designs and development, types of WTW, and how WTW is implemented.

Taking advantages of the flipped classroom strategy (see McCarthy, 2016), the researcher has stopped conducting lectures about four years ago. Instead, she uses the face-to-face sessions to conduct engaging activities to complement the notes uploaded in the Learning Management System of the NDUM. These activities arguably have been a form of transformative learning, which is active and collaborative. Students are required to understand the learning materials uploaded, which include videos, reading materials and pictures or diagrams, before attending the face-to-face sessions. The classes start with questions to probe students' understanding of the previous lessons, and to connect to the lessons of the day. Socratic dialogues, a method of questioning and probing for appropriate answers, are used to sharpen students' perspectives on previous, and lessons they are about to explore. WTW begins when students have no more questions.

WTW requires activities to be conducted in smaller groups. In these groups, students must brainstorm, and discuss the lessons (the critical concepts) of the day. Then, they will go to the white board, which is placed around the classroom (this arrangement of the classroom is inspired by the classrooms at the United States Military Academy, West Point). At the white board, they mind map the important concepts (see Picture 2 for an example of the mind mapping on a white board). These brainstorming and mind mapping encourage active, collaborative, exploratory learning and increase problem solving and communication skills.

Figure 1. The Classroom at West Point
(The Researcher, 2006)

Figure 2. WTW (Concurrent)
(The Researcher, 2018)

Over the period of four years, WTW has been expanded into four types of implementations. Each type is able to stand on its own or they can be used in a combination of any two. The types of WTW include (where mind mapping is already on the board),

a. WTW (Free Flow) – One student from each small group presents the critical concepts to the rest of the class. The presentation is conducted at the white board, where all students will gather. The researcher offers feedback on what has been explained and asks questions or adds, when appropriate. Students are encouraged to ask questions.

b. WTW (Rotation) – All small groups move from one white board to the other, which surround the class. All groups are able to read the critical concepts mapped by the other groups. They are also encouraged to add any missing information on other groups' mind map. About five to seven minutes are spent per white board before they rotate to other boards. The researcher visits randomly any board and listens to the discussions, adding where necessary, and correcting when needed.
c. WTW (Concurrent) – A representative from each group visits white boards of other groups; at a time concurrently, if there are five groups, that suggests that four group members will be visiting the other four groups' boards. Then the host of the white boards explains to the 'visitors' the critical concepts of his/her group. After question and answer sessions, 'visiting' members return to their groups and explain what they learn from the other four boards. The researcher allows for a 10-minute discussion before inviting representatives from each group to explain other groups' critical concepts. Missing or incorrect information is added on the relevant white boards.
d. WTW (Visual) – Students in smaller groups are to draw pictures or sketches to demonstrate their critical concepts. No texts are allowed on the board. Similar to WTW (Rotation), students will shift from one white board to the other, and discuss the visual. The researcher then asks questions when the groups have returned to their own white boards. Changes to the visuals will be done based on the discussions.

The rationales of using WTW are twofold. First, in order to prepare the future graduates to face Industrial Revolution 4.0, they need to be effective critical thinkers and problem solvers (Gray, 2016). It is argued that WTW could train students to be effective future leaders. Second, the Ministry of Higher Education, Malaysia encourages all education providers to expose students to be more active and collaborative, and thus, students must be developed using heutagogy (self-determined learning) and paragogy (peer-oriented learning). Further, learning, according to Higher Education 4.0 (Amanat Menteri Pendidikan, 2018), should be without lectures.

3. Methodology

This paper adopts a qualitative approach to research by means of observations and informal WhatsApp interviews. Since the researcher only adopts D-WTW for the past two semesters during the emergency remote teaching phase, D-WTW can be considered at its infancy. There are two critical stages; first students must be made aware of WTW as a learning activity from the face-to-face sessions, and then they would be informed of the similarity to D-WTW. D-WTW was used for eight hours in both courses taught by the researcher. During the execution of D-WTW, students were observed online on how they collaborated, and how they presented ideas. Second, selected students were interviewed informally about D-WTW. Four questions

(see questions in Section 4.2) were asked. These questions were posted in the main WhatsApp groups of the two courses, and students were invited to answer them voluntarily.

At the time of writing this paper, only the first WTW (Free Flow) was transferred to a digital format. The implementation of D-WTW (Free Flow) involves the use of Microsoft Teams (Ms Teams), a platform for video conferencing and Padlet, an online board, where both educators and students can collaborate, reflect, and share videos, pictures and/or links. Before the start of the lesson, the researcher prepared the link to the class on Ms Teams, and then prepared the board on Padlet; links to these were then shared with the students.

3.1. Sample Population

The researcher taught two different courses during Semester 1, Academic Session 2020/2021, which started in October 2020 and ended in the middle of February 2021. The number of students in these two courses were 80. About 85 percent of the students were at home, and the other 15 percent was on campus, including military cadets and students, who did not have stable and access to the Internet at home. For the informal interviews conducted through WhatsApp, students were selected based on convenience; questions were asked on WhatsApp groups for each course, and all answers were documented based on themes.

3.2. Research Instruments

Two research instruments were used. For the observation strategy, a checklist was used to document students' online collaboration and presentation. The checklist consists of three items each for collaboration and presentation. Moreover, the scale for the checklist includes Yes, No and Not Observed. For the informal interviews, four questions asked were about the respondents' experience and preference for online learning activities, including D-WTW.

4. Findings and Discussions

The findings of this paper came from the observations and informal interviews conducted on WhatsApp. For the observations, six items were documented using the scale explained earlier. Meanwhile, four questions were asked during the informal interviews. Thus, this section begins with discussions on the observation checklist, followed by the themes found during the informal interviews on the process and challenges of D-WTW (Free Flow).

4.1. Data from the Observation Checklist

Based on Table 1, it could be deduced that students using D-WTW were able to collaborate and present during online activities. However, during the first attempt for both courses, students were not able to collaborate effectively online (such as slow response rate and questions were asked personally through Direct Message to the researcher). For the final year

students, despite being exposed to WTW during their first year, the first attempt of D-WTW was a challenge for them too. For the other course, attended by first year students, the challenge is different since they had never had the exposure on WTW. Therefore, a briefing on how to participate in the learning activity was given, and questions were entertained on roles of each member during D-WTW.

What can be discerned further is that backchanneling *must* have happened. Backchanneling is argued to be a technique to monitor students' engagement and performance in learning (Reinders, 2014). The researcher defines backchanneling as discussions that happen during an online lesson on WhatsApp; not in the main WhatsApp group in which the researcher was added as a member, rather another WhatsApp group amongst the students only. In order to complete the tasks assigned to them, the researcher argues that backchanneling did happen, otherwise students were not able to brainstorm, discuss and later present critical concepts (all these processes were not evident in the main WhatsApp group).

Table 1. The Observation Checklist for Collaboration and Presentation Online.

	Items	Yes	No	Not Observed
1	Students are collaborating on the tasks assigned – progress on Padlet is consistent	√		
2	Backchanneling happens			√
3	Members in groups are adding information when needed on Padlet	√		
4	Group members help the main presenter during the presentation	√		
5	Those who presented do not take active part on Padlet		√	
6	Presenters add more information not shared on Padlet	√		

** The results presented are the third and fourth D-WTW of two hours each*

Fig 3. The Screenshot on a proof of Backchanneling (from the main WhatsApp group of one course).

Whilst the researcher is unable to get the screenshot of the backchanneling activities on students' WhatsApp group, Figure 3 illustrates that backchanneling did happen when the students were required to discuss something amongst the students only. This screenshot is from the main WhatsApp group when the students were assigned to group themselves

according to specific roles. Next, to further illustrate on the use of Ms Teams and Padlet for D-WTW, Figure 4 is an example of how D-WTW (Free Flow) is implemented online.

Fig 4. One example of D-WTW (Free Flow) on Ms Teams and Padlet.

4.2. Data from Informal Interviews

There were four questions asked during the WhatsApp interviews. The questions included, (a) Do you find it difficult to participate in this learning activity?; (b) What are the challenges of this learning activity?; (c) What are the things that can be improved for this learning activity?; and (d) What else do you think could help in this learning activity? The learning activity refers to D-WTW (Free Flow), as well as the use of Ms Teams, where everyone is able to monitor the activity, and the use of Padlet to collaborate and later to present ideas.

Based on these questions, three main themes emerge, including access and stability to the Internet, working collaboratively, and becoming more confident. These are further explained in Table 2 below. It is deduced that D-WTW (Free Flow) has improved students' collaboration with peers, and their confidence in presentation. Whilst it is hard to explain this scenario, the researcher opines that the students are Digital Natives, and that they adapt better to an online learning environment.

Table 2. Themes emerge from the Informal Interviews.

	Themes	First Year (Course LLS3324)	Final Year (Course LLS3773)
1	Internet stability and connection	3	5
2	Improve Collaboration	2	4
3	Improve Confidence	3	4

Because answering the questions was on voluntary basis, only eight respondents from both courses responded (see Table 2). Further examination on the table suggests that these eight respondents commented that they had issues with Internet connection as well as its stability. Given this, they further commented that they found all learning activities online became difficult, and they were disrupted by it. Nonetheless, six respondents claimed that they found D-WTW improves their teamwork with their peers when they were able to collaborate effectively. One first year respondent said that it was a challenge to work with 'unknown'

friends because they had never met 'face-to-face' and worked together before. However, after a few weeks, they were able to build the bond and collaborate better. Seven respondents further claimed that their confidence level has increased when they had to do presentation.

5. Conclusion

There are two main research findings of this paper; challenges and opportunities of digitising learning activities designed for face-to-face sessions. Challenges of digitising physical learning activities are; firstly, students found that without Internet connection and stability, it becomes difficult for them to participate in D-WTW (Free Flow), and secondly, students with zero experience with WTW required more time to understand how to be engaged in D-WTW. Moreover, there are also two opportunities of digitising physical activities. Firstly, students, who are used to physical activities can easily adapt whatever that they had experienced in face-to-face sessions into an online learning environment. Secondly, the educators are able to use whatever appropriate physical learning activities, and then digitise them to be implemented online accordingly.

In addition, educators may digitise their physical learning activities in two ways. Firstly, educators must not be afraid to experiment – 'trial and error.' They can use any existing learning activities, and digitise them using online platforms and apps available. Secondly, choose learning activities that educators are familiar and comfortable with, and choose easy to handle online platforms or apps such as Padlet.

To conclude, much is still needed to be done in order to ensure that D-WTW could benefit students to the fullest. At its infancy, only WTW (Free Flow) is effectively digitised – D-WTW (Free Flow). The other types of WTW may require different platforms and apps other than Padlet to make them achieve their potential of assisting students to learn. The researcher opines that with more experiments on digitising learning activities, an online learning environment could match the face-to-face session experience.

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Design principles for interdisciplinary collaborative learning through social, digital innovation

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Abstract

As academics, we are acutely aware of our responsibility in the design of our teaching and learning environment to instil principles of ethics, sustainability, agency and social justice. We are at the crossroad between the commodification of knowledge versus learning that steeped in well-being and innovative socio-ecological and or socio-technical transitions. These complexities prompted a Design-Based Research (DBR) project that commenced in 2020 to test and refine design principles that can facilitate an interdisciplinary, collaborative learning environment that exposes students to future challenges foregrounded in social justice perspectives of local voice, collaboration and co-design. A conceptual model informed by four pedagogical propositions of relationality, reflexivity, responsiveness and recognition is stipulated and nine design principles derived from these propositions are proposed. The overall purpose of this DBR project is to situate the student within a multifaceted learning experience that mimics the complexities associated with an interdisciplinary collaborative learning environment steeped in contemporary societal problems within a specific societal context. The ultimate aim of this project is to shift from interdisciplinary to transdisciplinary collaboration to explore a holistic approach to complex societal problems.

Keywords: *Design-based research; interdisciplinary learning; social digital innovation; interdisciplinary research.*

1. Introduction

Higher Education Institutions (HEI's) are at the crossroad between the commodification of knowledge on the one hand and learning that foregrounds well-being and innovative socio-ecological transitions on the other (Tassone *et al*., 2018). Such transitions require a broader perspective of complex challenges in society such as amplifying community voices while being socially, economically and environmentally responsible. In order for students to develop the ability to interpret and untangle complex, wicked problems, we argue and experiment with the value that multiple perspectives bring to the learning environment. Such an endeavour requires an interdisciplinary - and ultimately a transdisciplinary - design of learning environments to develop competencies and skills for ethical decision making.

In this paper, we propose pedagogical propositions and draft design principles for the design of a learning environment that facilitates social, digital innovation in an interdisciplinary, collaborative community. These findings stem from a Design-Based Research (DBR) project that commenced in 2020. The overall purpose of the DBR project is to situate the student within a complex learning experience that mimics the complexities associated with a transdisciplinary collaborative engagement with contemporary societal problems in the global South context.

We structure this paper by first providing an overview of the value that both social, digital innovation and interdisciplinary collaboration bring to creating a complex learning environment. We then contextualise DBR as a constructive methodology for this project. Next, we engage with literature and theory enriched pedagogical propositions to identify practical draft design principles and we conclude by plotting a way forward.

2. Social, digital innovation as a catalyst for empowered communities

As academics, we are acutely aware of our responsibility in the design of our teaching and learning environment to instil principles of ethics, sustainability, agency and social justice. We recognise the dual identity of students as both future professionals and responsible and responsive citizens. Our practice areas are Information Systems (IS) and Urban Planning (URP). In IS, students need to become aware of how technology can shape the future landscape and the implications thereof whilst URP planners are instrumental in design practices and their impact on society. We started considering how our students can learn from one another and how this will open up their perspectives. This resulted in a DBR project where we are busy collectively exploring the possibilities of social digital innovations within communities in Cape Town, South Africa.

Digital social innovation incorporates the use of digital technology in social innovations. We are looking at the potential thereof but want to view it primarily from the social and then find

digital innovations to alleviate specific social problems within the students' own communities. As argued by Baek, Meroni & Manzini (2015), the active engagement by a community in the collaborative production of solutions to their own social problems, creates a positive impact on society as a whole. By tapping into the lived and local knowledge of both students and their communities, we can focus on "the value of community resources or social capital" which represents the 'social' in social, digital innovation (van den Berg & Verster, 2020).

3. The value of interdisciplinary collaborative engagement

Although interdisciplinary collaboration is a well-established approach, especially in the social sciences, its presence and thus impact on learning environments are limited. Holley (2009, p1) argues that the reason for the lack of uptake by HEI departments of interdisciplinary collaboration might be the "separate, often isolated department" structure that we find in universities plus the complexity of guiding "students to interact with faculty and areas of knowledge from multiple disciplines". Interdisciplinary collaboration, because of its layers of complexity, takes time as Dorst (2018) rightly comments that engaging with complexity cannot - and should not - be hurried.

Although interdisciplinary collaborative engagements may be complex, the benefits such as creative engagement with new knowledge, negotiating complex perspectives, developing critical thinking skills, participating in different and challenging ways of communicating, overshadows the challenges.

The motivation to embark on this DBR project was multifaceted, one aspect that we identified was shortcomings in the design process within our disciplines. From our experience, there is a tendency for IS students to design a solution without clearly understanding the bigger, systemic problems. On the other hand, urban planners are well known for their ability to unpack and understand a problem in fine detail, to the point of neglecting implementation. Interdisciplinary collaboration presents opportunities for project teams that apply an urban planning lens to uncover the complexity of problem-solving in collaboration with communities and other stakeholders in order to identify a solution that can be prototyped and potentially implemented. This can facilitate a combination of urbanisation, technology-led solutions.

To test our hypothesis during the first phase of the DBR project, a pilot project with a group of IS students was launched in 2020 see (van den Berg and Verster, 2020). The outcome of phase one was four pedagogical propositions namely Relationality, Reflexivity, Recognition and Responsiveness.

4. Methodology

The four-phased DBR approach as defined by Reeves (2006) is applied to the project (see Figure 1). The first phase mandates collaboration between stakeholders such as researchers, practitioners and participants to improve teaching and learning practices.

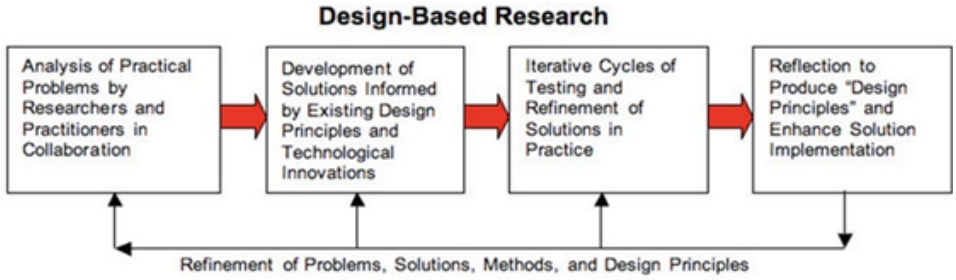

Figure 1. The four-phased DBR approach. Source: Reeves (2006)

The second phase of a DBR project builds on findings from the initial phase to develop draft design principles that are evaluated via a further review of relevant literature and theory. The outcome of this phase will be discussed in the following section.

5. Four pedagogical propositions with draft design principles

In this section we engage with literature and theory to enrich the pedagogical propositions in order to crystalise draft design principles. An important disclaimer to consider is that the four propositions are highly entangled and are all affected by each other. For example, when thinking with relationality, it is very difficult to remove it from recognition and its focus on acknowledging and comprehending human and non-human relationships. Sections 5.1 - 5.4 use a structure of first providing a short discussion of each enriched pedagogical proposition followed by its associated draft design principles.

5.1. Pedagogical Proposition 1 - Relationality

Students (as future designers) need to grasp the complexity of wicked problems that reside within the collective or societal sphere. These complexities can reside in the collective voice of a community and how communities depend on social relationships and relational structures to solve day-to-day and long-term problems. In this, it is important to harness the potential of interdisciplinary project teams to collectively dissect and position problem statements.

IS students need to approach interventions from a socio-technical perspective that incorporates aspects of the lived reality of people and how they interact within their community, whilst URP students need to engage with the implementation thereof. The design

of a technical system has to be based on understanding the social system (Baek et al., 2015). This will foreground the opportunities presented by digital innovation with an emphasis on local knowledge and agency. We need to design a learning environment steeped in a framework that enables students' appreciation of culture and how this determines thoughts and actions with self and others.

Draft design principle 1: Anchor the project on the proposition of relationality through an emphasis on the social within social digital innovations. Implement a capstone project that comprises interdisciplinary student groups that are situated within the students' communities. Provide structure by stipulating a targeted problem area, for instance, those derived from the Sustainable Development Goals (SDGs).

Draft design principle 2: Create a blended learning environment by incorporating an e-project portfolio that showcases the different stages of the project from problem definition to the development of a digital innovation prototype. There should be evidence of deep engagement with the problem and the community voice. Include digital stories, representative personas and video clips in the e-portfolio.

5.2. Pedagogical Proposition 2 - Reflexivity

We draw on Schon's (1987) theory that stipulates two types of reflective/reflexive action, reflection-on-action where students reflect on past activities or actions, and reflection-in-action where there is a reflection on actions as they are being performed. We understand reflection-in-action as closely related to reflexivity with its focus not only on being retrospective but being a forward-looking instrument that allows for changing and adapting practices as students move through the stages of the project. Reflexivity is a powerful learning tool that creates spaces for disrupting established and traditional understandings and perceptions. It can also acknowledge the student's voice and thus raise the levels of empowerment and as such position the student in the centre of the learning environment.

The political Ethic of Care (EoC) framework (Tronto, 2013) provides a useful lens to sensitise students to the elements of care that are especially needed within a complex context such as interdisciplinary collaborative learning. Elements such as "attentiveness, responsibility, competence, responsiveness, trust and solidarity" specify the expectations to students.

Draft design principle 3: Develop a formal reflexive practice by structuring reflexive exercises such as individual blogs and reflexive questionnaires throughout the lifespan of the project. Do not assume students are naturally reflexive individuals and focus attention and specific activities on developing the reflexive ability.

Draft design principle 4: Provide structure to what the expectations are of a student as part of a group/community of learning by introducing the EoC framework. Use the elements of this framework continuously during the project to monitor collaborative behaviours.

5.3. Pedagogical Proposition 3 - Responsiveness

Responsiveness acknowledges that change requires the collective intelligence of multiple stakeholders to identify systemic problems and that a collective, deep understanding of the problem is required (Tassone *et al*., 2018). Complex or wicked problems can only be interrogated once you have a grasp of the complexities and underlying nuances of the issues involved (Buchanan, 2019). The ability to respond to a problem/s by applying multiple lenses to dissect it requires reflexivity to situate the issue/problem. The duality of a deep understanding of a problem and further implementing a potential solution via social digital innovations are the core of our inquisition.

Draft design principle 5: Apply authentic assessment principles to design a creative and fluid assessment rubric to capture what is valued in this project. For example, levels of engagement and aspects about the giving and receiving of commentary and feedback (Boud & Molloy, 2013).

Draft design principle 6: Include peer reviews in the face-to-face and online environment that encourages experimentation. Innovation requires one to be willing to fail and to try other options (Ries, 2011). Peers must be involved in the feedback process to open the conversation and allow an environment of mutual sharing and learning.

Draft design principle 7: Implement a design thinking method in the project rollout using the Stanford School of Design method of five phases (empathize, define, ideate, prototype and test) (Brown & Wyatt, 2010).

5.4. Pedagogical Proposition 4 - Recognition

Recognition of context, in our case the global South and specifically South Africa. Here we are arguing for teaching and learning in the context of all the social ills and societal challenges that are not only part of daily life, but that our students would have to negotiate when entering the world of work (Fomunyam & Teferra, 2017).

Recognition of multiple perspectives, we argue with Fomunyam & Teferra (2017) that "plurality of voices provokes the creation of disciplinary and interdisciplinary spaces". A shift of the student from the outsider to the insider position, we argue, is thus possible through interdisciplinary collaborative learning.

A final aspect of recognition is engaging with the human and non-human relationship. This is especially relevant in a project where two disciplines have different focuses with regards to the centrality of the human (URP) and non-human (IS).

Draft design principle 8: Include government and NGO stakeholders as critical soundboards for showcasing student project artefacts and plan implementation pilots. Student teams should have the opportunity to present their findings to a wider panel and the winning group needs to be linked to an innovation hub to showcase findings to a community of designers and innovators such as Silicon-Cape or Innovation hub Africa.

Draft design principle 9: Frame the student project within a theme that has contextual relevance by focussing on local communities and their lived experiences. By acknowledging the student as a local community member, we are recognising and capitalising on the prior local knowledge that students bring to the learning environment.

6. Way Forward

Two important objectives are set for the future of this DBR project:

First, is the rolling out of a larger scaled interdisciplinary collaborative student project to include a cohort of IS as well as URP honours students with the learning environment specifically developed with the four pedagogical propositions and associated draft design principles, as developed in this paper, in mind. The design principles need to be tested and refined following an iterative process as defined in the third phase of DBR. We are planning three iterations between 2021 and 2022.

The second objective is to shift from interdisciplinary to transdisciplinary collaboration. The reason for this intentional shift is to capitalise on the value that a transdisciplinary position provides by transcending disciplinary knowledge into an innovative holistic approach to complex, wicked problems. In the global South context with its limited access to capital resources, following a transdisciplinary approach could result in more sustainable solutions.

In conclusion, the pedagogical propositions and associated draft design principles as developed in this paper should be considered as entry points to the highly complex and entangled real world challenges our students need to negotiate as young emerging professionals.

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Zoom data analysis in an introductory course in mechanical engineering

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Abstract

This investigation studies various data extracted from Zoom meetings which are used in teaching an introductory course in mechanical engineering online. The effect of using Chat tool is discussed by extracting and analyzing the data in chat report. The parameters, such as number of chatting students, chatting participation rate, as well as average numer of chats per student, can show students activeness from different perspectives. Particpcation in polling and polling performance are also studied by extracting data from polling reports. Non-graded polling activities are found to be effective of increase attendance of students. The using of breakout room doesn't show its effectiveness in online learning of this introductory course.

Keywords: *Online learning; engagement; attentiveness; engineering course.*

1. Introduction

Creating a good learning atmosphere is one of the key skillsets of instructors. Currently there is no standard definition what is a good learning atmosphere. But one of the key characteristics of a good learning atmosphere is that the class is highly participatory and students are greatly inspired and are actively engaged in the class activities. Students engagement and attentiveness are believed to play a critical role in active and effective learnings. Enhancing students engagement has been extensively researched in higher education in diverse environment and various strategies have been developed. Some research studies are conducted at institutional level and conclusions are drawn from institutional perspective. Kuh (et al 2005) finds institutions that accommodate diverse students learning styles tend to ensure higher engagement of students. Some studies evaluate the effect of different pedagogical technique on students engagement. Gao et al (2020) specifically find the playfulness and usefulness of blended learning platform positively impact on students participation and engagement. Bond (2020) particularly find flipped learning involving collaborative peer teaching and learning positively affect students engagement. Other investigations focus on certain courses in specific fields. For example, Pfenig (2020) finds lecture videos are beneficial to students concentration; Garcia and Valle (2020) suggest that collaborative tasks in virtural classroom increase students engagement. Wu et al (2020) described how drawing prompts have helped engaging students in an introductory engineering course.

Although online courses are increasingly adopted in many countries in recent years, online teaching and learning are still in the developing stage and faced with many challenges. Dynarski (2018) claims online courses are beneficial to academically well prepared and strongly self-motivated students, but are actually harmful to students who are faced with academic challenges. It is worthwhile to further study and develop effective methods of engaging students in online courses.

Since the outbreak of COVID-19 in beginning of 2020, majority of undergraduate courses are shifted to online learning. First year undergraduate students in Fall 2020 have faced double challenges. On one hand, they have experienced the transition from being high-school students to college students and adapted to new learning environment and new ways of college life in their first semester. On the other hand, they also have to cope with unique challenges imposed by outbreak of COVID-19 and online learning in almost all courses.

This paper shares how we have coped with these challenges in teaching first year undergraduate students an introductory course in mechanical engineering and what lessons we have learnt and what further approaches can be implemented to improve teaching and learning online. Particularly, we have studied the effect of various ZOOM tools on engaging students during lectures.

2. Data Analysis and Discussions

First year undergraduate course – Introduction to Mechanical Engineering for Modern Life – is a common core course which is intended to give a comprehensive picture of mechanical engineering and describe the contents of its multiple sub-fields, such as mechanics and materials; thermo-fluids; design and manufacturing, as well as aerospace engineering. This course is designed to offer first year undergraduate students a snapshot what impacts mechanical engineering has on modern life and what mechanical engineers do. Due to the outbreak of COVID-19, this course was conducted via ZOOM 5.3.1 (52879.0927) in Fall semester of 2020. At the time of registering this course, whole class is automatically divided into L1 and L2 session in order to achieve effective teaching and learning.

2.1. Using Chat for discussions in ZOOM

In face-to-face classes conducted inside a classroom, it often takes tremendous courage and confidence for students to ask questions and to speak in front of their peers, partly because this will have to interrupt the instructor and disturb the flow of lecture. Often only those who are not shy and with great confidence will do. Since classes are shifted virtually online via ZOOM, there is an advantageously effective tool – "Chat" – for students to speak, voice out feedback, express views, and have discussions among their peers. Communication through Chat tool serves as a channel that break the barrier of cold computer screen and bring students and instructors closer.

For each lecture, ZOOM records all chat contents in a text chat report file. From the downloaded chat reports, we have summarized the number of students who used chat to communicate and also have counted the number of "*effective*" chats. By excluding the number of chats for greeting purposes (e.g. good morning, thank you, etc.), we only counted the "*effective*" chats which are true communications, such as comments and questions related to course contents during the lecture.

Figure 1 shows the number of chatting students versus the number of attendants for lectures during Sept 8 to Oct 20, 2020. We have seen an obvious linear trend, i.e. when more students attend the lecture, more tend to chat during lectures. It is interesting to find that, for the same number of attendants, L1 session tends to have more students using Chat tool than L2 session. This trend shown in Figure 1 agrees with my observation during lectures that students in L1 session are more active than those in L2 session. Therefore, Figure 1 number of chatting students versus number of attendants can be used as a tool to assess the students activeness.

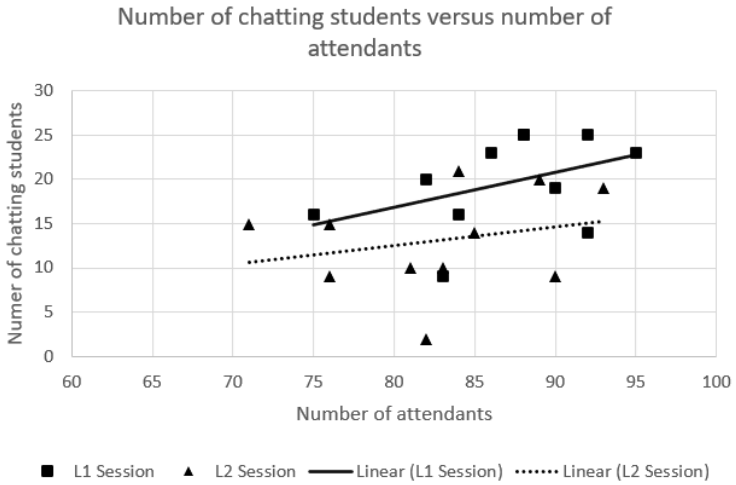

Figure 1. Number of chatting students versus number of attendants in lectures during Sept 8 to Oct 20, 2020.

Figure 2 shows the chatting participation rate versus lecture dates during Sept 8 to Oct 20, 2020. Chatting participation rate is defined as the ratio of the number of students who chatted to the number of attendants in a lecture. The linear fit shows that, when lecture proceeds with time, the chatting participation rate in L1 session gradually decrease, while the rate of L2 session gradually increases. Chatting participation rate, from a different perspective, can be used as an indicator as the trend or dyanmics of students activeness versus time.

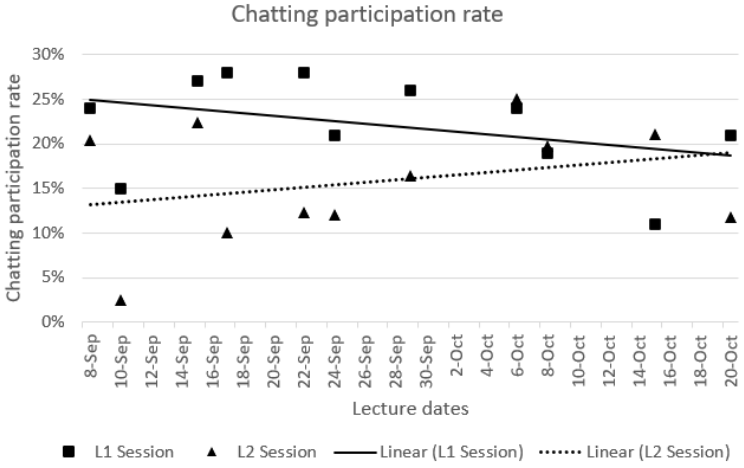

Figure 2. Chatting participation rate versus lecture dates during Sept 8 to Oct 20, 2020.

Figure 3 shows average number of chats per students versus lecture dates during Sept 8 to Oct 20, 2020. It is clearly seen that, in average, each student participating in chat in L2 session chats more than their peers in L1 session. This interesting finding shows that, while more

students in L1 session use Chat tool than those in L2 session (Figure 1), each chatting students in L2 session chats more (Figure 3). Therefore, the data in Figure 1 and 3 indicate that we can characterize students "activeness" from different perspective, i.e. either by using number of chatting students (i.e. Figure 1) or using average number of chats per chatting student (i.e. Figure 3). They may show different trend.

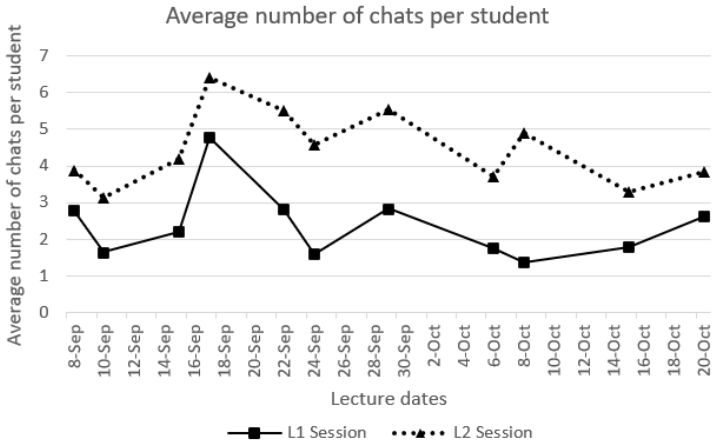

Figure 3. Average number of chats per student in lectures during Sept 8 to Oct 20, 2020.

In this introductory course, the first year undergraduate students are highly active in "Chat". It is suggested that certain class rules may be formulated to regulate the chatting and teaching assistants may be arranged to assist in answering the questions asked in Chat.

2.2. Using breakout room for small group discussions

In this introductory course, engineering ethics is a topic that does not involve any calculations and also a topic that may easily hypnotize students on the other side of the computer by teacher's monologue. Breakout rooms are employed and students are placed into each breakout room randomly. It turns out that breakout rooms are not effective for all groups. Some breakout rooms are very quiet and need an ice breaker, some breakout rooms are more active in discussions. It may be partly due to the fact that these first year undergraduate students have not met face-to-face and got to know each other well. How to use breakout rooms effectively in this course needs further investigations.

2.3. Using polling during lectures

Zoom has a tool – Polling, which allows users to input questions in the format of either single choice or multiple choices. It is intended to collect attendants' responses to polling questions. In this introductory course, Polling is used as evaluation of students' learning outcomes based on four questions representing four key points of each lecture. Polling evaluation results are not counted into students' grades. For each polling activity, Zoom generates a polling report

that summarizes the name of the participants as well as their answers to each polling question. Data extracted from the polling report include number of polling participants, participation rate, and performance (i.e. how many answers are correct) of participants in each polling activity.

Figure 4 shows the number of attendants for the lecture dates between September 8 to December 3 in 2020. Each color represents a lecture date. From September 15 to October 20, at the end of each lecture, we launched polling questions as in-class quizzes, but the results of quizzes are not counted to students' final grades. It is obvious that the number of attendants in the lectures with pollings is significantly higher than those without pollings. The average number of attendants for lectures with pollings is 85, while the average of number of attendants for lectures without pollings is 62. Therefore, polling is helpful to have more attendants in class. Since the polling activities are not graded, then the reason of more students attending lectures with polling may be due to the face that polling can improve their learning.

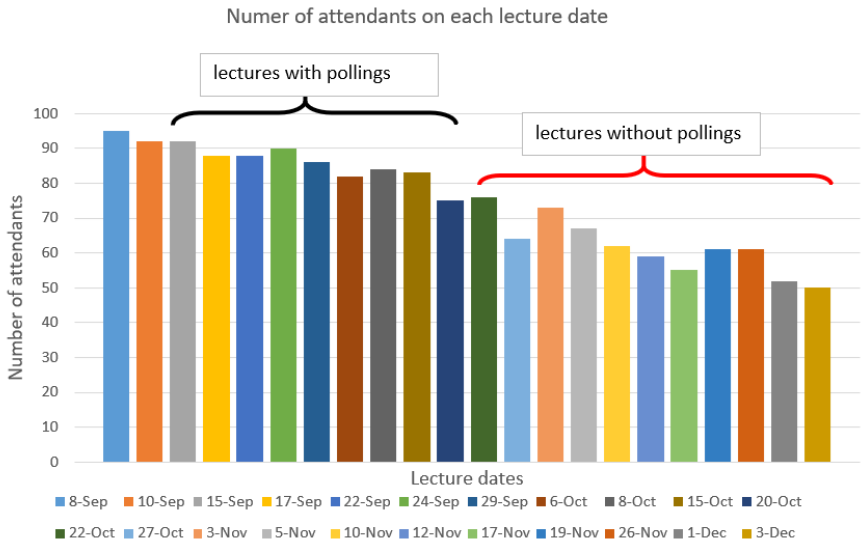

Figure 4. Number of attendants for each lecture date.

Polling participation rate is calculated as the percentage of the number of polliing participants out of the total number of attendants for a specific lecture. Figure 5 shows the polling participation rate versus lecture dates and demonstrates the range between 78% and 99%. L1 session exhibits slightly declining participation rate, while L2 session has a steady participation rate. It is clearly seen that polling can be used as effective tool to engage students in the in-class activites.

Polling performance is calculated as the percentage of participants (with 100% and 75% correct answers) out of the total number of polling participants in each polling. Figure 6 shows the polling performance (ranging between 50% to 87%) versus lecture dates of L1 and L2 session, respectively. It is interesting to note that L2 session demonstrates a more pronounced increasing trend in polling performance than L1 session.

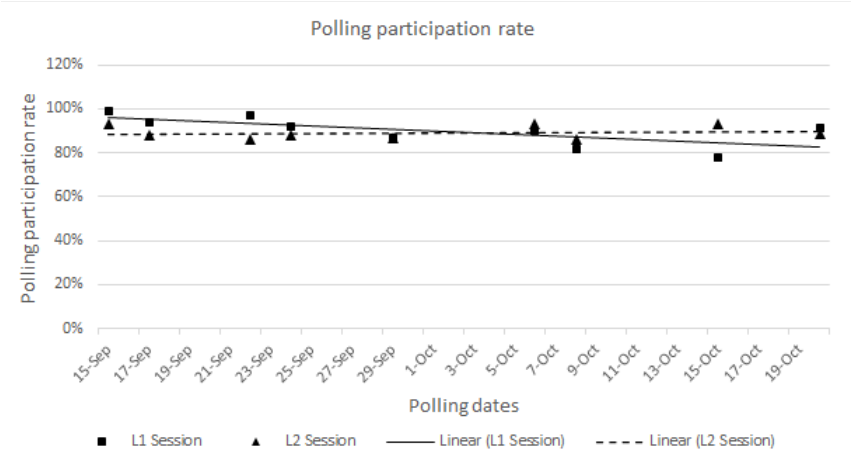

Figure 5. Polling participation rate on lecture dates during September 15 to October 20, 2020.

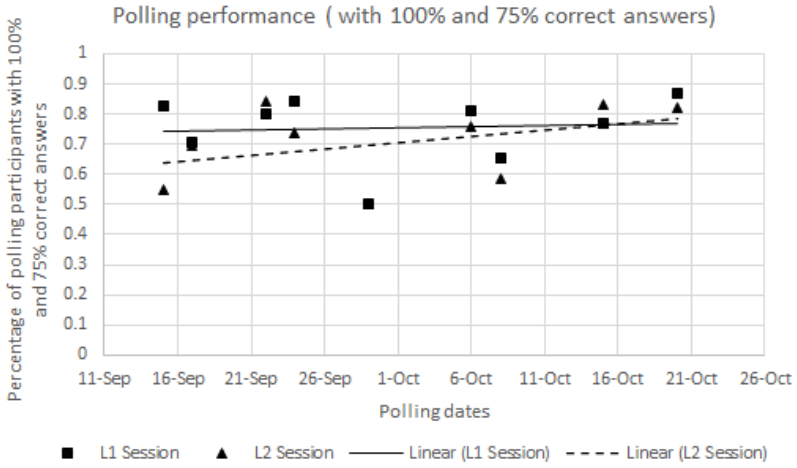

Figure 6. Polling performance (with 100% and 75% correct answers) on selected lecture dates.

3. Conclusions

The Chat tool in ZOOM makes boundaries imposed by the cold computer screen dissppear and is very effective for students to communicate with instructors and to discuss course questions among themselves during lecture. The data, i.e. number of students who use Chat, chat participation rate, as well as average chats per student, extracted from the Chat reports, can serve as an indicator for students activeness from differenct perspectives. For classes with very active students such as first year undergraduate students, arranging teaching assistants to help answer questions in chat will partially relieve instructors work load and ensure instructors enough time concentrating on lecture delivery. Polling is another useful tool in Zoom meetings and can be used as in-class quiz tool. The data extracted from polling report can assess students participation and also learning outcome.

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Impacts of the socio-political instability in Hong Kong on university students' learning experience

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Abstract

Since the Anti-Extradition Law Amendment Bill Movement in 2019, Hong Kong has entered an era of socio-political instability. The conflict between student protesters and the government has become increasingly intense, whereas several universities even became the battlefield of the protest and were abruptly shut down in November 2019. To add fuel to the fire, the outbreak of the COVID-19 pandemic in early 2020 has prompted all universities in the territory to suspend all face-to-face classes and activities for two semesters consecutively. All these have impacted university students in Hong Kong socially, academically and psychologically.

In light of this, this study aims to explore the ways in which the learning experience of university students in Hong Kong has been impacted by the socio-political challenges. Through conducting a mixed-methods study at a public university in Hong Kong, it was found that university students have a high perceived level of stress, high political involvements, unsatisfactory learning experience and poor learning motivation under this socio-political backdrop. It is hoped that this study can provide informed insights for teachers to understand students' burdens, stresses, and emotional instability associated with socio-political unrest.

Keywords: *University students; socio-political instability; learning experience, perceived stress.*

1. Introduction

Hong Kong, a former British colony, was handed over to China peacefully in 1997 following the "one country, two systems" principle preserving its capitalist system and the way of life for 50 years. Since Mid-2019, however, the Anti-Extradition Law Amendment Bill (Anti-ELAB) Movement has rocked the city with fragmented, decentralized and radicalized protests where many university students have been involved in these events demanding institutional reforms, investigation into alleged police brutality, and universal suffrage for Hong Kong people (Choi, 2020). Radical protesters often adopted disruptive and violent tactics to achieve the movement goals, while several universities were occupied by protesters and turned into a battlefield between student activists and riot police (Pang & Smith, 2019). All on-campus classes, exams, and research activities were forced to shut down and were switched to online mode as a contingency measure.

Entering January 2020, the outbreak of the COVID-19 pandemic called off the street protests and quieted every place in Hong Kong. All universities in Hong Kong suspended their on-campus activities and switched to online mode again for the entire Spring semester of which students are the ones who suffered a lot from the social movements and pandemic. On the other hand, since university students also played a major role in the Anti-ELAB Movement (Lee, 2020), many students might feel stressed, anxious and/or depressed when faced with uncertainties and personal risks, which could result in lower motivation to study and poor academic performance (Hope, Velez, Offidani-Bertrand, Keels & Durkee, 2018).

Despite the research significance of learning more about university students' learning experience under socio-political instability, very little is known in this area. This study is one of the pioneers in Hong Kong to fill in the research gap by investigating how university students perceive their learning experience amid the social movement in 2019 and the outbreak of the COVID-19 pandemic in 2020.

This study is significant for at least three reasons. First, it helps narrow the research gap on the impact of social unrest on university students' learning and academic achievement, which aligns with the growing literature investigating the rise of student activism in Hong Kong (Cheng, 2016; Cheng & Chan, 2017). Second, it provides insights for teachers and senior management to implement interventions and policies that alleviate students' burdens, stresses, and emotional instability associated with social unrest (Gershenson & Hayes, 2016). Third, in an era of uncertainties, it is believed that the findings gathered in Hong Kong can be applicable or even transferable in dealing with other countries' learning problems induced by precarious political and social difficulties.

2. Theoretical Framework

Hong Kong university students' learning experience under the backdrop of socio-political instability is best investigated and interpreted through the lens of Bronfenbrenner's (1979) Nested Ecological System Theory (EST), which views a person's development as taking place within a set of environmental systems interacting with one another. According to Bronfenbrenner (1979), human development is highly complex, individuals and their environments are interrelated and mutually shaping in five spheres, namely the microsystem, mesosystem, exosystem, macrosystem, and chronosystem. The quality of interactions and resources embedded in an individual's environment shapes one's potential for success or failure (Ceci & Hembrooke, 2005). The model is very useful to understand the factors co-influencing students at different levels. The nested diagram in Figure 1 represents the ecological systems in which the university students in Hong Kong are situated.

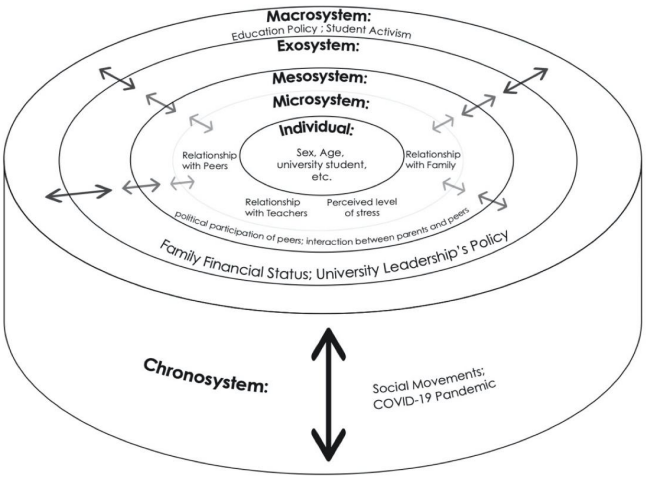

Figure 1. The Nested Ecological System Model of Hong Kong University Students' Learning Experience Under Socio-Political Unrest.

Microsystem refers to the settings that individuals directly interact within their daily lives. Home, university, library, workplace, and neighborhoods are typical contexts for university students to engage with their family, peers, teachers and supervisors. It is in this environmental layer that students perform their daily activities, fulfill their social roles, and develop their interpersonal relationships, hence this is the most direct, interactive and influential level of the theory (Bronfenbrenner, 1994). During the socio-political instability, the most immediate microsystem factors affecting students' learning experience include students' perceived stress level, relationship with teachers, interactions with peers and peers' level of political participation. All these factors influence and are influenced by the learning experience of university students.

For Mesosystem, it is a "system of microsystems" (Bronfenbrenner, 1977, p. 514). It comprises the interactions between the different parts of a person's microsystem. In other words, this is where a student's microsystems interconnected and assert influence upon one another. According to Bronfenbrenner (1979), development is a result of interactions between the complex webs of microsystems. The school-family relationship can have both positive and negative impacts on a high school learner (Leonard, 2011). On the other hand, if parents both work out of home and disengage from their children's education, both parents and children report more stress which can affect their work and academic performance (Acs & Nelson, 2003; Hanson & Lynch, 2004). It is believed similar findings will also be found in the undergraduate students who are dependent on their parents.

And for Exosystem, it refers to the larger social settings that are external to the individual but would impact, delimit, or foster the development of the individual. (Bronfenbrenner, 1977). One typical relevant example will be the work lives of the parents, which directly relates to household resources and parental stress, can influence family dynamics and subsequently impacts the life of the child (Subotnik, Olszewski-Kubilius & Arnold, 2003). In the world of a university student, exosystem may also include the family financial status, and university leadership and the Education Bureau which are similarly distant from his/her daily experience but powerful in shaping the overall learning experience of the student.

Furthermore, Macrosystem is the wider socio-cultural environment that includes the micro, meso, and ecosystems. This layer comprises values, beliefs, laws and ideologies that underlie a particular culture and are shaped by all levels of the ecological system (Bronfenbrenner, 2005). As culture can be passed from one generation to the other, the dominant cultural practices and belief systems of parents and teachers on the notion of success can directly affect how the children organize their daily routines to achieve their goals, thereby also influencing their learning experience and academic performance (Amatea, 2009). Apart from that, macrosystem can be interpreted as the overall condition of the society that impacts the structure and functioning of individuals' social-ecological system (Stokols, Misra, Runnerstrom & Hipp, 2009).

Last but not least, Chronosystem is the outermost layer pertaining to the environmental events and transitions in life. It involves transitions in life and sociohistorical events that shape how a person or society works (Bronfenbrenner, 2005). Undeniably, the recent ELAB social movements and the outbreak of COVID-19 pandemic in Hong Kong have disrupted the normal social ecology of every student. It is foreseeable that the devastating consequences brought by this socio-political turmoil would alter students' learning experience and their conceptions of life value.

3. Methodology and Research Design

The objective of this study is to examine how university students perceive their learning experience under socio-political instability in Hong Kong, and whether such an unfavorable environment would impact their perceived level of stress and academic performance. The focus is to examine the factors that affect students physically, emotionally and academically. Specifically, there are three research questions guiding this study:

(1) How do Hong Kong undergraduate students perceive their learning experience under socio-political instability from 2019 to 2020?

(2) What is the perceived stress level of undergraduate students in Hong Kong under socio-political instability?

(3) What are the levels of political participation of undergraduate students in Hong Kong?

This study is conducted after the Anti-Extradition Law Social Movement in 2019 and during the outbreak of COVID-19 pandemic in 2020. To address the above research questions, a mixed-methods methodology consisting of an online questionnaire and semi-structured interviews was carried out by the researcher from August to September 2020 at a public liberal arts university in Hong Kong. The purpose of having a mixed-methods study is to gain a comprehensive view of the impacts of socio-political instability on university students' learning experience. The participants of the questionnaire study included 59 university students aged 18 and above enrolled at a public university in Hong Kong. As for the online interviews, participants are six Year 3 and Year 4 student representatives who are in a leadership position within a student society or organization. Participants may have different majors, but all have been enrolled at the University for at least a year. No incoming freshmen are being recruited.

It is important to understand the context of this research study in a more detailed fashion. The online questionnaire was collected between 7th and 14th August 2020 when Hong Kong was experiencing the third wave of the COVID-19 pandemic where the total number of infections exceeded 4000 cases. Also, this study was conducted after the implementation of the National Security Law on 30th June 2020 which was unpopularly viewed by the critics as an erosion of the city's freedom of speech. Specifically, participants of the online questionnaire were recruited through a convenience sampling technique by sending an email invitation to all his former students. As for the semi-structured interviews, a purposeful sampling method was used, where the researcher first generated a list of potential participants whom he knows are 18 or above and is/was a committee member of a student society, union, hall of residence, or university senate. These criteria allow the researcher to find active student members of the university community, who have frequent engagement with students, faculty members, staff, alumni and/or university leadership and have a more holistic picture of the changes brought

by the socio-political instability on university students' learning experience. This can ensure that the key informants have a unique perspective and background knowledge related to the study (Etikan, Musa & Alkassim, 2016).

4. Data Analysis

Among the data collected by the mixed-methods research, the findings could be divided into four important parts: High perceived stress level, high political involvement of students, unsatisfactory learning experience and poor learning motivation.

4.1. High Perceived Stress Level

In this study, the 14-item Perceived Stress Scale (Cohen *et al*., 1983) was used to evaluate the extent to which university students in Hong Kong consider environments in their life to be stressful. This scale comprises seven items worded negatively, and seven items worded positively. Participants need to rate the degree of their general agreement with these 14 items on a five-point Likert scale ranging from 0 (never) to 4 (very often), and their responses are then totaled, with higher scores indicating a greater level of perceived stress. Cohen and his colleagues (1983) found high internal consistency reliability (α = .84 to .86) in college freshmen, introductory psychology students, and individuals enrolled in a smoking cessation program. According to Cohen, Kamarck and Mermelstein (1983), the results of the scores can be compared with scores pre-determined for the questionnaire. For instance, scores between 0-28 can be viewed as a low level of perceived stress, 29-42 means moderate, while scores above 43 indicate a high degree of perceived stress.

One of the objectives of this study is to find out if students suffer from a high perceived level of stress under the socio-political instability. Among the 59 participants, 48 valid responses were collected for measuring their stress level. By comparing the aggregated mean scores (i.e. 44.8) with Cohen's (1994) reference scores, it was found that Hong Kong university students had a high degree of perceived stress level. However, it remained unknown what constituted such a high level of stress of students. Therefore, six semi-structured interviews were carried out to further comprehend the data. It was found that the sudden suspension of face-to-face classes, worries of having poorer academic results under online learning, social and political tensions during the social movements, and uncertainties of the career prospects after graduation are common stressors reported by the students.

4.2. High political involvement of students

In the online questionnaire, participants were being asked to indicate if they have engaged in any forms of political actions in the past. Sample items include: "Did you go to vote in the legislative district election?", "Have you ever taken part in any class boycott activity?", and "Have you ever participated in any rally or demonstration?". Furthermore, participants

assessed their political activeness on a five-point Likert scale, ranging from “apolitical” to “politically very active”. Also, they needed to indicate how much time they spent on acquiring political information on a daily basis and to rate how often they discuss politics with significant others.

As expected from the literature, university students in Hong Kong show a high degree of political involvement. Approximately 73% of the respondents went to vote in the legislative district election, although only 9% of the students indicated that they are affiliated with a political group/party. More than 63% of the respondents signed a petition in the last 6 months for supporting a political idea. And more significantly, over 68% of the students claimed that they have participated in a rally or demonstration before. These findings showed that students are involved in both conventional and unconventional forms of political engagement.

4.3. Unsatisfactory learning experience

To investigate how university students perceive their learning experience amid socio-political instability, open-ended questions were used in the online interviews to gain insights into students’ accounts of their learning experience. Participants were being asked in both the online questionnaire and semi-structured interviews to elucidate how their learning experience has been affected since the social movement in 2019.

By analyzing the responses of the two open-ended questions and the interview data, it was found that the majority of the respondents revealed that their learning experience in the academic year of 2019 and 2020 was unsatisfactory. Many of them complained about online learning under campus closures. For example, one student pointed out three problems of having classes online, including “not active”, “inconvenience in taking online exams”, and “feeling helpless when encountering technical problems”. Also, several students blamed teachers' incompetence in delivering the course content effectively in a virtual environment. For instance, there were concerns about “cancellations of the lessons”, “lack of engagement between teachers and students”, as well as “uncertainties about the grading and assessment arrangement”. These findings align with the arguments of other studies that the effectiveness of learning emergently online relies on teachers’ competencies of online teaching and instructional design. However, a few students said they enjoyed the learning experience because they could enjoy more leisure time than before.

4.4. Poor learning motivation

This study used self-reported cumulative grade point average (CGPA) as the key measure of academic performance. This can ensure the anonymity of each participant as no identifiable personal information such as name, academic major and transcript are gathered. To better understand the potential challenges faced, participants are being asked to rate ten different factors (e.g.. political tensions, class suspensions, academic stress, student-teacher

relationship) that may affect their academic performance at school in a five-point Likert scale, ranging from "Not at all" to "Extremely".

Among all the respondents, 31 of them self-reported that their CGPA is 3.0 or above in the Spring 2020 semester, meaning that they are the high achievers. However, when asked about their perceptions of how socio-political instability affects their academic performance, many of them agreed that the unfavorable social conditions have negatively affected their learning motivation. In particular, two students explicitly mentioned that their attention was distracted by studying remotely at home. Yet, a few students did not agree that their learning has been adversely affected as they could easily raise questions by email or making online calls with professors during the pandemic. Also, they had more time to self-study under the class suspension. Again, further investigation is needed by conducting semi-structured interviews with student representatives.

5. Conclusion

This research study aims to explore the ways in which the learning experience of university students in Hong Kong has been impacted by the socio-political challenges since 2019. By conducting a mixed-methods research, it was found that university students had a high degree of perceived stress and political involvement in the years of 2019 and 2020. Regarding their learning experience, many of them claimed that they had a bad experience learning remotely at home. The overall learning experience was unsatisfactory because of the incompetence of teachers, lack of technical support, and poor interactions among peers and teachers. Despite the significance of the findings, this study was constrained by the low sample size drawn from one university in Hong Kong, hence the representativeness of the findings is relatively low. Moreover, the generalizability of the results is also limited by the convenience sampling method employed to collect the online survey data. As the pandemic continues, future studies should be done in a city-wide scale to further examine the impacts of socio-political unrest on university students, and to formulate informed interventions to improve their overall learning experience.

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Demola Co-creation Approach: The Students´ Perspective

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Abstract

On the wings of New Public Management (NPM) and the Bologna Process, Higher Education Institutions (HEI) needed to innovate towards market orientation, both students demanding and social relevance. One way to achieve these objectives is through co-creation processes, involving students and partners outside as companies and public institutions. The purpose of this paper is to assess the satisfaction of Instituto Politécnico de Bragança (IPB) students who actively participated in a co-creation process called Demola, which aims the pedagogical innovation and strengthening the link with and the community. Quantitative data was collected through an online survey that included questions about students' perception on the impact of the co-creation process Demola. The population is 250 students who participated in eight batches in the last four years, working in 44 co-creation cases or challenges. 87 students answered the questionnaire, corresponding to 34,8% of the sample. Main results and conclusions suggested high levels of satisfaction among IPB students' and are perceived as having very positive impact in skills' development.

Keywords: *Innovation; co-creation; higher education institutions; pedagogical innovation.*

1. Introduction

The spread of the NPM paradigm, from the late 1970s onward, saw the growth of a new discourse of public administration management (Hood, 1991; Broucker, & De Wit, 2015), suggesting functioning in a quasi-business manner with market orientation and frequent customer satisfaction surveys and performance assessments (Diefenbach, 2009). HEI were also influenced by the movement of NPM (Broucker, & De Wit, 2015).

The Bologna Process and the "*European Commission has put forward a clear vision for the governance of European Universities, which includes, among other things, a diversification of funding sources, an intensification of ties between universities and industries and a closer match between the supply of qualifications and labor market demands*" (Dobbins, Knill, & Vögtle, 2011, p.666). The same authors (2011, p.666) refer that "*result of transnational pressures and domestic exigencies, national systems of Higher Education (HE) governance are, to a greater or lesser degree, being reshaped, transformed, modernized and in many cases ''marketized''*".

Meanwhile, as part of the process, "*students have begun to show interest in adopting active and participatory roles that allow them to interact and work collaboratively with educators*" (Dziewanowska, 2017, p.210). Dziewanowska (2017) pointed out that students and professors play the two main roles in higher education service value co-creation process, thus resource integration is largely an interaction process between and among the parties.

HEI continuously invest in innovation, future orientation and knowledge transfer, what can benefit stakeholders, however this relation tends to be unidirectional in what knowledge is concerned. Co-creation processes between HEI and external organizations are still scarce, but if correctly implemented can concretize an opportunity to generate value for those directly involved and other stakeholders. In this sense, co-creation can be described as a "*collaborative creation of value by the company and the customer*" (Prahalad & Ramaswamy, 2004, p.8). This is operationalized in a co-creative customer experience, where the customer is actively involved and contributing in some way in the design, delivery, and creation of the customer experience. "*This concept is an emerging one that has been discussed intensively in various industries*" (Saragih, 2019, p.466).

The introduction of co-creation processes as learning process in HEI makes "fundamental to analyze and study students' satisfaction", as previously suggested to other changing processes in HEI (Alves & Raposo, 2007, p.1262). These authors suggested that the "image" of HEI has the biggest influence in satisfaction, namely in aspects as student's expectations, the quality perceived or value perceived, student loyalty and student's involvement in positive word-of-mouth actions. HEI are "*becoming increasingly aggressive in their marketing activities*" to communicate an image that is favorable to students, employers and society" (Ivy, 2001, p.276).

Demola is an international co-creation platform operated by Demola Global and partner academic institutions together. The idea is to build multidisciplinary teams of the most motivated higher-education students and combine the insights from these teams with expert facilitator know-how to create visions of the future and competitive advantage for the participants and partner organizations. By building a bridge between the decision-makers of yesterday, today, and tomorrow, Demola drives improved and more democratized ability to react to changes as a society. Demola co-creation model and thematic areas are in line also with Sustainable Development Goals and European Commission's European Skills Agenda for sustainable competitiveness, social fairness, and resilience.

This paper aims to study students' satisfaction and perception of the impact of co-creation projects as part of their learning curriculums in IPB. The paper proceeds as follows. After this introduction and theoretical parts, the second section presents the methods and the third section the preliminary results. We concluded with discussions and main conclusions.

2. Methods

Quantitative data was collected through a survey specifically designed for the purpose of this study. The survey included questions about students' satisfaction and perception on the impact of the co-creation process, such as i) Overall assessment of activities; ii) Perception of worthiness of participation; iii) Perception of change in attitude towards new challenges; iv) Perception of change in attitude towards entrepreneurship; v) Perception of improvement in the ability to work in a multidisciplinary and multicultural team; vi) Perception of improvement in initiative and project management skills; vii) Perception of improvement of creativity skills; viii) Perception of improvement of technical skills; and ix) Recommendation of the project to friends. Answers were given in a *Likert* scale. For items i) to viii) we define a scale with 4 points (1- not productive at all to 4 - very productive) and for last item we define a scale with 10 points (1 - never to 10 - definitely yes). The survey was distributed between December 2020 and February 2021 to students enrolled in 8 batches of co-creation projects occurred between 2017 October and 2021 February. The online survey ensured the confidentiality of data. The participation was voluntary and after academic assessment, ensuring students that participation would not affect any grades.

3. Results

The study comprised a sample with a total of 87 students, with a mean age of 25,4 (SD=4,56), from 19 different nationalities. The sample included 33 females (37,9%) and 54 males (62,1%) students. Considering the European Qualifications Framework (EQF), this sample has 68 (78,2%) bachelor students (level 6 EQF), 18 (20,7%) master students (level 7 EQF) and 1 (1,1%) PhD student (level 8 EQF). Attending the academic studies, this sample

comprise by increasing order: one student (1,1%) from Health and Social Protection; three students (3,4%) from Tourism, Sport and Leisure; four students (4,6%) from Agricultural Sciences and Natural Resources; six students (6,9%) from Education and Teacher Training, 15 students (17,2%) from Arts, Communication and Multimedia, 16 students (18,4%) from Business Sciences and Law and 42 students (48,3%) from Technologies. As we can see, the Demola project is very multidisciplinary and multicultural.

Table 1. Descriptive Analysis of Students' Satisfaction.

		Gender			**Participation**		
	Mean (SD) n=87	**Male Mean (SD) n=54**	**Female Mean (SD) n=33**	***p*-value**	**One Mean (SD) n=68**	**> One Mean (SD) n=19**	***p*-value**
How do you assess the activities taken during Co-Creation sessions? (1-4)	3,43 (0,60)	3,4 (0,60)	3,5 (0,62)	0,683	3,5 (0,56)	3,3 (0,75)	0,563
Do you think it was worth participating? (1-4)	3,7 (0,65)	3,6 (0,73)	3,8 (0,46)	0,224	3,8 (0,63)	3,5 (0,70)	0,078
Do you consider that having participated in Co-Creation projects changed your attitude towards new challenges? (1-4)	3,4 (0,71)	3,4 (0,79)	3,4 (0,56)	0,547	3,4 (0,72)	3,4 (0,69)	0,908
Co-Creation contribution to entrepreneurship, emergence of new business ideas. (1-4)	3,4 (0,74)	3,4 (0,80)	3,4 (0,61)	0,957	3,4 (0,76)	3,3 (0,65)	0,251
Co-Creation contribution to improving the ability to work in a multidisciplinary and multicultural team (1-4)	3,6 (0,57)	3,6 (0,62)	3,6 (0,49)	0,700	3,7 (0,56)	3,5 (0,61)	0,314
Co-Creation contribution to the development of initiative and project management capacity. (1-4)	3,5 (0,64)	3,4 (0,66)	3,6 (0,61)	0,268	3,5 (0,61)	3,3 (0,73)	0,165
Co-Creation contribution to the development of creativity skills (1-4)	3,4 (0,69)	3,4 (0,69)	3,5 (0,71)	0,929	3,5 (0,63)	3,2 (0,85)	0,148
Co-Creation contribution to the development of technical skills. (1-4)	3,1 (0,86)	3,1 (0,96)	3,2 (0,66)	0,559	3,1 (0,86)	3,3 (0,87)	0,377
Would you recommend a Co-Creation experience to friends and colleagues? (1-10)	8,8 (1,70)	8,4 (1,88)	9,3 (1,21)	**0,009***	8,9 (1,47)	8,2 (2,29)	0,138

* The Mann-Whitney test (p=0,05) was performed to test equality of means. Source: Own Elaboration.

The assessment of how much was worthwhile participating was scored with 3,7 +/- 0,65 out of 4 points. The perception of contribution of co-creation projects to the development of

several skills was in all cases assessed over 3 in a 4 points scale, with the highest assessment for the co-creation contribution to the improvement of the ability to work in a multidisciplinary and multicultural team rated with 3,6 +/- 0,57 points, and the lowest for the co-creation contribution to the development of technical skills 3,1 +/- 0,86 points. The overall sample reported high rates of satisfaction assessed by the level of recommendation to friends (8,8 +/- 1,70 out of 10) (Table 1).

Students' satisfaction and perception on the impact of the co-creation process did not differ significantly among genders, with exception for the level of recommendation of the Co-Creation experience to friends and colleagues, with females recommending significantly more (p-value= 0,009) than males, respectively 9,3 against 8,4 (Table 1).

From all respondents, 19 (21,9%) participated twice or more in co-creation projects. Analyzing the differences in students' satisfaction and perception on the impact of the co-creation process did not differ significantly among different participation frequency (Table 1).

4. Discussion & Conclusions

The recommendation of this process is one of the measures of HEI student satisfaction, as previous authors already claimed in the context of HI. Ueda & Nojima (2012) confirmed that students with higher levels of satisfaction will speak positively about their experiences and recommend to friends and family and care about the HEI reputation (Sutarso, Halim, Balqiah, & Tjiptoherijanto, 2017).

This study shows that IPB students' satisfaction level with co-creation projects is high. This conclusion is reinforced by the perception of high impact of co-creation projects in skills development. Previous studies about co-creation projects also report high levels of satisfaction (Ribes-Giner, Perello-Marín, & Díaz, 2016) and skills development (Yeo, 2009). One study developed in Indonesia concluded that co-creation is related to a stronger attachment of students to HEI and higher value of student experience, and that even if co-creation does not directly affect student satisfaction, it does indirectly as it affects experience value (Gunarto, & Hurriyati, 2020). If the value of experience is higher, student satisfaction will also be higher. These results are very important if we consider that student satisfaction mediates the relationship between the antecedent variables of perceived university reputation and competency, and student citizenship behavior (Elsharnouby, 2015), contributing to a better society. In fact, HEI are looking for innovative ways to improve student satisfaction, and co-creation projects have consistently, in several studies, showed favorable effects in terms of satisfaction, trust, and loyalty, it is a pragmatic tool to be considered and implemented in HEI, so we need to foment and explore methodologies for applying these

projects in order to increase the level of retention, word of mouth, and student loyalty (Pantoja Díaz, Ribes-Giner, & Perello-Marin, 2016).

Students' satisfaction and skills development, as pointed out by Yeo (2009) seem to be higher in co-creation activities, hands-on, multidisciplinary and collaborative projects (Al-Sheeb, Hamouda, & Abdella, 2018), when compared with traditional teaching (Kastolani, Arenggoasih, Indah, & Susilayati, 2020). All skills development variables are highly scored, but the highest scoring was given to the development of skills to work in multidisciplinary teams.

No differences among genders were identified in skills development perception, which is aligned with previous studies regarding higher education students (Ain, Sabir, & Willison, 2019). Gender differences however exist in satisfaction measured by likelihood in recommendation. Females seems to be more likely to recommend co-creation projects to friends than males, what can be a result of learning strategies differences between genders. In the past it has been suggested that male gender showed a greater preference than female gender for the abstract conceptualization mode of learning, while female gender preferred hands-on experiences and learning for the sake of the learner (Severiens, & Ten Dam, 1994).

This result may be related to the skills not stimulated in females in regular teaching approaches, e.g., analyzing and synthesizing skills. The same authors also indicate that this incomplete skills set may lead to lower employer satisfaction with graduate skills (Ain, Sabir, & Willison, 2019). Co-creation projects seem to be perceived as interesting, useful and skills enhancement tools, regardless the number of participations. We assume that the fact that each participation involves different challenges and different teams, novelty is maintained, and skills are always improved, characteristic also enhanced by other authors (González García, Pastor Pérez, Girona Campillo, Merino Rubio, & Palou Vives, 2017).

We can conclude that co-creation projects produce high levels of satisfaction among students and are perceived as having very positive impact in skills' development. Future work is still necessary to understand the satisfaction and impact of results in HEI and stakeholders, as well as in lectures/facilitators and companies and public institutions members of teams. It will be useful and timely to deepen our understanding of how we must change HEI policies accelerating the move from rigid value chains to newer ones, with the objective of materializing and concretely practicing the co-creation approach.

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Educational quality and dropout risk: a causal analysis of the university dropout phenomenon

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Abstract

University dropout is one of the main problems of the Spanish university system due to its high rates. The latest report issued by the Ministry of Science and Innovation (MICINN, 2020) shows that more than 30% of students drop out of an undergraduate degree program. In order to explore the phenomenon, in line with the scientific literature, we have focused on identifying personal and family variables associated with university dropout. Using an ex post facto, quantitative, descriptive and causal design methodology, we observed significant relationships between the dependent variable "completion of university degree" and the independent variables "age", "marital status" and "number of siblings". In agreement with other researches (Belloc et al, 2010; Diaz Peralta, 2008; Lizarte Simon, 2017) we conclude that university dropout is a multicausal phenomenon that needs to be fully understood. This will allow to maximize the use of resources allocated to higher education and optimize university access, permanence and quality policies.

Keywords: *Drop-out; higher education; statistical analysis; educational quality.*

1. Introduction

The concept of educational quality in higher education has been the subject of numerous analyses and definition proposals. Initially linked to the economic sector, it has been progressively incorporated into the educational sphere due to the imperative need to respond to the problems affecting higher education globally and more specifically in Spain: institutional reforms as a result of the unification of undergraduate and postgraduate curricula driven by the creation of the European Higher Education Area (EHEA); accelerated enrollment growth accompanied by a major expansion of academic offerings; or high university dropout rates that question the success levels of success of the system.

In particular, university dropout, as we conceive it in this contribution, is an expression of how educational quality is managed in each specific context. At the macro level, it has been the subject of numerous reports which repeatedly show that it is a phenomenon that is both relevant and problematic at the global level due to the high rates it presents (AIRef, 20020, MICINN, 2020, OECD 2019). The latest statistics published by Eurostat (2020) point to Malta as the country with the highest university dropout rate, with 18.4%; followed by Spain with 18.3%. In third place is Romania with 18.1%.

These data are worrying, if we take into account that European institutions set the 2020 target of reducing university dropout to 10%. Moreover, the current figures have political, socio-economic and academic consequences that are felt by students, as well as by the university institution and the State as a whole (Patrick *et al*., 2016; González-Ramírez and Pedraza-Navarro, 2017). This impact has aroused great scientific interest. Various research projects have focused on exploring the phenomenon by identifying its causes and motives. According to Belloc *et al*. (2010), Diaz Peralta (2008) or Lizarte Simon (2017), university dropout is a multicausal phenomenon that is conditioned by the influence of personal variables and those related to the family and socioeconomic environment of students. The most current research (Behr *et al*., 2020) call for this problem to be tackled at the micro level, situating the nature of the problem in the specific context in which it occurs and always linked to institutional quality policy, identifying how it is tackled and the singularity of its intervention.

1.1. Personal, family and socioeconomic variables associated with university dropouts

Among the *personal variables*, "sex", "age", "marital status" and "ethnic origin" are crucial. Research indicates that male dropout rates prevail over female dropout rates, despite the fact that the percentage of men enrolled in university is lower (Casquero and Navarro, 2010). Likewise, university dropout mainly affects younger students given their low vocational maturity (Al Ghanboosi and Ayedh, 2013). Although non-traditional students over the age of 25 also drop out of university, as they have the need to allocate part of their time to work and family care (Garcia de Fanelli, 2014). According to Stoessel *et al*. (2015), combining studies and family care is difficult, which is why married students are at higher risk of dropping out

of university. In addition, populations composed of ethnic minorities or specific groups, such as the handicapped and high-performance athletes, are at a higher risk of dropout. Belonging to an ethnic group implies a language barrier (with mother tongue different from the official), and discrimination experiencies and prejudice that has negative repercussions on social adaptation (Fonseca and García, 2016).

"Family size", "type of housing", "socio-educational level of parents" and "presence of difficulties" are the most influential *family variables*. According to Rodríguez Urrego (2019), the greater the number of siblings in the family unit, the greater the risk of abandonment. It also increases the risk when living away from the university, especially, in a home that is not owned (Jara *et al*., 2008) and outside the family environment (Zanchin, 2017). Remarkably, students' family environment significantly influences their academic life. According to Garbanzo Vargas (2007), a favorable family environment, marked by commitment and democratic coexistence, has an impact on adequate academic performance. Another important element of the family environment is the educational level of the parents. The literature highlights, especially, the educational level of the mother as a relevant variable in this subject. Marchesi (2000) reveals that when mothers' academic level is higher, children perceive greater support for their studies and seek to achieve the goal of graduating. On occasions, the students' trajectory is influenced by the presence of family difficulties that generate discouragement. Despite their low frequency, there are situations such as illness or death of a family member that lead to the decision to abandon university studies (Rodríguez-Pineda and Zamora-Araya, 2020).

The *socioeconomic variables* include the student's "purchasing power", his or her "employment status", the "way of financing his or her studies", the "lack of economic resources" to cover transportation, tuition, materials, among others, and "family responsibilities" in the "presence of economic difficulties". Conversely, students who come from affluent families are more likely to pass higher education (MDSyF, 2003). It is true that combining studies with work is difficult, since it requires a lot of time dedication. Therefore, the risk of dropout in students who work is higher (Íñiguez *et al*., 2016). Those students who pay for their studies thanks to financial aid from parents or some financial agency are less likely to drop out (Jones-White *et al*. 2014; Ononye and Bong, 2018). Unfortunately, changes in personal and family conditions are strongly associated with socioeconomic aspects that influence university dropout. Unexpected situations such as the loss of a job of the breadwinner or the death of the father are factors that prevent students from continuing their university studies, since they are obliged to support their families.

2. Methodological research design

Throughout this research we emphasize the multidimensionality of the phenomenon of university dropout, analyzing the sociological profile of students who dropped out of an undergraduate degree at the Faculty of Education Sciences of the University of Seville. This fact allows us to identify personal and family variables associated with dropping out, a problem that affects 27.8% of students at the University of Seville. The figure is worrying, even more so when it causes an annual loss of 974 million euros (12% of annual university expenditure) (BBVA Foundation, 2019).

The methodology used was ex post facto, quantitative, with a descriptive and causal design.

From a total population of 477 students who started an undergraduate degree in the 2009/2010 - 2010/2011 entry cohort and failed to complete it, we randomly located 50% of the students who dropped out of each of the academic years that comprise it (first, second, third and fourth year). Thus, the resulting number of participants is 239. In order to summarize the sociological profile of these students, we present Table 1.

Table 1. Sociological profile of participants.

Variables	Prevailing value
Sex	Female (75.3%)
Marital status	Single (85.7%)
Average age	28.55 (DS= 5.012)
Employment status	Active (54.2%)
Place of residence	Seville (73.3%)
Type of housing	Family (60.8%)
Number of siblings	1.66 (DS= 1.385)
Parents' educational background	Primary (36.6%)
Father's employment status	Active (51.5%)
Mother's employment status	Inactive (50.3%)
Parents' marital status	Married (79,7%)

Source: own elaboration (2021).

An ad hoc questionnaire was used for data collection. A review of the bibliography served as a reference for its elaboration.

The SPSS v.22 statistical program was used to test the validity and reliability of the scales used. Reliability was estimated from Cronbach's alpha statistic, which provided an overall coefficient of 0.843. The construct validity was performed by factor analysis, using the

maximum likelihood procedure. The adequacy of this type of analysis is observed in Bartlett's test of sphericity, for each of the scales analyzed represents a degree of significance of 0.000. Furthermore, these results are reinforced by the Kaiser-Meyer-Olkin test, which obtained values between 0.5 and 0.8.

3. Research results

In response to our scientific objective, we present the personal and family variables associated with dropping out of a degree program. Specifically, we developed different hypothesis tests comparing the dependent variable "completion of university degree" with the independent variables "sex", "age", "marital status of students", "number of siblings" and "parents' educational background".

The Kolmogorov-Smirnow normality test allows us to test the significance of each of these variables ($p > 0.05$), which do not follow a normal distribution.

Table 2. Kolmogorov-Smirnow normality test.

Variables	Test statistics	Sig.
Sex	.469	.000
Marital status	.500	.000
Average age	.280	.000
Number of siblings	.260	.000
Father's educational background	.255	.000
Mother's educational background	.282	.000

Source: own elaboration (2021).

Given the nature of the independent variables, we performed nonparametric tests using the Mann Whitney U test for two independent samples and the Kruskal-Wallis H test for more than two independent samples.

Before showing the results obtained in the hypothesis tests, it should be clarified that the hypotheses were formulated in the following terms:

- H^0 (null hypothesis): there are no significant differences between the completion of studies and the specific variables analyzed, with an alpha risk of error of 0.05%.
- H^1 (alternative hypothesis): there are significant differences between the completion of studies and the specific variables analyzed, with an alpha risk of error of 0.05%.

Table 3. H^0 and H^1 accepted in the different hypothesis tests.

Relationship of variables		Value		p	Accepted hypothesis
Dependent	**Independent**	**U**	**K**		
Completion of university degree	Sex	435.000		.092	H^0
	Marital status		9.378	.002	H^1
	Average age		7.522	.006	H^1
	Number of siblings		8.293	.004	H^1
	Father's educational background		.136	.712	H^0
	Mother's educational background		.612	.434	H^0

Source: own elaboration (2021).

In Table 3, we observe that “age”, “marital status of students” and “number of siblings” are associated with university dropout. Each of these variables obtains p-values lower than 0.05. These results lead us to reject the null hypothesis and, consequently, to affirm the alternative hypothesis in each of the relationships.

On the other hand, there is no significant relationship between the dependent variable “completion of university degree” and the independent variables “sex” and “parents' educational blackground”. These variables obtained p-values greater than 0.05, allowing us to accept the null hypothesis in each of the relationships.

4. Discussion and Conclusions

The results obtained in this study allow us to identify personal and family variables associated with dropping out of university studies and to better understand the multidimensional nature of the dropout phenomenon. According to Belloc *et al*. (2010) or Lizarte Simon (2017), among others, students' university trajectory is affected by personal variables and variables related to the students' family and socioeconomic environment.

The hypothesis test shows that age and marital status are two personal variables associated with university dropout. According to García de Fanelli (2014) dropout substantially affects students over the age of 25, since these students not only focus their attention on studying, but also working or taking care of the family. Although most of the students who drop out of the faculty under study are single, coinciding with Oloriz and Fernandez (2013), university dropout also affects other marital statuses, such as married or divorced.

Among the family variables associated with university dropout, the number of siblings the student stands out. Most of the participants in the study have a sibling, reaching a maximum

of 10 in the family unit itself. This fact supports Rodriguez Urrego's (2019) assertion that the probability of dropping out increases, the greater the number of siblings in the family unit.

Parental educational background is not presented as a variable associated with university dropout. It would be convenient to study the collinearity effect between the variables marital status, mean age and number of siblings, as this effect could make parental educational background insignificant.

All considered, it is advisable to continue identifying variables associated with university degree completion, as well as investigating the different dropout situations. Using the perspective of the students themselves and contemplating essential elements of interaction generated between them and the context that triggers dropout, we will be able to know the effectiveness of certain mediating agents in the resolution of the problem of university dropout.

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Fostering the resilience of graduate students

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Abstract

This paper originates from research carried out by an international team of university professors interested in protective factors promoting the resilience of graduate students, in particular regarding the student-supervisor relationship. Following a literature review on the subject, the paper presents the resilience factors affecting the student and those relating to the supervisor. The main factors that appear to promote the resilience of graduate students are individual, family and environmental protective factors (as gender, temperament, cultural background, personal history of schooling, motivation, family support, being childless, wealth of the social support network, means offered by the supervisor and the university). For the supervisor, the main protective factors appear to be individual (experience, style and role assumed towards the student, support the student's empowerment as his/her schooling progresses). The reciprocal adjustment throughout the studies between the supervisor and the student appears essential to promote their tuning for the resilience and the success in the graduate studies.

Keywords: *graduate studies; resilience; protective factors; supervisor; student.*

1. Introduction

We talk more about dropping out of high school students than about the situation of university graduate students. However, in all countries, the dropout rates of master's students and, even more so, of doctoral students are found to be very high (British Council & DAAD, 2018; Conseil supérieur de l'éducation, 2010; Lacroix et Maheu, 2017). Perseverance in graduate studies is therefore a challenge and a major issue.

This paper has its origins in an international research (Grant AUF-FRQ) examining the protective factors that promote the resilience of graduate students, in particular regarding the student-supervisor relationship. The research team developed a two-step research protocol (student questionnaire, then interviews and Study Line test with students and supervisors). The questionnaire was culturally validated by 9 international experts. Due to the pandemic at COVID-19, the project has been delayed and the handing over of the questionnaire will begin at the end of May 2021.

Following a literature review on the subject, we will present the risk and protective factors affecting the student, then those relating to the supervisor. Factors pertaining to the student-supervisor relationship conclude this paper with the presentation of a summary of the factors that appear to be the most influential for the success of graduate studies.

2. Method

A literature review was carried out on February 21, 2021 in the PsycINFO database with the keywords student-supervisor, master or doctoral degree or PhD. The results of this bibliographic search yielded 36 references, 5 of which were not of interest for our paper. These 31 references were added to an article bank built over the past years which now includes a total of 170 articles. Indeed, since the beginning of the research, all team members, contributors to the project, are collecting articles on this topic, including the grey literature. The experience of the faculty members of the international team made it possible to generate this reflection article on the protective factors favoring the success of graduate students, and more especially, those of the student-supervisor relationship. We have categorized the factors according to whether they relate to the student himself, the supervisor, or both. The analysis of these factors is subdivided into individual, family and environmental factors.

3. Resilience factors relating to graduate student

3.1. Individual factors

Among the individual factors identified, some are immutable, such as the student's gender (Ducker, 2011), race or ethnicity (Moore, 2014). Note that women usually finish their studies

faster than men (Ducker, 2011). On the other hand, coming from a minority or a marginalized group (McClure, 2018) or not being from the same ethnic group and the same culture as his supervisor (Moore, 2014) is a risk factor. Certain skills were identified as constituting protective factors: the ability to manage one's time (Albertyne et al., 2008), to organize oneself (Denholm, & Evans, 2006), self-efficacy (Anderson, 2011), autonomy (Devos et al., 2015), critical thinking (Lee, 2007), capacity for autonomous regulation (Nottingham, 2017), use of adapted coping strategies (Sandoval, 2018) and ability to seek help and support when needed (Baness King, 2011). These different personal characteristics constitute very good basic skills for undertaking graduate studies. Wao et al. (2011) also mentioned the great importance of motivation and it is clear that studying must be a continuation of our goals in order to maintain our motivation (Sandoval, 2018).

Indeed, undertaking graduate studies constitutes a commitment and an investment of time and energy so great that it is essential to have reasons to do so as well as to really want to, otherwise the risk of discouraging and giving up is great (Sandoval, 2018). As students constitute a population vulnerable to problems of exhaustion, physical illness and mental health disorder (Haag, 2018) which constitute high risk of dropping out of studies (Leggat, & Martinez, 2010), it is essential to take care of yourself and maintain a good balance in one's life (Jones, 2013). Obviously, the fact of having had a good previous academic preparation (Wao et al., 2011) and of having already acquired good research skills (during the 1st university cycle for example) and of always seeking to improve them (Ndayambaje, 2018) constitutes a protective factor for the success of master's and doctoral studies (Duke, & Denicolo, 2017). The student who chooses a research topic that is at the same time accessible, feasible and interesting (Bégin, 2018) and who believes in his skills (Denholm, & Evans, 2006) has beautiful protective factors in this. Being more advanced in your student career would generate better self-esteem (Nottingham, 2017), a protective factor recognized as essential. Having a positive perception of your supervisor and his relationship with him would increase the chance of completing his program (Jones, 2013). Finally, the student's satisfaction not only with his supervision, but also with his studies and his program constitutes an important protective factor (Gemme, & Gingras, 2006).

3.2. Family factors

At the level of the student's family risk factors, the main ones are related to family obligations and responsibilities (Parker, 2018). Risk factors are constituted by life events such as having children (Arus, & Vierstraete, 2018), more specifically a newborn baby (Trudgett, 2014), having a separation or a divorce (Wao et al., 2011), etc. In addition, have unmet financial needs, not having strong and supportive family relationships (Terry, & Ghosh, 2015), as well as living at a distance from his family for his studies (Ndayambaje, 2018) are risk factors. These factors further influence the graduation rate of women, this being explained by the fact that still today it is mainly women who take care of the children, manage the household

chores and the medical appointments of the children. The fact of not being confronted with these life events constitutes protective factors: being childless, not going through a separation, enjoying a warm and supportive family, living close to one's family (who can provide support, concrete help and good meals), for example.

3.3. Environmental factors

The first environmental protective factors relate to fellow students who can provide important support (Terry, & Ghosh, 2015), through maintaining good relationships and socializing with them (Jones, 2013) or being part of a slightly more peer support and mentoring group (Denholm, & Evans, 2006). Support from the faculty (other professors than the supervisor; Terry, & Ghosh, 2015), institutional support (information, services and resources provided like the scholarships offered; Albertyn et al., 2008; Aris, & Vierstraerte, 2018) and the quality of the campus climate (Veilleux et al., 2012) are also important. All supportive and mentoring relationships are beneficial, especially if they are numerous and diverse. Some characteristics of the program may (or not) have a supportive role, such as the chosen study program (Lacroix, & Maheu, 2017), whether the program is distance-based or not (Orellana et al., 2016), the format and structure of the program (Wao et al., 2011). Group supervision, compared to traditional individual supervision would have beneficial effects. Integration into the scientific community is recommended, it makes the university course at the graduate level less stressful and more pleasant (Denholm, & Evans, 2006).

4. Resilience factors relating to supervisor

4.1. Individual factors

Individual factors refer to the characteristics and ways in which the supervisor acts in favor of the success of his students. Personal qualities such as being honest, professional, helpful and respectful (Fairbanks, 2016) and a personality as compatible as possible with that of his student (Sambrook et al., 2008). The personal experience of a university student (how he has been supervised; especially important for novice supervisors: Vereijken et al., 2018) plays a role in the way of supervising (Denis, & Lison, 2016). As most supervisors learn on the job how to coach well (experiential learning), skill level is often related to the supervisor's number of years of experience (Denis, & Lison, 2016). A competent supervisor is a supervisor who has good professional knowledge and expertise in his field (Halse, & Malfroy, 2010), who knows how to adapt to his students (ability to adopt different styles of supervision depending on the context and needs of his students; Fernando, & Hulse-Killacky, 2015), and especially who learns from his/her mistakes, can adjust if necessary and questions himself, practice reflective thinking. The style of the supervisor (goal-oriented, very supervising or controlling, disengaged in front of the student) as well as the roles he employs

have a great influence on the success of the supervised student (Gruzdev et al., 2019; Mhunpiew, 2013). While it is necessary for the supervisor to adapt his style according to the need of his student, he must support his empowerment as his/her schooling progresses (Devos et al., 2015; Fernando, & Huls-Killacky, 2005). The supervisor must offer a minimum of availability and meetings (Bégin, 2018), to ensure rigorous follow-up by meeting, hearing from and taking note of his/her student's progress on a regular basis (Albertyn et al., 2008) and provide adequate and timely feedback (Ndayambaje, 2018). As for the role adopted, the studies mention that is the best protective factor for the student's success is that of mentor (Gadbois, & Grahm, 2009) who supports, supervises, guides and facilitates the student's career development (Kogler Hill et al., 1989). In this sense, the support of the supervisor both in terms of concrete help provided (scientific development, access to resources, opportunities to participate) and psychological support (motivation, encouragement) allows a professionalization of the student (Fullick, 2013; Gremmo, & Gérard, 2008; Pearson, & Kayrooz, 2004). Providing an organization and a supportive structure, with realistic expectations towards his/her student, the supervisor's interest in the research project, as well as his level of commitment to his/her student and their common project are also protective factors. It is important that the supervisor is sensitive to the culture of his student and adapts to it (Glynn, & Berryman, 2015; Pumaccahua, 2017). A supervisor who practices an approach focused on the successes, strengths and dreams of his students (Goyette, & Dubreuil, 2019) and who turns their vulnerabilities into strengths (Rademaker et al., 2016) increases the likelihood of his students being successful, just like when he genuinely cares about his students (Gray, & Costa, 2019; Hodz, 2007).

4.2. Family factors

We did not find any study that addressed the family factors of supervisors. However, we know that any family factor (birth, illness, separation, bereavement, for example) preventing the supervisor from being fully available to his students will have a negative impact on the progress of their studies.

4.3. Environmental factors

The main factors coming from the supervisor's environment are the comments and feedback from the students (which allow them to improve themselves; Maihard et al., 2009), the support of peers (fellow professors; Lee, 2007), the fact of being trained, guided by documents (Fairbanks, 2016) or being supervised by a mentor (Emilsson, & Johnsson, 2007).

5. Conclusion

A positive relationship (tuning) between the supervisor and his student is essential to the success of the student's studies (Barnes, 2009-2010). It is important that this relationship is

based on mutual trust, that both parties develop strategies to increase and maintain it (Robertson, 2017). This trust must go hand in hand with mutual respect (Halse, & Malfroy, 2010), open, effective and positive communication (Hodza, 2007). If there is a problem or discomfort, both parties should be comfortable talking about it constructively. It is essential that expectations and operating methods are clearly expressed and explained at the outset (Masek, 2017). The fact of planning the research stages in advance, establishing the modes of operation, and the reciprocal expectations makes it possible to avoid later tensions and conflicts. Both the student and the supervisor must be able to adapt to the personal and professional circumstances of the other and maintain a firm and reciprocal commitment to collaborate in obtaining a graduate degree (master or PhD) otherwise the risk of abandonment increases (Halse, & Malfroy, 2010). Gratitude is also emphasized as being essential between the student and the supervisor (Howells et al., 2017). Finally, it is necessary that their relationship be more collaborative than a power one (Hemer, 2012) and that their level of proximity and affiliation be high (de Kleijn et al., 2012).

The main factors that appear to promote the resilience of graduate students are individual, family and environmental protective factors (gender, temperament, cultural background, personal history of schooling, motivation, family support, wealth of the social support network, means offered by the supervisor and the university). For the supervisor, the main protective factors are individual (experience, style and role assumed towards the student, support the student's empowerment as his/her schooling progresses). The reciprocal adjustment throughout the studies between the supervisor and the student appears essential to promote their tuning for the resilience and the success in the graduate studies. Our reflection on published research results, as well as the results of ongoing research, will help us to propose measures to be implemented to promote better student-supervisor tuning, and thus facilitate graduate success. Among the spin-offs of the project, we anticipate a "toolbox" with advice and training content, considering also cultural differences, to offer to new supervisors.

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Tell me what you study and where you live! Exploring the role that these aspects play when choosing a university

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Abstract

Previous literature on students' decisions and choices regarding universities contains a large number of factors that influence these process. This research focuses on two of these factors and its aim is twofold. First, it is analyses how prospective students' study areas impact on the relative importance of different university selection criteria. Second, it examines whether the environment of residence (i.e., the size of the municipality) leads to differences in these criteria. The results obtained from a sample of 605 prospective university students who live in the Spanish region of Castilla-La Mancha allowed us to conclude that there were significant differences in most of the selection criteria according to the field of study and the size of the municipality (i.e., five and six out of nine criteria, respectively). Some practical implications for the design of segmentation strategies and communication campaigns in the context of higher education institutions are presented in this work.

Keywords: *University selection criteria; prospective students; field of study; size of the municipality.*

1. Introduction

The literature on the choices and decisions that students make regarding which Higher Education (HE) institutions they should apply to is influenced by a considerable number of factors (Baker, 2019).Little, however, is known about how the students' places of residence (rural or urban areas) influence this decision. The work of Rosvall (2020) stresses that the transition to HE and careers could be more difficult for students in rural areas than for their urban peers. This author also states that students in rural areas are dealing with an ambivalence as regards staying in and leaving rural areas, and the poverty of access that occurs in some cases. Recent studies have indicated the growing gap between rural and urban areas in terms of economic growth, access to social services and employment opportunities (Bernard, 2019; Rignall & Atia 2017).

Universities compete by employing a variety of marketing techniques, and students subsequently receive their prospectuses and make decisions on the basis of a variety of factors. In this study, we wished to examine whether the selection criteria used depends on the knowledge discipline (degree/career) that the prospective student is planning to study. We additionally considered whether students living in rural or urban areas are influenced as regards the selection criteria employed when choosing their university studies.

2. Theoretical background

2.1. University selection and academic disciplines

An integrated knowledge of learning and teaching processes across different disciplines requires an in depth understanding of the context and the culture in which the learning process occurs and the attitudes of both academics and students toward teaching, educational goals, values, philosophies and orientations (Neumann, 2001).

Discipline-related differences have been evaluated by focusing on various issues, such as academics' relationship with knowledge, the relationship between students and educators, and the type of expertise that students are supposed to attain (Kemp & Jones, 2007).

Several previous studies have extensively used the Biglan (1973) classification of academic disciplines (Coughlan & Perryman, 2011). Biglan proposed a 2x2x2 typology for disciplines by considering three classification criteria (Kember& Leung, 2011): (1) the degree of consensus paradigm development (hard versus soft); (2) the presence of practical application (pure versus applied), and (3) the presence of a living organism (life versus non-life).

Academic disciplines vary as to their views of the application of practical problems, cognitive processes, concern with life systems, faculty time commitments and scholary output (Becher,

1987), assessment patterns (Jessop &Maleckar, 2016) and students' ratings of teaching quality (Kember& Leung, 2011).

Students' preferences for higher education disciplines can be explained in accordance with their vocation, its innovative nature, the relative strength of its theoretical and practical components, study program efficiency (survival rates), the quality of academic life, the level of the entrance grades required and employment perspectives. Students selecting a university course for the first time generally tend to place great importance on vocation and employment perspectives, while other factors such as the innovative nature of the discipline and the relative strength of its theoretical or practical components are less relevant when planning their academic career (Tavares et al., 2008). However, prospective university students really know very little about the specific characteristics of courses and universities, and there are numerous differences between segments, including particular disciplines (Khanna et al., 2014).

The following hypothesis is, therefore, proposed:

H1. The university selection criteria used by prospective students depend on their field of study.

2.2. University selection and environment of residence

University location and distance from home also influence how students plan where and what to study. Many students will generally not travel more than 50 km in order to study, and this could even be a psychological barrier for many. Students from a better social and economic background may be more likely to travel and place less importance on economic factors and the cost related to higher education. Those who choose not to leave their current home often choose courses from those that are available rather than what they really want to or can do, because those courses are not available locally (Tertiary Education Commission, 2018).

In many countries, students living in rural areas have limited access to career counseling, preparatory college courses, career academies, and school-to-work programs while at high school (Provasnik et al., 2007). This limited access impedes students from gaining the confidence and determination required to see higher education as an option. The study by Griffin et al. (2011) found that when college preparatory resources were limited in rural communities, high school students often looked to their parents/guardians and high school counselors for information.

This challenge is more complex when parents/guardians are less likely to have attended college, and high school counselors are limited as regards the resources they can provide in schools in rural districts. The work of Courrege (2011) stated that guidance counselors play multiple information roles within high schools, from facilitating standardized testing to developing student course schedules. These multiple roles that school counselors perform

limit the time that they can devote to helping students attain a detailed knowledge of the different university programs and colleges, along with what is required in order to enrol (Courrege, 2011). The following hypothesis is, therefore, proposed:

H2. The university selection criteria used by prospective students depend on the size of the municipality in which they live.

3. Method and results

3.1. University selection and academic disciplines

This study analyses a sample of 605 questionnaires obtained from students at 15 high schools in the Spanish region of Castilla-La Mancha. A personal survey method was used. There were more female than male respondants (55.7%). With regard to the field of study at high school, 31.1% were studying Social Sciences, 28.9% Health Sciences, 27.3% Technological Sciences and 12.7% Humanities. With regard to the size of the municipality, 39.5% resided in a village/town with more than 50,000 inhabitants, 25.6% in one with 10,001 to 20,000 inhabitants, 19.5% in one between 20,001 and 50,000 inhabitants and 15.4% in one with less than 10,001.

The questionnaire included socio-demographic questions (gender, the field of study at high school and the size of the municipality in which the students lived). It also contained nine criteria affecting the choices made by prospective students, which were rated on a 10-point Likert-type scale and based on the work of Joseph et al. (2005). The study additionally included two focus groups comprising university administrators in charge of student recruitment.

3.2. Results

The differences in the students' selection criteria according to the field of study at high school and the size of the municipality were studied using the one-way ANOVA procedure when the homogeneous variance assumption was correct, or the Welch Test when the variances were heterogeneous. The Tukey HSD test for equal variances and the Games-Howell test for unequal variances were used as post hoc comparison tests. These statistical analyses were performed using IBM SPSS Statistics 24.0.

As can be seen in Table 1, social science students placed more importance on the city's social and night life, independence from parents and the city's quality of life than did technology students. There were also differences between the former students and those from humanities in the case of the variable "becoming independent from parents". Furthermore, health science students placed more importance on study abroad programs and admission cut-off marks than did social science students. In the case of this last variable, there were statistically significant mean differences between health science students and those from other fields.

Table 1. Differences in students' selection criteria according to the field of study at high school.

Selection criteria	Mean (M)					Levene test		ANOVA/ Welch Test		*Post hoc* test (Tukey HDS / Games-Howell Test)
	Technological Sciences TS (n = 165)	Health Sciences HS (n = 175)	Social Sciences SC (n = 188)	Humanities HU (n = 77)	Total	F	p	F	p	p < 0.05
High school teachers' advice	3.12	3.19	3.32	3.44	3.25	1.396	0.243	0.482	0.695	
Economic aspects (family income)	4.84	4.93	5.35	5.45	5.10	0.856	0.464	1.705	0.165	
Cut-off marks for admission	7.18	8.06	6.73	6.53	7.21	4.466	0.004	11.751[a]	0.000	HS > TS, SC, HU
Social activities/city night life	5.52	6.25	6.37	6.18	6.08	1.111	0.344	3.254	0.021	SC > TS
Becoming independent from parents	6.65	7.33	7.65	6.27	7.11	4.048	0.007	5.769[a]	0.001	SC > TS, HU
City's quality of life	7.32	7.78	7.88	7.31	7.63	2.541	0.056	2.868	0.036	SC > TS
Accommodation costs (rentals)	7.17	7.46	7.53	7.27	7.38	2.759	0.042	0.683[a]	0.563	
Study abroad programmes	6.25	6.95	6.07	6.60	6.44	3.808	0.010	3.294[a]	0.021	HS > SC
Internships/practicum programmes	7.49	7.07	7.27	6.77	7.21	2.125	0.096	1.746	0.156	

Note: [a]Asymptotically F distributed.

Table 2 shows that students living in larger municipalities (with more than 50,000 inhabitants) placed less importance on the following criteria: "becoming independent from parents", "city's quality of life" and "accommodation costs (rentals)", than did the rest of the students. The criteria "cut-off marks for admission" and "social activities/city night life" were more important for students from municipalities of between 20,001-50,000 inhabitants than for those living in municipalities with more than 50,000 inhabitants. Lastly, economic aspects were less important for students living in a municipally of less than 10,001 inhabitants.

Table 2. Differences in students' selection criteria according to the size of the municipality.

Selection criteria	Mean (M)					Levene test		ANOVA/ Welch Test		*Post hoc* test (Tukey HDS / Games-Howell Test)
	Under 10,001 inhab. A (n = 93)	10,001-20,000 inhab. B (n =155)	20,001-50,000 inhab. C (n = 118)	Over 50,000 inhab. D (n = 239)	Total	F	p	F	p	$p < 0.05$
High school teachers' advice	2.92	3.19	3.54	3.26	3.25	2.152	0.093	1.395	0.243	
Economic aspects (family income)	4.31	5.65	5.00	5.10	5.10	1.665	0.173	4.807	0.003	B > A
Cut-off marks for admission	7.35	7.06	7.73	7.00	7.21	2.722	0.044	2.695[a]	0.046	C > D
Social activities/city night life	6.20	6.37	6.41	5.68	6.08	1.100	0.348	2.944	0.032	C > D
Becoming independent from parents	7.75	7.99	7.87	5.90	7.11	30.470	0.000	20.910[a]	0.000	B, C, A > D
City's quality of life	7.82	7.97	8.03	7.13	7.63	6.845	0.000	6.891[a]	0.000	C, B, A > D
Accommodation costs (rentals)	7.76	7.88	7.88	6.66	7.38	10.311	0.000	10.338[a]	0.000	B, C, A > D
Study abroad programmes	5.89	6.54	6.59	6.51	6.44	0.154	0.927	1.325	0.265	
Internships/practicum programmes	7.00	7.35	7.17	7.21	7.21	0.246	0.864	0.390	0.760	

Note: [a]Asymptotically F distributed.

4. Conclusions

The results of this research provided empirical support for the two study hypotheses (H1 and H2). With regard to H1, it was possible to conclude that the relative importance of five out of the nine university selection criteria considered varied according to the to the field of study at high school. The most noticeable differences specifically appeared among social sciences students and those from other fields. Career-focused degrees — such as business, education and law — are more prevalent at less selective schools than are pure sciences degrees. Some

previous studies emphasize the relevance of studying the connection between degrees and fields of study at the graduate degree level (Becker &Toutkoushian, 2013). With regard to H2, the size of the municipality of residence had a significant impact on almost all the university selection criteria, with the sole exceptions of high school teachers' advice, study abroad programs and intersihips/practicum programs. These results are consistent with previous studies that have highlighted the importance of the environment of residence (rural versus urban) in the choice of university (Rosvall, 2020).

The discovery of differences or similarities between disciplines and students' sociodemographic backgrounds are a foundation on which many questions related to communication strategies could be analysed, in addition to the nature and composition of the organizational structure of multidisciplinary HE institutions. From a practical point of view, the results obtained are useful for the design of HE institutions' communication campaigns. On the one hand, the field of study and the environment of residence are two potentially relevant criteria or segmentation bases for the design of marketing strategies aimed at attracting prospective university students. On the other, the effectiveness of a specific communication tool used to to reach a particular target audience could be improved if the relative importance of the different university selection criteria were taken into account.

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The effect of an online active learning-based course on approaches to teaching

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Abstract

The quality of teacher training research postgraduate (RPg) students receive is highly likely to determine the quality of teaching and learning they will provide when they are given teaching duties. Designing and developing such a teaching development course is considerably challenging, particularly if it is fully online. Owing to its focus on student learning, we integrated group learning, case-based learning and technology-enhanced learning approaches of active learning into an online Professional Development (PD) course at a university in Hong Kong. The course intended to enhance RPg students' student-focused teaching approaches which, in turn, would help their students demonstrate high academic performance and achieve learning objectives. We relied on the concept of teaching approaches to build the theoretical foundation of this study and used Approaches to Teaching Inventory (ATI) to test the effectiveness of the PD course in improving the RPg students' teaching quality. The quantitative analysis of the survey conducted showed that there was a significant increase in both Conceptual Change/Student Focused (CCSF) and Information Transmission/Teacher Focused approaches to teaching among the RPg students. The results provided opportunities to make informed decisions for further enhancement of the course design and start a new potential dialogue in studies of teaching approaches.

Keywords: *Approaches to teaching; active learning; student-focused learning; online course design; professional development; teacher training.*

1. Introduction

It is widely acknowledged that there has been a transformation in higher education teaching and learning from an instructor-focused approach to a learner-centered approach (Barr & Tagg, 1995). Such paradigm shift is a result of evidence from the fields of Learning Science, Cognitive Science and Educational Psychology that supported the effectiveness of active learning in facilitating student-centered learning to achieve educational objectives on all levels of education (Michael, 2006). As a constructivist method, active learning emphasizes the importance of focusing on what the student learns and how, rather than the methods and materials the teacher uses to teach. There are several categories of active learning that effectively support student-centeredness of the teaching and learning process (Harold & Joel, 2003). Referring to the principle of 'teach as you preach', Struyven et al. (2010) found that there was a strong relationship between the methods of teaching and learning used for training pre-service teachers and their perceived approaches to teaching. The authors explicated that the pre-service teachers' tendency to implement a student-centered teaching approach was a result of them receiving student-activated teaching during the training. Several studies supported the linkage between the quality of teacher training and approaches to teaching (Gibbs & Coffey, 2004). While the scientific community advocate the assumption that student teachers learn from the way they are taught and will apply the same teaching approaches when they are expected to teach in the future in traditional 'brick and mortar' universities, there is still a strong need for empirical evidence to support such claim within virtual realms of higher education. Therefore, this study aimed to help enrich the literature by investigating how the online active learning-based design of a Professional Development (PD) course would shape research postgraduate (RPg) students' approaches to teaching. By adopting some of the active learning approaches in its fully online design, the PD course planned to develop a more student-focused teaching approach among the RPg students than a teacher-centered approach. The extent to which the RPg students adopted a more student-centered approach or a more teacher-centered approach was evaluated using Approaches to Teaching Inventory (ATI) by Prosser and Trigwell (1999). In the following sections, the theoretical background and relevance of ATI will be explored thoroughly followed by a detailed description of how the online PD course incorporated active learning approaches to equip the RPg students with student-focused teaching methods.

2. Approaches to Teaching

The concept of Approaches to Teaching was initiated by Prosser et al. (1994) who studied the main variations of 24 university science teachers' conceptions of teaching and identified the following five main categories: (a) teaching as transmitting concepts of the syllabus, (b) teaching as transmitting the teachers' knowledge, (c) teaching as helping students acquire concepts of the syllabus, (d) teaching as helping students acquire the teacher's knowledge,

and (e) teaching as helping students develop conceptions. The end result was the construction of ATI with two main scales of Information Transmission/Teacher Focused (ITTF) and Conceptual Change/Student Focused (CCSF) with overall 16 items (Trigwell et al., 1999). While self-descriptive, the ITTF approach is concentrated on transferring factual information to students without consideration of their prior knowledge and the importance of active learning whereas the CCSF approach is to help students construct their knowledge actively and the teacher is there to facilitate the learning process (Trigwell & Prosser, 1996).

When preparing the theoretical background of the study, we faced the issue of limited up-to-date literature on the influence of teaching development courses on approaches to teaching (Gonzalez, 2009). Though dated and little, the existing literature on the use of ATI to measure the effect of PD and training courses on teaching approaches helps shed a fair light on the common trends in the area. Struyven et al. (2010) studied the effect of a 'student-actived' course design on child development on Year 1 pre-service undergraduate students' perceived approaches to teaching in comparison to the impact of a traditional lecture course that taught the same subject. Although both groups achieved statistically significant differences between the pre-test and the post-test, the authors found that those who received the traditional lecture treatment demonstrated higher results than their counterparts in the 'student-activated' group in both CCSF and ITTF. In contrast, Gibbs and Coffey (2004) reached different results from a year-long investigation of teaching approaches of newly appointed teachers who received teacher training and those who did not. While the training group achieved a significant shift in CCSF, the control group showed no noticeable changes in either CCSF or ITTF. In a similar study, academics from 7 research-intensive universities in the UK were invited to complete the 22-item version of ATI (Trigwell & Prosser, 2004) before and after completing an accredited teaching development programme (Hanbury et al., 2008). The findings showed that the participants perceived their teaching approach to be more CCSF and less ITTF after the completion of the training. Similar findings were reported in Finland where 200 university teachers with different years of work experience scored significantly higher in CCSF and lower in ITTF after completing pedagogical training than before (Postareff et al., 2007). While these past studies are relatively informative with regards to the appropriate use of the inventory, we could not draw direct parallels between them and the PD course design being evaluated in this paper due to lack of relevant and up-to-date literature. Therefore, this work aims to fill the literature gap by investigating the role of the active learning-based fully online PD course in shaping the RPg students' perceived approaches towards teaching.

3. Active learning-based course setting

The PD course consists of five modules providing an introduction to teaching and learning in higher education and is a graduation requirement for all RPg students at the university. The course is conducted to better prepare RPg students for their Graduate Teaching Assistant

(GTA) duties which include teaching undergraduate students as tutors. After completing all the course requirements, RPg students proceed to carry out their GTA duties arranged by their home department. In outlining the alignment between certain active learning approaches and the major elements of the PD course, we follow the categorization proposed by Harold and Joel (2003): case-based learning, group learning, and technology-enhanced learning.

3.1. Active learning through case-based learning

In case-based learning, knowledge and skills are constructed through the process of solving complex, real-life problems which the learner will encounter and be expected to solve in the future (Harold & Joel, 2003; Williams, 1992) such as the GTA duties. The learning activities and assessments in the PD course are designed to develop active teaching techniques in a learner-centered classroom (Module 1) by adopting effective presentation and facilitation strategies (Module 2) and giving constructive feedback to students (Module 3). They also need to master the use of Canvas[1] (Module 4), the Learning Management System adopted by the university, before consolidating the teaching and learning principles in a peer-evaluated micro-teaching session (Module 5). Micro-teaching is the most important learning exercise of the course that encompasses all five modules and functions as the final assessment task. The design of micro-teaching reflects the GTA duties which involve designing learning activies and materials, delivering tutorials, evaluating student performance, and providing timely and constructive feedback.

3.2. Active learning through group learning

Most of the learning activities and assessments of the PD course are designed for group learning. Six to seven students from similar disciplines were grouped together throughout the course duration. The rationale behind putting students with identical backgrounds into groups was to allow them to have more in-depth discussions and collaboration when completing the online synchronous group learning activities and designing the final micro-teaching demonstration. The online group learning activities entailed intensive communication, collaboration, and negotiation among group members. For instance, in the activity of developing Intended Learning Outcomes for the 50-minute tutorial, team members discussed each others' ideas, evaluated their pros and cons, debated and negotiated to come to an agreement on the final response. During the process, we believe that group learning enabled the students to learn from each other, develop soft skills, and engage actively with the learning materials, all of which support active learning (Harold & Joel, 2003).

[1] Canvas is a learning management system (LMS) for instructors to design interactive courses by customizing course content, quizzes, discussion and others.

3.3. Technology-enhanced active learning

Due to the COVID-19 pandemic, the university shifted all the teaching and learning activities to an online mode in the Fall semester of 2020. The previously flipped design of the PD course was adjusted to be delivered fully online; while the pre-class and post-class materials and activities were already made available for self-paced online learning, the in-class components were redesigned for weekly online synchronous sessions. Prior to the synchronous sessions, the students were to cover all the learning materials such as lecture videos and supplementary readings on Canvas. Also, they were given online knowledge-check quizzes to complete.

The PD course facilitated a highly interactive online learning environment for students to actively engage in. Zoom[2] was used to conduct the synchronous sessions as well as breakout room group discussions while Miro[3] was adopted for groups to draft their ideas in the in-class activities, document assignment progress, and prepare the final micro-teaching lesson plan. On Miro, each group was allocated a separate 2D box-shaped working board area for virtual collaboration and co-creation. In each module, there were three learning activities for groups to work on through discussion and application of the theories and concepts learned. The use of Miro in the online course not only provided the students with the opportunity to co-create and learn from each other but also allowed them an authentic experience of facilitating an active learning environment, which is valuable for their future teaching.

4. Methodology

4.1. Participants

The RPg students enrolled in the PD course in the Fall semester of the 2020-2021 academic year at a university in Hong Kong were invited to participate in this study. There were 656 students enrolled in the course divided into 6 cohorts. The gender ratio in the course was 66% male students to 34% female students. The students were from various PhD and MPhil programmes across Schools of Science, Engineering, Business and Management, Humanities and Social Sciences as well as interdisciplinary institutes of the university. The response rates of the pre-test and the post-test surveys were 57% and 37%, respectively. After data cleaning and matching, it was revealed that 193 students responded to both pre-test and post-test surveys which was equal to 29% of the course population. Of the 193 participants, 22.8% reported having some level of past teaching experience while the other 77.2% had not had

[2] Zoom is a video conferencing software that provides a video chatting service to multiple participants concurrently.

[3] Miro is an online collaborative whiteboard platform that allows users to co-create on a canvas-looking whiteboard in real-time.

any prior experience in teaching. Most of the survey participants were from School of Engineering (50.3%), School of Science (21.2%) and Interdisciplinary Programs Office (9.8%). Compared to the total course population, there was a fair representation of the mentioned schools of the university by the 193 participants.

4.2. Survey procedure

An online version of ATI was distributed to the RPg students before and after the course. In both cases, due to the fully online nature of the course, the survey link was placed on Canvas. The students were then invited to complete the survey voluntarily. Consent was granted by the survey participants regarding the use of their course enrolment data and survey responses for research and publication. IBM's SPSS Statistics 26.0 was utilized to carry out the quantitative analyses of the data collected.

5. Results

5.1. Internal Consistency of ATI Scales

In order to check the internal consistency of ATI with the target group, Cronbach's alphas of ITTF and CCSF were calculated for both pre-test and post-test surveys. The results showed that ITTF and CCSF demonstrated $\alpha = 0.73$ and $\alpha = 0.73$ in the pre-test and $\alpha = 0.81$ and $\alpha = 0.79$ in the post-test surveys, respectively. Alpha scores of 0.7 to 0.8 are commonly considered acceptable in social science research (Bland & Altman, 1997).

5.2. Changes in Approaches to Teaching

The RPg students enrolled in the PD course were invited to complete ATI before and after the course in the Fall semester of the 2020-21 academic year. Paired sample t-tests were conducted to confirm if there had been any significant changes in the RPg students' approaches towards teaching. It was discovered that there was a statistically significant difference between the pre-test ITTF and the post-test ITTF at $t(191) = 5.44$, $p < .001$. However, it was also observed that CCSF achieved a statistically significant shift between the pre-test and the post-test surveys with $t(191) = 6.13$, $p < .001$. The details of the t-tests are given in Table 1. It is worth pointing out that the change in CCSF managed to achieve a statistical significance despite extremely high mean scores in the pre-test survey.

Table 1. Paired samples t-test results of ITTF and CCSF.

Scales	Mean	Mean Differences	Std. Deviation	t	p-value
Pre-test ITTF	3.60	-0.27892	0.70984	5.445	.001
Post-test ITTF	3.88				
Pre-test CCSF	3.95	-0.24689	0.55764	6.135	.001
Post-test CCSF	4.20				

6. Conclusions

Three active learning strategies were incorporated into the fully online design of the PD course with the intention of facilitating student-centered learning which, in turn, was expected to result in the development of CCSF teaching. The influence of the active learning elements on the RPg students' approaches to teaching was studied using ATI. The results showed that the students significantly improved not only CCSF approaches but also ITTF approaches to teaching. While the remarkable increase in CCSF was projected, a comparable trend in ITTF was not. The findings of the study are valuable in identifying which aspects of the PD course design are in parallel with the learning objectives and which areas still have room for improvement. They help the course team approach further enhancement of the online active learning design from a top-down approach as its general characteristics with regards to shaping RPg students' teaching approaches have been well uncovered. Having said that, a further empirical study of the underlying variables that determined the quantitative results is required, particularly the areas that could help explicate the improved ITTF among the RPg students after taking the course. It will also help to conduct a thorough qualitative evaluation of the course components and objectives as well as students' perceptions of approaches to teaching. In the meantime, the existing literature helps interpret the outcomes of the current quantitative analysis. Having studied the relations between teachers' approaches to teaching and their students' approaches to learning, Trigwell and Prosser (2004) concluded that the results deriving from ATI should be viewed from a contextual and relational perspective and that "the approach adopted by a teacher in one context may not be the same as the approach the same teacher would adopt in a different context." (p. 420). With respect to the main characteristics of differing teaching contexts that dictate which approaches to teaching are adopted, Prosser and Trigwell (1997) explained that those teachers who had appropriate teaching workload, homogenous and competent students, a manageable class size and a certain level of control over the teaching content tended to follow CCSF while those who neither saw a real commitment to teaching nor had control over what was taught were more inclined to adopt ITTF. In addition to the mentioned factors that determine which teaching approaches are preferred, it will also be worth investigating the role and

influence of fully online course delivery and design where applicable. Such analysis is of a particular importance at the moment where conventional teaching and learning practices are not necessarily guaranteed and the only affordable method is through virtual means.

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Fostering Research and e-Learning-Communities' Integration: a MOOC on the project DETECt

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Abstract

This paper provides an overview of the methodologies and infrastructures used to build a MOOC based on the European Union's funded project DETECt. Despite the many advances in terms of course architecture and improvement of the learning tools, the question around the right methods and approaches to design humanities-oriented MOOCs is still very debated. This research project aims to open up the traditional implementation of e-learning environments, which are often based on the use of conventional educational approaches and tools, through the combination of a multi-layer, research-oriented learning platform and blended pedagogical approaches.

Keywords: *Massive Online Open Course (MOOC); e-learning; teachers; learners; education.*

1. Introduction

This paper aims to explore the current development of a specific MOOC concept that interprets the research outcomes and educational goals of the project DETECt - Detecting Transcultural Identity in European Popular Crime Narratives (https://www.detect-project.eu/), funded by European Union's Horizon 2020. The intention is to build an e-learning environment that challenges and overcomes the traditional, lecture-focused e-learning setting commonly implemented by the leading MOOC platforms.

Despite MOOCs' opening up to new alternatives within the creation of more subject-shaped and interactive learning environments, their still predominantly textbook structure represents nowadays a challenge for the designing of highly interactive settings, needed for instance by humanities/literature-based MOOCs (Peng 2016). In particular, in the framework of this project, the educational approaches offered by the edX platform, on which the MOOC on the DETECt project is based, presented several discrepancies with our original educational targets posing a challenge on the pursuing of our goals. This points on the creation of an interaction between the public and the DETECt research community as well as between educators and learners.

The model presented in the context of this research paper focuses on the creation of a MOOC that questions the e-learning and e-teaching tools offered by the edX platform. These are generally anchored on the use of a unique platform and a traditional -limited set of activities. On the contrary, our purpose is to go beyond these fixed elements and to develop a multifaced environment that connects better with the actual research practices and environment to upgrade learner's engagement and interactivity while strengthening the DETECt learning community.

2. Creating a MOOC on literature and media: the DETECt project

DETECt - Detecting Transcultural Identity in European Popular Crime Narratives (https://www.detect-project.eu/) is a large collaborative project funded by the European Union Horizon 2020 Research & Innovation Program. Grounded on the cooperation between top researchers and professionals from eighteen different European universities and institutions, the project aims to draw public attention to the role played by European crime narratives in the creation and representation of a European cultural identity. Through the investigation of a selected corpus of literary and media crime narratives produced in different European countries from 1989 to the present, the main goal of DETECt is to investigate how the dissemination of the European popular culture was influenced by media and literary co-production, serialization, translation, adaptation, or distribution. The core of the project is represented by the diffusion of the acquired knowledge through a rich program of cultural, learning, and public initiatives.

Among the multiple initiatives developed by the project, DETECt has the purpose to bring its research outcomes to a larger audience and broaden its online learning community through the creation of a MOOC on European crime fiction called "Euro Noir: Transcultural Identities in European Popular Crime Narratives". This will be addressed both to users with an academic background and crime fiction enthusiasts. Developed by teachers from six universities (KU Leuven, University of Bologna, University of Limoges, University of Debrecen, University of Bucharest, University of Aalborg) of the eighteen partner institutions that are part of the project, the MOOC aims to lead the students to the discovery of crime fiction features and influences in several European countries. For this purpose, the MOOC was not only conceived as the result of a highly collaborative environment among the educators, but also as an interactive, non-static ecosystem built on a combination of different levels with the main goal to support the users' learning engagement and knowledge construction .

The MOOC development process is currently managed by KU Leuven. As a longstanding partner of the edX consortium, KU Leuven will host the MOOC on its edX platform "KULeuvenX" (https://www.edx.org/school/kuleuvenx). The creation of this edX course required not only the contribution of the six university partners, which were involved in the creation of their module and their teaching material, but also a specialized development team that comprehends experts in ICT e-learning platforms, scenario writers, video artists, educational professionals, and support staff.

3. Overcoming the traditional MOOC models: challenges and methodologies

One of the primary challenges related to the creation of a MOOC lies in the necessity of creating and designing a learning environment that is capable of having a positive and effective impact on the distance learning process (Phan 2018).

Besides, it should succeed in enriching the students with solid expertise on the topics explored in the course (Mullen and Milechin 2018). Although the development of a high variety of MOOC models and the distinction of two different main approaches (the connectivist model applied the cMOOC and the behaviorist model applied to the xMOOC) tend to offer more versatility in terms of learning design (Mary Queen and Vel Murugan 2020), there continues to be a lack in terms of pedagogical flexibility when it comes to shaping the learning approach in accordance to the subject on which the course is based (Peng 2016). For instance, none of them seem either to discern between humanities and scientific-pedagogical approaches or to recognize the necessity of adopting this distinction (Peng 2016).

This tends to limit the possibilities of offering a more pedagogically structured environment centered on the teaching and learning of a humanities subject (Peng 2016). In this framework,

further critics are related to the lack of equilibrium between MOOCs' pedagogic, technological and organizational dimensions, as well as to the fixed nature of the MOOC environment which limits the course's interactivity (Atiaja and Guerrero-Proenza 2016).

To overcome these challenges, and going beyond the staticity offered by edX as a platform we developed a new formula combining two different strategies:

1. Adoption of the KU Leuven methodology for the designing and building of MOOCs, based on centered and robust pedagogical support. This resulted essential in the creation of an environment shaped on the educational goals and the subject explored by DETECt.
2. The integration on the same edX platform of aspects belonging both to the xMOOC and the cMOOC. This enabled the creation of a flexible environment where the traditional education structure is blended with openness, connectivism, and participatory teaching.

The combination of these two methodologies was once again shaped to create a sort of synergy between the MOOC public and the DETECt environment on one side and among teachers and learners on the other side.

3.1 Learner's Approach

Students' engagement in the e-learning platform context has represented the core point of many research studies since the spread of the MOOC as an educational concept (Xing et al 2020). Some of the elements that distinguish the MOOC -such as the independent remote learning, the student's background and culture disparity, limited student/teacher interaction - have often been considered a limitation to the effective delivery of the traditional educational objectives (Phan 2018). This debate is certainly still open especially as far as the effectiveness and quality of humanities-based MOOC is concerned and whether they can represent a good space for developing and practicing critical thinking, speaking, and writing skills (Peng 2016).

The question around the best way to leverage the many potentialities of the online environment, offering a learning experience that could go beyond the traditional -platform-based- space offered by edX, was also at the base of the building process of the edX course on European Crime Fiction. The purpose was not only to successfully convey the research outcomes of the DETECt project but also to ensure the learner's knowledge construction and elaboration.

For this reason, we chose to challenge the main tendency to employ edX as a unique e-learning platform for the users. Instead, we adopted a multi-layer ecosystem which includes

as part of the learning package, the combination of the MOOC platform together with several external environments developed for the DETECt project:

- The DETECt Portal: it is conceived not only to contain research outcomes of the project but to be the core of the learning community. Through the portal it is possible to access the research data, further learning material in form of videos, articles, interviews, etc., as well as the DETECt web app.
- The DETECt Atlas: a consultable analytical atlas of European crime fiction. It contains multiple interactive graphs realized using tools (e.g. Gephi and Tableau), which help understand crime fiction transmediality throughout Europe.

The combination of different environments has not only the purpose to integrate and support the MOOC educational structure but also to upgrade the learning process with further interactive elements. This structure is strengthened from a pedagogical point of view by the use of Digital Humanities tools to support students' engagement within the online course.

3.2. Teacher's Approach

Although their role in the context of the MOOC development and design still results partially underrated, teachers' contribution is essential to the process of knowledge construction and creation (Ross et al 2016). Educators and learning designers do not only have to create a coherent educational framework but they also have to make it suitable for the e-learning and individual learning context (Ross et al 2016). In this process, an essential element is further represented by the collaboration between the teachers.

For this purpose, within the framework of the MOOC development based on the DETECt project, it was created a Moodle instance linked to the main DETECt platform (https://www.detect-project.eu/portal/learning/). The Moodle is conceived as a content repository for the unique use of the teachers involved in the project, and developed as a testbed platform for the final use of the MOOC platform. In the last two years, the Moodle platform was continuously enriched with content that would be re-shaped and re-elaborated, and used as learning material.

Such a setting would guarantee preliminary testing of the interaction between the students and the content, as well as the communication for the educators in terms of design and refinement of their learning approach and modules structure. This represented an essential element not only to ensure a smooth collaboration among the educators as far as the design process of the course was concerned but also to rely on an external environment that could serve for the preparation of the learning material.

Chief in this regard was the management of the intercultural and multilingual features of the consortium. Although the theme of "Euro-Noir" is a truly European given (there are no EU countries that do not participate in this new "brand" of crime fiction) and although many

works, be it books, TV series or movies, easily migrate from one country to another, the huge presence as well as the wide circulation of this material reveal both the emergence of a common cultural space in Europe and the importance of strong local (national, regional, and even subregional) traditions, habits, preferences, uses and creative reuses of the non-local "import". "Euro-Noir" is a good example of glocalization, yet in a very particular way. Given the production and commercialization costs of most works, certainly in the audiovisual sector but also in the literary domain "Euro-Noir" productions need to be sold abroad, and therefore local producers (be it a television station in Danemark, a publisher in Bucharest or a film company in Berlin) try to cater to local as well as the global (EU and non-EU) audiences, yet not by wiping out the local characteristics (as was done for many years in, for instance, Belgian comics), but on the contrary by dramatically highlighting these local features. However, the success of this glocalizing strategies which link a "universal" theme (crime) with highly local features, does not involve that all products are received by all audiences, and even less that they are interpreted in similar ways: there remain a lot of cultural and linguistic barriers, that make that not all "Euro-Noir" works are the same. In order to tackle these issues in a creative manner, the DETECt MOOC has not only focused on the international success stories but also made room for productions that have difficulties in crossing regional, national, and linguistic borders. Moreover, the MOOC also demonstrated the differences within each of these two categories: the success of The Bridge TV series is not that of the Montalbano brand, while the reasons that prevent female Flemish authors to be read abroad are not the same as the one that limits the audience of certain Eastern-European writers. It was the international composition of the DETECt consortium, but also the already existing collaboration between most of their members and the long-standing tradition of student and teaching exchange that allowed the project not to skip these differences and to convert them into a central focus of the learning experience.

4. Conclusions

The strategies described in this paper and adopted for the still ongoing development of a MOOC on "European crime fiction" based on the project DETECt, want to represent a possible way to confront the many challenges and- at the same time - emphasize the opportunities that e-teaching and e-learning humanities pose. With this research project, we aimed to highlight on the one hand the relevance and necessity to enhance the dialogue between the research and learning community, fostering the accessibility of the academic research. On the other hand, we expect to offer an example of how alternatives in the expansion of the "traditional" MOOC formula could promote the aperture to new educational solutions within the MOOC concept. Although the project is currently in progress and therefore the lack of data does not allow yet to fully evaluate the outcomes of these investigation, we expect to find in the limitation of the edX platform and especially in the

difficulty of establishing fluid discussions and partecipations through the internal forum, the main obstacle to the adoption of a social network approach that should ease the creation of a learning community. However, at the same time a comparison with the already completed MOOC on "Creating a Digital Cultural Heritage Community" created with the same educational methodologies and approaches developed for the MOOC based on DETECt, it is already possible to predict a positive response from the students in the engagement, interaction and involvement with the learning content both inside and outside tha platform.

The future phase of this research will consist in the analysis of the edX learning analytics as well as in the creation of a final survey. These intend to investigate students' behavior and engagement and will represent the natural following step of this study.

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Partnerships and Pedagogy: Transforming the BA Online

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Abstract

There has been much written recently round the "digital revolution" of universities (Nascimento Cunha et al*., 2020). Indeed, in 2020 the COVID-19 pandemic demonstrated the need for universities to adapt and adopt new technological tools for teaching and learning, as both the global world we live in changed, and as students adapted to the continually evolving digital landscape. The BA Online is a new interdisciplinary online presence for the humanities and social sciences, and includes a focus on constructive alignment, innovative learning objects, and social learning. The semester-long courses were built as a supported social learning experience that is purposefully constructed with a narrative. This article reveals how the BA Online project was realised through the use of partnerships, particularly that of the university learning designers who worked very closely with both the online learning platform FutureLearn and academic staff in curriculum design and course transformation.*

Keywords: *Online learning; partnerships; pedagogy; digital learning; TEL; learning design.*

1. Introduction

The pre-2020 landscape for online learning in the global higher education sector suggested that universities were facing new challenges to formats, delivery modes and student experience outcomes. The arrival of COVID-19 intensified these demands. Some commentators are positing this as a multi-faceted transformation of education, a set of changes happening across technology and degree models, as well as educational offerings from non-university higher education providers (Nascimento Cunha *et al*., 2020). A sustained interest in massive open online courses (MOOCs) over the last decade has morphed into debates about "unbundling learning" (disaggregating qualifications into their component parts). Recently, the conversation has been directed at how technological "disruption" is changing the higher education sector. Disruption is transformational and problematic for the sector because it challenges some precepts of the higher education institution as a space and place of learning, especially following decades of investment in on-campus student experiences. The disruptive technology involved in online learning "is at work in higher education, allowing both for-profit and traditional not-for-profit institutions to rethink the entire traditional higher education model. Private universities without national recognition and large endowments are at great financial risk. So are public universities, even prestigious ones" (Christensen & Eyring, 2011, p. 18). If this threat of dramatic change to the sector is realised, we can assume we need to continue to think about the role played by open online courses and other online study options.

Bachelor of Arts (BA) degrees in Australia have received much attention over the past decade. National research about the value and relevance of the undergraduate "liberal arts" in the Australian context reveals the need for new pedagogical approaches (see Gannaway, 2015). There is also recognition for the degree competencies in the current higher education context, including support from business, science, and technology leaders (Doidge & Doyle, 2020). Challenges include thinking about new ways to present disciplinary content. At the University of Newcastle (UON), the BA degree program needed reinvention to meet the manifold challenges facing the humanities and social sciences (HASS) sector at large, including shrinking funding pools and fluctuating enrolment numbers (Turner & Brass, 2014). This process of change had been progressively in motion at UON since 2016. This meant teamwork to redesign the core curriculum of the degree and innovate teaching approaches, including a strong emphasis on multidisciplinary, inquiry-based and social learning. These processes allowed the team—comprised of professional and academic staff from different areas of the University, mainly HASS and the University's learning and teaching unit, Learning Design and Teaching Innovation (LDTI)—to introduce new intellectual and creative energy into a long-established degree program. Transformation of the degree required specific interventions including engaging with new digital online learning platform and external partner, FutureLearn. This article showcases the project we

commenced in partnership with FutureLearn, and reflects on this relationship to date and its teaching and learning outcomes. By making UON's processes and partnerships visible—and the lessons learned along the way—we aim to inform other universities' efforts to rejuvenate HASS programs.

The project required the identification of majors for online delivery and signalling a new identity for this degree for global and national learners. The process of designing courses for online delivery, creating quality content, and embedding intuitive interaction has been a collaborative project operating at scale. In particular, we focus on the role of the university learning designers who worked closely with the FutureLearn platform, encouraged academic staff involved in curriculum design and transformation, and were deeply involved in decision-making informed by expectations surrounding quality assurance. FutureLearn's pedagogy-first philosophy enabled fresh ways of imagining the teaching of humanities content and assessment, including developing and employing online curriculum design principles. In this article, we outline the process of developing UON's online BA degree, our collaboration with FutureLearn, approaches in collaborative design within the institution, and the project's broader implications for pedagogy and online learning in humanities.

2. The FutureLearn Partnership: A new BA (online)

Recently, there has been a shift of focus for the education technology sector from *what* and *how* each technology might "disrupt" the higher education sector to "much more about **how** the teaching and learning process is being changed by edtech" (Field, 2019, para. 1). This means educators must now knowingly make choices in their teaching design about how content, learning outcomes, and assessment are constructively aligned (in other words, aligning teaching and assessment to the outcomes we want students to achieve). Hunt *et al*. (2012) address shifts in higher education that have resulted in increased engagement with online learning, arguing pedagogy is shaped by both physical and virtual spaces. Examining a case study at the University of Southern Queensland, the authors note the importance of deliberate design with consideration to pedagogy. Online learning has been increasingly celebrated, but also scrutinised, as universities seek to develop meaningful learning experiences for students in the context of learning with digital technologies. Using a case study from the University of Leicester, Salmon (2011) identifies and evaluates the processes involved in designing and executing a new learning innovation strategy focused on online learning. She emphasises the need for a combination of radical and incremental innovation. Here, Picciano (2017) proposes an integrated model for online education, which requires "the phenomenon of pedagogically driven online education. Key to this model is the assumption that online education has evolved as a subset of learning in general rather than a subset of distance learning" (p. 187). One way the humanities disciplines at the University of Newcastle are embracing and leading in this field is engaging with technology-enhanced

learning that is driven by strong pedagogical design for social learning. It is clear from the literature—and our experiences in this space—that it is important to assert that academics should not consciously use technology for its own sake, but rather to think about equitable access to quality education with a good student learning experience at the centre of learning design.

The pursuit of pedagogy-led online learning brought UON into partnership with FutureLearn. Launched in late 2013 by Open University (UK) with only "open courses" (MOOCs), in recent years it has broadened its range of education options with degrees—mainly postgraduate—and more recently, microcredentials. Pedagogy is at the fore of FutureLearn's research and development, with partners encouraged to adopt the platform's social learning philosophy. FutureLearn has expanded its footprint in Australia in recent years, partnering with 17 Australian universities at the time of writing. The principles the platform is designed around are "learning through storytelling", "discussion for learning", "visible learning", and "community supported learning" (FutureLearn, 2020). In other words, FutureLearn has been intentionally underpinned by a social constructivist approach (Swinnterton *et al.*, 2017).

The University of Newcastle signed with London-based FutureLearn in mid 2018 with the key intent of utilising the platform for the delivery of four majors of the BA Online. An objective of the BA Online is to offer a contemporary, multidisciplinary degree that widens avenues for higher education participation, especially for non-traditional students. The renewed degree enables this access by affording greater flexibility in delivery mode. Additionally, it includes a focus on constructive alignment and innovative learning objects with high production values. This was also a new endeavour for FutureLearn: the BA Online was their first undergraduate degree. The partnership was realised with the launch of the first 6 courses in early 2019 (Semester 1 in Australia); in total, 35 courses are scheduled to launch over the 3 years of the project. (Courses are 12 week semester-long units of study). The scale and newness of this project were daunting, but moving to an online degree with FutureLearn was necessary to increase high-quality, online, and flexible study options for our incoming and current students.

2.1. Moving the BA degree online

A Bachelor of Arts is traditionally a flexible degree in terms of course selection, essentially allowing students to create their own path. The BA Online at UON is a degree for students interested in studying a selection of majors, minors and courses fully online. Students can either opt to take their degree completely online, or choose some online courses and some face to face, giving students flexibility. The courses for the four majors—Film, Media and Cultural Studies; English and Writing; History; and Sociology and Anthropology—and the BA core courses are being progressively developed and delivered between 2018 and 2021. Integrating FutureLearn into existing enrolment and teaching systems has its challenges.

Therefore, courses on the platform still launch from the learning management system (LMS), which is used for summative assessment and for administrative tasks, whereas FutureLearn is used for content delivery and discussion.

Courses redesigned for online delivery via FutureLearn comprise specific learning components (see Fig. 1). For example, each course has four modules (each 3 weeks long). The majority of the first-year courses also have the first module as a "open" course on FutureLearn. Both UON students and FutureLearn learners have access to this 3 week module. The other three modules are "closed" or "for credit", where learners need to be UON students (Award or Non-Award) to be able to complete the final three modules of the course.

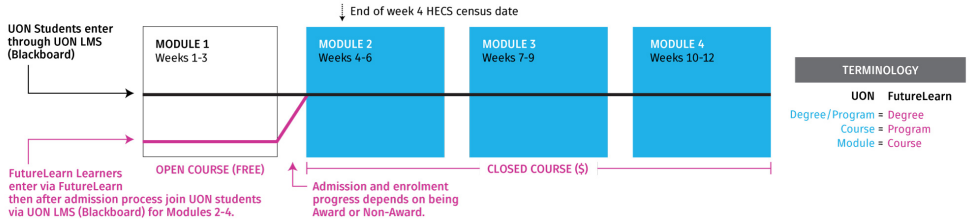

Figure 1. Diagram showing the student entry points for the BA Online at the University of Newcastle.

2.2. Transformative Practices: The Role of Learning Designers

Developing online courses with experienced academic staff can create challenges that arise from seeking to change embedded teaching practices in a domain in which they are well established and/or credentialed. Indeed, working with academic resistance and indirectly furthering educator development are topics that would benefit from further enquiry. In the traditional lecture theatre or tutorial space, academics are generally unused to another party reviewing their course content and teaching style and recommending best practice (Brigance, 2011). Additionally, teaching staff who are unfamiliar with online course delivery often have little insight into what learning designers can do to help them to facilitate involved and interactive learning experiences (Hsu, 2020). The complexity of designing learning for online environments at the tertiary level is summed up by McInnes (2019):

> The ability to produce instructor-centric multimedia, which cuts together content-centric materials as necessary, is a resource-intensive process which requires a significant amount of planning, time and training. Whilst this is a process that is ideally suited to the supportive nature of the collaborative team approach, it is a complex process and as such the resource constraints of large-scale intensive curriculum development mean that developing instructor-centric styles of multimedia can be difficult (p. 10).

Sims *et al.* (2002) argue that planning and design in online learning needs to involve proactive evaluation and participatory partnerships. This means, personnel involved in course design—

both learning designers and course coordinators—should develop a shared understanding of the design steps needed to accomplish "the complex interaction between disciplinary content, learning outcomes and online learning environments" (Sims *et al*., 2002, p. 137). One of the most significant pedagogical challenges we faced in transitioning humanities courses to FutureLearn lay in what we call "unbundling the traditional humanities tutorial". This meant that we had to adapt the traditional Socratic method of tutorials and lectorials to an online-only learning environment. The Socratic method, as the name suggests, revolves around Socratic questioning—challenging students' thinking through a series of questions designed to elicit more than yes/no responses, probing their answers with further enquiries, and ultimately encouraging them to defend or change their position. While Socratic questioning can prove effective in online teaching (Picciano, 2017), issues can arise when considering the asynchronous learning style encouraged by FutureLearn.

The role of the learning designer and their relationship with the course coordinator in this project has been significant. Hsu notes that although the learning designer's "role and the composition of their tasks might vary across institutions, their involvement in helping faculty design and develop online or blended course content becomes vital" (2020, p. 50). The team has found little need to be too prescriptive with the type and style of planning, instead enjoying collaborative planning, modelling content design, and facilitating the planning phase through workshops and meetings, all of which have all been demonstrated to work. Individual academics have brought different experiences and challenges to bear on these interactions. The learning design team has arrived on standards for planning processes which are negotiated with the academics in a collaborative process. Courses with multiple people involved in the planning especially demand a cloud-based document-sharing platform for content decision-making. Otherwise, we suggest, the task of planning a course becomes unmanageable and challenging to replicate at scale.

Incorporating pedagogy at the core of development of courses, the learning designer worked collaboratively with the course coordinator in workshops to develop or redevelop a course for an online learning context. The learning designer and course coordinator developed a course plan, modularising content, before breaking down the key concepts of each week. This plan was constructively aligned by jointly determining the learning outcomes of each week, dividing these into "activities". Each activity incorporated opportunities for active, social learning, as students were introduced to a topic by a video or text article, applied the concept, reflected on the topic, and produced outputs with their new skills. Regular opportunities for reflection, feedback, or further instruction were included, with in-built comment sections for each step. Some steps included discussion prompts to guide reflection, whereas others were left open to allow students to extend their ideas and facilitate open discussion. The learning designer and course coordinator developed videos, audio, text, and other multimedia. The learning designers sourced innovative digital tools, with an emphasis on those that were

genuinely beneficial or could be tailored to course aims and learning outcomes. These aided the asynchronous learning environment, where students could return to tasks and engage in social learning practices throughout the week.

Reflecting on experiences in the learning design phase is vital to ensuring the staff evaluated and evolved their approach from their own experiences and that of their team members, accommodating for a range of pedagogical approaches between academics. They reflected on student experience and feedback from surveys to review and update the courses. The project to reinvent the degree has also resulted in a tangible culture shift for academics in the institution who have been encouraged to think freshly about their pedagogies and disciplinary content.

3. Conclusion

Working on a large-scale online teaching and learning project requires a partnership approach, both between the university and the learning platform, and the collaborative relationship between academic and learning designer. The strengths of this approach are evidenced in the positive student feedback and experience. The collaboration between academics, the learning design team and FutureLearn has meant students' learning experiences have been transformed. It has demonstrated how learning in the online environment can be social, can be high quality and engaging. These partnerships have allowed for our own "disruption" of learning, employing innovative technology to reconsider how we teach the humanities in an evolving educational space. Additionally, the project placed the degree and teaching academics in a strong position for the required pivot in teaching during the COVID-19 shutdown in 2020.

Key takeaways from the project have highlighted the benefits and the importance of working with a whole program approach (and not just a single course) and the advantages of having a flexible and collaborative course development framework/method. Following the success of social learning on FutureLearn, and reinvigoration of their pedagogical approach, some academics have revisited their approach to teaching and learning in a face-to-face environment as well, incorporating the tools and practices used to create an informative social learning experience online in their face-to-face classes. The BA Online has been a force for a step change for staff and students alike, with the added benefit that learners become part of a global classroom in the open courses, meeting another aim for the BA degree in Australia—to internationalise our arts degrees. The collaboration between FutureLearn, academics, and the learning design team has meant students' learning experiences have been transformed. The University of Newcastle's BA Online proves that humanities learning in the online environment can be a social, high-quality and engaging experience.

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Designing Interactive Narratives for the Fashion System. MOOC and blended learning in a transdisciplinary design module

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Abstract

From distributed interactive narratives to games and playful systems, complex interactive projects challenge the fashion ecosystem introducing new possibilities that require innovative and transdisciplinary competencies to be adequately tackled. However, to properly deal with digital media, designers need to master their logic, potentialities, and implications. Therefore the urgency to include such knowledge in building, reframing, and implementing the curricula and design education of today's and tomorrow's fashion designers. This considers the complexity of getting acquainted and implementing vocabulary, design methodologies and practices from other fields of studies. This paper presents the lessons learnt from the first application of the MOOC "Data Science, Visualization and Interactive Narratives for CCIs" to an intensive design module in the Design for the Fashion System. Attention is posed on how it was included in a Blended Learning context to meet the scope and answer previously identified criticalities as providing knowledge from neighbouring fields, and to what extent it succeeded.

Keywords: *MOOC; blended learning; interactive narratives; transdisciplinary; fashion system; design education.*

1. Digital Media for the Fashion System: A Multidisciplinary Approach

The Fashion system is undergoing a major digital transformation, touching all its facets, layers, and processes. This situation progressively brings to a paradigmatic shift where the material and immaterial production of the fashion system is molded by and for the media (Rocamora, 2017), with digital media, mediatization, and its instances impacting and reshaping the field of fashion (Hepp, Hjarvard, & Lundby, 2015). In this scenario, companies and brands are trying to reach higher maturity levels about digital transformation and its implications for fashion communication. However, the gap between awareness and complete process integration is vast and asks for new professional figures able to exploit contemporary possibilities at best, guiding fashion into an aware implementation of possibilities and resources coming from contemporary media and emerging technologies. This means, for instance, being trained to catch opportunities coming from digital media, dealing with the creation of new narratives able to engage audiences. Therefore the urgency to include such reasonings in building, reframing, and implementing the curricula and design education of today's and tomorrow's fashion designers (Bertola & Vandi, 2020). To master logics, potentialities and implications of digital media, building on their affordances (Mariani & Ackermann, 2021; Harrell & Zhu, 2009), it is necessary to open to a variety of neighboring domains of knowledge (e.g., media studies and game studies) and fields of practice (e.g., storytelling and game design) while reaching out to scholarship in terms of branding, communication, and interaction design. In 2019, the "Advanced Interactive Narrative" (AIN) module was built to address this specific urgency.

Since the last decade, growing attention has been drawn to narratives designed to be distributed across media and games with communication purposes. The ground was particularly fertile due to the coexistence of the need to communicate brands and their values, and the new consumption behaviours that see active user engagement and participation as critical aspects (Mariani & Ciancia, 2019a). This condition further accelerated because of the covid-19 outbreak, which encouraged fashion companies to increase their efforts for transferring most of their business online while igniting a series of innovative experimentations. An example is *Afterworld: The Age of Tomorrow*, the game launched by Balenciaga for the Fall 2021 RTW Collection (videogame.balenciaga.com). Fashion design is thereby hybridizing its boundaries (Delgado-Ballester & Fernández-Sabiote, 2016; Fog, 2010) building imaginative universes of sense that can be actively explored by audiences. The result are multiple attempts of transmedia experiences, by nature articulated on multiple channels, platforms, and media, often shaped as interactive narratives and games, as instances that can be encountered at different times and with different shapes (Dena, 2009; Giovagnoli, 2011).

The first edition of the AIN module in AY 2019/2020 consisted of 8 lessons of 4 hours, all in presence. Although high-quality outcomes were achieved, students showed criticalities

regarding (i) getting acquainted with vocabulary, design methodologies and practices from other fields of studies, and (ii) understanding the logics and mechanics of complex interactive artefacts as interactive narratives and games. This resulted in a general difficulty in taking in such a high amount of information in a short time and being able to directly apply them for finding creative and innovative design solutions. To prepare the next generations to leverage on the vast and promising opportunities of digital media, coping with the emerging challenges (Kalbaska et al, 2019), the Higher Educational Institutions (HEIs) opened research lines and introduced approaches for providing students with transdisciplinary knowledge (Iannilli & Sancassani, 2020). Open Educational Resources, e-Learning, and Massive Open Online Courses (MOOCs) are being progressively integrated into HEIs, exploring innovative forms of pedagogies (Griffiths et al., 2015; Morris, 2014). Taking that into account, the second edition of the AIN module (AY 2020/2021) integrated a series of open-access lessons from the MOOC "Data Science, Visualization and Interactive Narratives for CCIs" (pok.polimi.it). Designed for introducing fashion designers to the realm of branding and narrative strategies, part of the MOOC explores storyworld building and interactive narratives for communicating brand values through digital media. Developed within the EU project DigiMood (digimood4cci.eu) (Bertola, Mortati, & Vandi, 2020), the MOOC allowed reframing the module as a Blended Learning (BL), where the part online (MOOC) anticipates the part in presence (design studio setting).

In the following we present the lessons learnt from applying the MOOC to the AIN module as a BL in AY 2020/2021. Specific attention is posed on how the MOOC met previously identified criticalities and to what extent it succeeded in providing propaedeutic transdisciplinary knowledge for accessing the in-presence design phase.

2. Design and Research Methodology

This paper reports on the results obtained applying such an innovative didactic model in a BL context, considering three aspects: (1) instructional and pedagogical achievement, derived from steering informed critical discussions and applying knowledge throughout the design phases; (2) students' group projects as final outcomes; (3) students' perceived quality of the MOOC and BL. While data on (1) and (2) were gathered by means of participant observation with the help of field notes, (3) are derived from the self-assessment that students filled at the end of the module. Through open questions it investigated: (i) perceived benefits from having content delivered via MOOC before the module; (ii) criticalities encountered; (iii) suggestions and (iv) potential issues on how BL could improve/hinder design teaching and learning. The field test involved 65 MSc students from the Final Synthesis Design Studio (MSc in Design for the Fashion System, School of Design, Politecnico di Milano). Equivalent to 2 ECTs, it consists of video lectures, readings, quizzes and exercises for verifying learning, and a forum for discussions. Being propaedeutic to the design-studio-setting part of the AIN

module, the MOOC was to be completed before the starting of the in-presence activities. Analogously its final quizzes were to be passed by the end of the module, since they contributed to the final evaluation. 75% of the final mark relates to the project developed in teams, while the individual score from the MOOC constitutes the remaining 25%.

3. From theory to practice: applying transdisciplinary knowledge and tools

From distributed fashion interactive narratives to games and playful systems, complex interactive projects are challenging the fashion and communication ecosystem introducing new degrees of complexity, which require innovative and transdisciplinary competencies. To tackle this challenge, the AIN module addresses: (i) the role and potentialities of communication systems and user engagement within the fashion domain; (ii) strategies for building communication systems as interactive artifacts able to convey values and meanings; (iii) media affordances, opportunities, criticalities, and risks. To maximise time in class, focusing on designing and reviewing, the MOOC lessons provided beforehand theoretical knowledge, together with tools for storyworld building and interactive narratives. On Sept 3rd 2020, two weeks before the starting of the in-presence module, students were asked to accomplish the MOOC. In parallel, they were required to fill a map for collecting and visualising the skills and attitudes of every participant. On its basis, balanced groups of 6 to 7 persons were built, covering the diverse expertises needed for designing interactive projects. The MOOC introduced a set of narrative tools for the design activity while sharing strategies on how to successfully engage audiences in interactive experiences across media. In particular, the Transmedia Design Framework (Ciancia, 2018), Storyworld Canvas and Character Wheel (Mariani & Ciancia, 2019b; Piredda et al., 2015) were presented. Scheduled twice a week from Sept 17th to Oct 9th, with 8 blocks of 4 hours, each in-presence lesson started with a theoretical recap and advanced discussions related to the design activities to be run in class, then the tools introduced in the MOOC were applied in contextual exercises. Once in presence, for example, the complex topics of interactive and transmedia storytelling and the techniques for conveying brand values exploiting digital technologies then became the object of case studies analysis. In terms of schedule, Day 1 was devoted to (i) systematise and operationalise knowledge, (ii) understand how to apply it into interactive narrative projects, and (iii) initiate the design phase selecting brand values as starting points for building storyworlds and characters. From Day 2 ahead, the initial short recap on fundamentals, tools, and methods to be applied in that stage of the design was followed by in-presence tutored activities with 30-mins reviews per group to discuss the project and its implementation.

In terms of outcomes, the final results of the AIN module are 9 projects that can be clustered in 5 macro groups: (i) two interactive narratives on Instagram shaped as choose your own adventure stories; (iii) four interactive narratives developed as HTML 5 Choose your-own-

adventure stories, implemented using the software Twine; (iv) a Role-Playing Game for mobile devices built with RPG Maker; (ii) a transmedia experience with a Twitch campaign, an app with several mini-games, and TikTok for video challenges; (v) a transmedia interactive experience using Instagram and TikTok, an App and dedicated website, and physical events to engage users with a series of challenges.

4. Conclusion and discussion

Comparing the two editions of the course, it clearly emerged that the MOOC played a critical role in introducing fashion designers with the domains of branding, communication, and interaction, encouraging novel design trajectories. It provided guidance and equipped students with fundamental knowledge to face such a challenging task. This result is confirmed by the self-assessment that shows (i) the effectiveness of the BL approach and the MOOC in respect to the entire module; and (ii) its didactic quality. The analysis of the self-assessments (Bertola et al., 2020) was compared to the observations conducted during the design activities, also considering the maturity of the final projects. Our application confirmed that integrating the MOOC in a BL context allows to balance flaws discussed in literature (Margaryan, Bianco, & Littlejohn, 2015) by (i) providing hands-on moments of demonstration of how new knowledge could be applied, (ii) granting timely expert feedback on the learning activities and assignments, (iii) enabling collaborative learning, while (iv) being receptive to the different learning needs surfaced in the class. Nevertheless, concurring with what stated by Holotescu and colleagues (2014), and Morris (2014), even though the MOOC succeeded in reducing content-related gaps, several weaknesses were identified. In the following, benefits and criticalities are discussed.

Getting acquainted with new topics and tools. Leveraging cross-sector innovative practices and transdisciplinary scholarships for creating added value in the Fashion Industry, the MOOC served as an entry point to new topics, so far distant from their domain of study. Even though it introduced students to new topics beforehand, filling eventual gaps of knowledge, the MOOC alone could not fully succeed in making all the students achieve the same level of knowledge. It is the BL situation that triggered learning-by-doing and re-balanced the understanding through specific reviews and discussion.

Contents tackled in little time and applied. From an educational point of view, students grasped knowledge on the state of the art in the game and interactive narrative fields, understanding possibilities for the fashion domain. Although specific lessons introduced students to current trends, media uses, and contemporary experimentations, their limited length implied to reduce complex discourses into short lectures, being often perceived as non adequate in-depth explorations. The key topics were then more extensively recalled in class, becoming the object of tutored design exercises, demonstrating again the relevance of a direct

exchange to verify the acquisition of knowledge. Throughout the design phases students demonstrated to be able to incorporate most of the methodologies and tools to design complex artefacts introduced, spontaneously and mostly correctly applying them. Also in this case, the exchanges and discussion on the projects that occurred during the reviews made it possible to assess the application and timely fix specific misunderstandings and errors, completing the teaching activity.

More time for design activities and project reviews. Since concepts, terminology, and practices were shared in advance, the in-class time could be effectively spent for informed and critical discussion on more advanced theoretical aspects. This favoured a sort of informal flipped-classroom, where students actively participated in debates. Moreover, it allowed us to spend most of the time on hands-on activities and project reviews.

Students as active learners. As other thematic analyses related to students' perception towards online learning revealed (Galway et al., 2014; Kemp & Grieve, 2014; Bruff et al., 2013), "convenience" is an important common theme. Having a less stressful approach to lessons contributed to transforming students into active learners. They became responsible for their own learning, schedule their activities, operate on video lessons pausing and rewinding when necessary, personalising the fruition. Moreover, it gave the possibility to spend time searching for insights or investigating topics making use of the references provided. A further support are subtitles, seen as facilitators of learning and understanding.

Benefitting from various experts' knowledge. The learning experience resulted to be enriched because of the presence of many professors and experts involved within the online course, therefore students had more points of view to consider and sources to analyse.

The absence of a learning atmosphere. Even though collaborative learning and feedback among peers are recognized as one of the main quality criteria of MOOCs (Feitosa de Moura, Alexandre de Souza, & Noronha Viana, 2021), the absence of human interaction, and the lack of engaging and interactive results easily led to increased boredom. Although the POK platform included a discussion forum, it has never been used, demonstrating that it is not a privileged mode of interaction for the target (Bruff et al., 2013).

Online learning for offline discussion. The MOOC was valued as a valuable opportunity to possibly be extended to other topics, contributing to building the curriculum. Further suggestions regarded the possibility (i) to provide extra-materials about design innovation to be later discussed offline, (ii) to further improve the coupling (Bruff et al., 2013) between the online and in-presence activities, showing more concrete case studies from the industries, and (iii) to engage students in more participatory activities and reflections.

Although criticalities are still present and require to be tackled, the field test showed that online learning within a BL context can be successfully integrated to overcome the challenges

of dealing with complex, transdisciplinary topics in a limited time frame, prompting students to directly apply the acquired knowledge to find creative and innovative design solutions. Especially given current times in which distant learning is a praxis able to open new possibilities to access knowledge, approaching MOOCs as tools for mastering theory in the design discipline is certainly a valuable practice that can no longer be neglected. However, within the design domain, especially the MOOC integration in a BL context emerge as promising, consenting to put into practice the results of the individual learning, having feedback and exchanges on the project being developed. Indeed, when design activities are included, ad hoc reviews are fundamental to impact students' learning. In parallel to the results obtained from the field test, the inclusion of self-assessment activities gave the opportunity to reflect on possible improvements for better integrating MOOCs within traditional, in-presence academic courses.

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Factors essential for successful and sustainable e-learning

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Abstract

E-learning has been viewed as a positive initiative in Higher Education Institutions (HEIs) as it is said to improve opportunities for critical thinking, develop better problem-solving abilities and assists in the improvement of productivity and efficiency of employees. For higher HEIs to benefit fully from the advantages of e-learning there needs to be continuous research done on how best can HEIs ensure that there is successful and sustainable e-learning. This paper focused on understanding what factors are needed for achieving successful and sustainable e-learning. Secondary data literature was reviewed and in collecting primary data six participants from one of the South African HEIs (UKZN) were interviewed. Information gathered through primary data collection was in line with the information obtained from the literature. The difference was when the primary data revealed additional factors which are essential for successful and sustainable e-learning. These include the importance of finances and regular discussions and engagements with champions/experts and researchers in the field of e-learning. Most of the literature highlights the importance of engagement with students, faculty and academic staff and not much emphasis is placed on engagements with all stakeholders. The paper concluded by providing recommendations that need to be considered by HEIs on how best they can achieve successful and sustainable e-learning.

Keywords: *Effectiveness of e-learning; e-learning success; e-learning system readiness.*

1. Introduction

There is a need for new methods in the field of education, especially in the information society, which is Information Communication Technology (ICT) based (Kim, 2016). Humayun (2020) stated that the Covid-19 pandemic has resulted in a shift from the traditional modes of teaching to online learning. According to Blackburn (2016), e-learning improves opportunities for critical thinking, develops better problem-solving abilities and assists in improving employees' productivity and efficiency. He also stated that for Electronic Learning (e-learning) to be effective, investments must be made into teachers as facilitators rather than teachers as lecturers. E-Learning offers transformation and new opportunities for teaching and learning. It is essential to highlight that using technology does not fully promise or guarantee to make a difference in teaching and learning. What is important is how well technology is used in support of teaching and learning (Blackburn, 2016). This is true, as institutions can have all the improved technological systems but this does not guarantee the actual use of those systems, because stakeholders such as students and academic staff are those who must use the system. If they do not wish to use it, e-learning will not be a success. With e-learning, students have an opportunity to combine their learning experience with information technology advancement (Tarus *et al*., 2015). Promoting e-learning allows for developing countries to advance in the knowledge economy and it is viewed as the most cost-effective way of facilitating the learning of large groups with the use of ICT (Tarus *et al*., 2015).

2. Problem statement

The South African higher education institutions (HEIs) are under immense pressure to increase the participation of a different group of students to produce the skills that are required in a rapidly changing labour market (Jaffer, Ng'ambi and Czerniewicz, 2007). There is a social demand for improved access to higher education and e-learning systems have become critical as competition in higher education institutions is increasing with most institutions needing to reduce costs while attracting more students (El-Masri and Tarhini, 2017). The introduction of e-learning brought numerous challenges for South African HEIs. Simelane (2011) added that these challenges are not only limited to South African HEIs but HEIs throughout the world. The challenges faced by South African HEIs include, but are not limited to, inadequate technical support and curriculum design, infrastructural constraints, limited resources, no institutional support, academic ability, low computer and internet access and a lack of ICT skills (Msomi, 2016). These challenges are no different from those found in other developing countries. Karunaratne, Peiris and Hansson (2018) confirmed that as much as ICT is used as a solution to enhance education, it has not always been successful because of many reasons including lack of funds, skills and motivation of stakeholders. The

main aim of this study is to get a broader understanding of what are the factors which are essential in obtaining successful and sustainable e-learning.

3. Literature Review

The main purpose of the literature review is to provide a foundation of knowledge on the topic.

3.1. Effectiveness of E-Learning

It is important to provide suitable infrastructure and to overcome social and gender inequalities to ensure that e-learning becomes a success. These are all needed to enhance e-learning so that the benefits of traditional face-to-face learning are not lost (Blackburn, 2016). Bari *et al*. (2018) added that the ICT skill of students can impact the effective use of different technological technologies. Therefore there is a need for relevant ICT skills which will contribute to ensuring that the learning process is effective, where students should be comfortable with using computers as this will minimise some barriers to social interactions. Blackburn (2016) recommended e-learning categories and their main influences and these are top-down and bottom-up approaches. The top-down category includes the improvement of directives of where we look at the legal environment, governance, strategy and finance and the bottom-up approach includes the improvement of suggestions through hands-on experience, observation, knowledge and research. Bezuidenhout (2018) argued that for e-learning to be effective the impact and role of the distance educator (DE) need to be identified. The DE should be prepared to accept their appropriate roles in the ever-changing digital environment meaning that their competencies should be prepared. Furthermore, the DE needs to unlearn their old-fashioned/outdated habits and behaviours and learn new skills and behaviours which will help them in dealing with the digital era. Rothmann and Cooper (2015) agree that they have highlighted the vital need for training as a strategy that should be linked to the business needs, measurements of results and performance effectiveness of the HEIs.

3.2. Factors Essential for E-Learning Success

Karunaratne, Peiris and Hansson (2018) have identified several factors which are essential for successful and sustainable e-learning. These factors include focusing on the educator's perspective; commitment from all the stakeholders; having relevant resources, backup policies/strategies and guidelines, collaborating with both local and international ICT organisations and developing the educators professionally. Several other authors have written about the factors that are essential for successful and sustainable e-learning. These authors have different but similar views According to Vovides et, al (2014), Queiros and de Villiers (2016), Yew and Jambulingam (2015), and Bruhn-Suhr (2004) the factors essential for

eLearning success includes, student engagements, Technical expertise, faculty engagement, infrastructure and support system, instructional support, students preparation, the competence of teachers, continuous evaluation and revision and the role of change agents.

3.3. E-Learning Systems Readiness Assessment

Several organisations have challenges in sustaining e-learning systems. One of the contributing factors is no proper assessment for organisational readiness for e-learning (Alshaher, 2013). To minimise the risk of failure, it is the responsibility of all organisations to assess their readiness for e-learning systems within their organisations. According to Odunaike *et al*. (2013), readiness can be defined as the presence of the factors that are needed for successful and sustainable e-learning. Alshaher (2013) proposed a model to be used when assessing e-learning systems' readiness. The author proposed the McKinsey 7S Model, which was developed by Tom Peters and Robert Waterman in the early 1980s when they worked at the McKinsey and Company consulting firm. The model comprises seven variables that all begin with the letter S, namely structure, strategy, systems, skills, style, staff and shared values/super-ordinate goals. In as much as the Covid-19 pandemic has forced universities to conduct their teaching and learning online, universities need to take a step back and assess their 7s if they want their eLearning initiatives to be sustainable.

4. Methodology

The case study is the method that was adopted in the study. A qualitative study was chosen because the researcher wanted to get an in-depth understanding. UKZN was used as a case study. The researcher conducted one-on-one interviews with 6 participants made up of two support staff members, two management and two members who belong to the accreditation bodies at UKZN. The criteria that the researcher used for selecting the participants were stakeholders who use MOODLE regularly and who have been using MOODLE for at least 2 years. The information gathered from participants was recorded and the recordings were transcribed. Data analysis was done using the coding method where responses were coded into themes and patterns.

5. Findings/Discussion

Participants agreed that a combination of factors is required for e-learning systems to be a success. Well-trained staff and staff members who are willing to be trained. Nguyen, Newby and Macaulay (2015) indicated that there are several benefits that information technology provides for organisations and one of these benefits is a sustainable competitive advantage. This is the reason that staff members should be trained on how to use information technology so that the organisations can benefit from these IT benefits. It is important for ICS staff to be

competent and to understand teaching pedagogies, as well as the software, so they can offer support to users. Proper IT infrastructure, where the server can handle anything that is put on it, networking, Wi-Fi, hardware and backups, maintenance of the MOODLE system and computer training for students who do not have the computer skills are all needed.

In dealing with engagement with staff and all stakeholders to minimise resistance: The most important role players in all organizations' activities are the stakeholders (Al-Sabawy, 2013). According to Maric (2013), educational institutions can have the best systems in the world but what is most important is the actual use of these systems by the stakeholders, as e-learning systems are no good unless perceived as useful by the stakeholders. One of the participants highlighted the importance of regular discussions and engagements with champions/experts and researchers in the field of e-learning so that the institutions can gain a broader understanding of how MOODLE works and how they can make it more effective.

Financially, money is needed to upgrade the system and to successfully implement e-learning. According to Nguyen *et al*. (2015), information technology has encountered several challenges about implementation. Lack of resources, more specifically capital resources, has limited information technology skills. Baker (2016) highlighted the importance of money and that investing in students could have a positive effect on higher education students' outcomes. Policy-makers must be advised on the critical choices that they make regarding institutions' finances. Management has an important role in finances, as they allocate budgets. If management does not agree with the importance of e-learning, they will not understand the budget that is needed to ensure that e-learning becomes a success. According to Nguyen (2015), the execution of projects often fails or suffers due to a lack of support from management.

Evaluation of e-learning systems, for the institutions to gain an understanding and feedback from the users about their opinions of the current MOODLE system's performance in their challenges, so that the MOODLE system can be upgraded to make it more user-friendly. Thuseethan, Achchuthan and Kuhanesan (2014) hold that selecting the appropriate technique for the evaluation of the Learner Management System (LMS) depends on the complexity and functionality of that system. The authors suggested two approaches to evaluating LMS, namely evaluating the usability of the LMS and testing the effectiveness of the LMS.

These factors are essential for successful and sustainable e-learning and are supported by current literature on the subject, with several authors highlighting the importance of student engagements, technical expertise, faculty engagement, faculty support of teaching and learning, infrastructure and support systems, e-learning environment and infrastructure, institutional support, didactical standards, e-learning competence of teachers, the attitude of educators, presentation and delivery of course content, course development, course structure, students' preparation, student support, continuous evaluation and revision, evaluation and

assessment and role of change agents (Vovides *et al*., 2014; Queiros and de Villiers, 2016; Yew and Jambulingam, 2015; Bruhn-Suhr, 2004).

There is however new information that has emerged from participants on the factors that are essential for the success and sustainable e-learning and these are finances and regular discussions and engagements with champions/experts and researchers in the field of e-learning so that the institutions gain a broader understanding of how MOODLE works and how they can make it more effective. Most of the literature highlights the importance of engagement with students, faculty and academic staff and not much emphasis is placed on engagements with all stakeholders. Several participants stressed the importance of including all stakeholders in engagements.

6. Conclusion

It is evident from the information gathered that many factors contribute to ensuring e-learning becomes a success. Participants have raised their views on what they view as important. One of the most common things identified in the study is the importance of engagements. These engagements are not only limited to engagements with stakeholders within the HEIs but also engaging experts who started early with the implementation of e-learning as several things could be learned from them. The findings have led to several recommendations.

7. Recommendations

After conducting the research the researcher came to some valuable recommendations which are: Engagements are very important because every stakeholder needs to understand what e-learning is all about because if there is resistance from stakeholders the e-learning initiative is bound to fail. Furthermore, there are experts in the field who can be used as part of engagements to find out how they have dealt with the challenges that they have faced in implementing e-learning. These experts have proven to be very valuable especially during the time of the Covid-19 pandemic that led to most universities having to do away with traditional face-to-face teaching to online teaching. These experts will greatly assist in finding easier yet efficient ways to offer courses that were previously not offered online to be offered fully online.

To minimise the risk of failure, it is the responsibility of all organisations to assess their readiness for e-learning systems within their organisations. In assessing readiness for e-learning it is recommended that the model comprises seven variables that all begin with the letter S, namely structure, strategy, systems, skills, style, staff and shared values/super-ordinate goals. The structure will indicate the different roles, responsibilities and accountabilities, and usually has many layers. The strategy will assist in the transformation

of the organisation from the current position to a new position, the systems will support the strategy and structure through formal and informal procedures. Skills which need to be improved to be able to work on the e-learning systems, style and culture are crucial as it indicates leadership style and staff which need to be trained and empowered properly on utilisation of e-learning systems. The seven variables will be easier to assess currently as most universities are offering most of their courses online. It is therefore not just to assess readiness but to check on how best can universities improve the variables to ensure that their online offerings are indeed beneficial to the stakeholders.

It is recommended that the e-learning effectiveness assessment be conducted by institutions to check how effective e-learning in their institutions is. This could be done by using Kirkpatrick's model which consists of four levels. These levels include; reactions, learning, transfer and results.

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On an Architectural Concept for Didactics in the Context of Constructive Alignment

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Abstract

In the wake of the massive digitalization in education brought about by the Covid-19 pandemic, a vast variety of didactic concepts, methods, activities, tools and technologies came into use and are now widely discussed. However, a lack of clarity is observable, as to how these different concepts, activities and tools integrate into a big picture, when to use what, and which aspects have to be considered and addressed to create solutions that work effectively towards achieving specific learning and teaching objectives. To systematically structure this vast variety of didactic concepts, activities and tools, we introduce an architectural concept for didactics in the context of constructive alignment. We achieve this via an abstraction process, which clusters the existing didactic concepts, activities and tools, and specifies interrelations between the identified clusters. On this basis, it is possible to quickly adapt our model by subtractive customization, thus focusing on what is really needed within a specific teaching and learning situation.

Keywords: *Teaching methods; didactic design; learning technologies.*

1. Introduction and Motivation

The Covid-19-pandemic and correlated lockdowns induced teachers and lecturers worldwide to transfer their teaching and learning activities from on site or hybrid into purely virtual formats. Due to the highly acute crisis, this transition had to be realized extremely quickly, to ensure maximum health safety while minimizing educational losses in our learners. Even though the transition to virtual teaching went remarkably well in many instances, it nevertheless shows traits of "emergency remote teaching", thus leaving room for systematic improvement that should be invested before these emergency induced approaches establish themselves as general practice.

In many cases, additional funding was provided to support these efforts, which expedited the increasing divergence of didactic concepts, methods and tools. However, these new ways and means also create several new challenges for all stakeholders involved in providing higher education:

- As lecturers, the general setting for executing our everyday work is expanded by an additional dimension, which creates a host of new options for doing our job. Facing these new options entails the challenge of unerringly selecting from this multitude a subset that is suitable to promote one's teaching and learning objectives within a specific setting, and then getting this subset into practice.
- For decision makers in educational strategy and politics, an everlasting question is where to invest the usually scant monetary resources, in order to achieve the best possible benefit. A well observed pattern is to spend large sums of money on buying technological devices and then medially brag about it to generate publicity. (Note that as technology tends to be haptic, it is more tangible and thus easier to brag about than e.g. didactic methods, which tend to be purely abstract.) However, if these investments are not founded on and aligned with appropriate goals, conceptual methods and the enablement of all parties involved, the new equipment will not bring about the intended benefit.
- The organizational dimension of a university needs to take into account that the professors' main area of expertise usually lies within their technical domains, rather than e.g. in media design, tool usage or the development of didactic methods. Thus for all of these areas, lecturers need enablement and support which the institution ideally should provide, well-adjusted to the lecturers' actual needs.

To tackle these challenges, we applied established modeling methods from software engineering to structure the landscape of didactic concepts and topics into different dimensions, and define interrelations between these different aspects. (So we applied the

engineering approach of the domain of our technical expertise to design our teaching and learning activities as well.)

The result of these efforts is an architectural concept for modern didactics, which can be easily customized to ones' individual needs. Thus, this work helps all the above stakeholders by creating some sort of map that provides orientation in the vast domain of didactic concepts, teaching and learning methods, media and tooling.

2. Related Work

Starting point is the concept of Constructive Alignment, whose principles are described by Biggs and Tang as being the foundation for modern constructivist didactics (Biggs & Tang, 2011). According to that model, intended learning outcomes (ILOs), teaching and learning activities (TLA), as well as assessment must be carefully aligned (cf. Figure 1). They describe the necessity of a systematic transition from ILOs to methods for TLAs. However, they do not mention the possibility of considering didactic intentions (such as motivating or activating students) that might be involved when selecting a sequence of methods during the design of teaching and learning activities (e. g. lectures, or units for self-regulated learning).

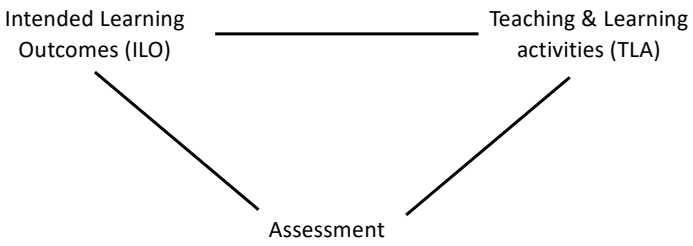

Figure 1. Constructive Alignment of Intended Learning Outcomes, Teaching/Learning Activities, and Assessment.

The question of how to systematically deduce appropriate TLAs from previously defined ILOs seems to be under-researched, even though it is an essential aspect of our everyday teaching efforts. Therefore, we focus on that path from ILOs to TLAs in this paper. Note that similarly, the systematic deduction of assessments that constructively align with ILOs and TLAs is non-trivial as well and should be subject of further research.

The SAMR-model (Puentedura, 2006) adds the aspect of technology to support TLAs, thus enabling a variety of TLAs that are not only enhanced by technology, but only become feasible because of technology. However, the SAMR-model raises several challenges, one of them being the risk to focus on generated products rather than on the students' learning process behind this product generation (Hamilton, Rosenberg, & Akcaoglu, 2016).

As well, several sites (Lathan, n.d.), (e-teaching.org) list more or less comprehensive selections of didactic concepts or teaching methods, but tend to intermingle TLAs, media or even the artefact generation process.

The Global Learning Landscape (Brothers & Spies, 2020) aims at providing a taxonomy for innovation that happens in education. As such, the work is a high-level view and does not focus on details. However, the interactive design of the web-site is inspiring with respect to its visualization of the relationships between detailed didactic issues.

3. Architectural Concept

The core question in teaching design boils down to "What do I address how, and why?". The "why" denotes the didactic function or goal, whereas the "how" corresponds to both the method and the media and tools involved. Embedding these aspects and their interrelation into the principle of Constructive Alignment leads to our model (see Figure 2 for an overview), which aims at refining the connection between intended learning outcomes and teaching and learning activities of Figure 1.

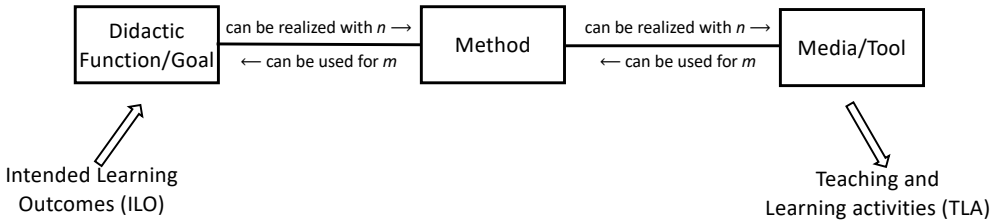

Figure 2. Architectural model refining the connection between ILO and TLA

We claim that the path from ILO to TLA must form an aligned chain from didactic goals via methods to media and tools. Note that didactic goals and teaching methods are interconnected by an m-to-n-relationship, indicating that for each goal there might be more than one appropriate method, and vice versa. The same holds true for the relation between methods and media or tools that can be used to put the methods to work. In the following, we focus on the different aspects in more detail.

3.1. Didactic Goals

Foremost, the selection of the sequence of didactic functions for a unit of teaching and learning is driven by the intended learning outcomes (ILOs) as described in (Biggs & Tang, 2011). These ILOs can be considered as the roots of a design process leading to the teaching and learning activities.

Analogous to ILOs that are formulated using verbs describing what the students are expected to perform, didactic goals are described using verbs describing the teacher's intention, i.e. "I want …"

- to present factual knowledge to students
- to activate students (with respect to either content or in a mental, or in a physical manner)
- to design appropriate guiding questions for self/group learning
- to induce students to corporately work on a given problem
- to students to present a piece of work or information together
- to give feedback to students
- to receive feedback from students
- to assess students' knowledge (formative or summative)
- to induce students to reflect on something
- students to cooperatively solve a design task

Intentions like "I want to produce teaching videos" or "I want to use tool xyz" are no valid didactic goals since a selection of methods and adequate tools is part of a follow-up step.

3.2. Teaching Methods

Experience shows that many teachers tend to place teaching methods in the center of their course design, thus focusing on what they intend to be doing. However, in remote digital teaching scenarios, these teaching methods must be put into practice using appropriate digital environments and tools. This transition entails the risk that the whole design process will be driven by merely looking at the tools that appear to be quite cool, rather than focusing on didactic functions or goals.

Selecting specific methods and media which then will form a teaching and learning activity (unit) is driven by the physical setting in which the teaching and learning will take place. This physical setting must be considered with all its facets, not just restricted to the context of remote teaching scenarios imposed by the Covid pandemic. We differentiate two types of physical settings:

Asynchronous Setting, where students learn on their own, in their own pace and in any place, and

Synchronous Setting, where more than one person meets at the same time, and with or without a teacher being involved.

The synchronous setting can be further discriminated into three variants:

1. In-classroom teaching, i. e. the classical variant of teaching.

2. Virtual teaching, where the class meets in a virtual classroom.
3. Hybrid variants, i. e. part of the class meets in a classroom and the lecture or other activities are simultaneously streamed or transmitted using a virtual classroom via a conferencing system.

Furthermore, teaching methods can be labeled or organized into clusters, such as gamification, engaging methods, or cooperative methods.

As a next step, a closer look at many modern teaching methods uncovers a kind of method-specific intrinsic structure, as many methods indeed comprise a variety of sub-methods. We illustrate this on a small set of examples more or less randomly picked from the enormous amount of teaching methods that have been published up to now.

The methods Just-in-time teaching and Flipped Classroom (as many others) combine phases of self-regulated learning and interactive student-centered in-class activities (Bishop & Verleger, 2013). Designing TLAs according to these methods requires a combination of several smaller methods, whose number is not even well designed by the method itself. The phase of self-regulated learning for example could require a presentation of factual or some kind of procedural knowledge. Subsequent in-class activities could require student activation, quizzes, or collaborative activities to apply the knowledge gained by self-regulated learning – and many more.

The Play Projects described by (Yakovleva & Yakovlev, 2014) require several steps: i) selecting and fixing a research problem, ii) splitting students into (two) groups, iii) asking students to craft solutions, and finally iv) organizing a meeting where students then present and defend their solutions.

(Bescherer & Spannagel, 2009) introduce – among several other patterns –the Technology on Demand Pattern. Implementation of this pattern requires the selection of an appropriate problem that has to meet given requirements, the design of appropriate questions, tasks and hints to guide students through a solution process requiring software tools.

3.3. Media and Tools

Finally, putting a method to work usually requires some kind of prepared media or material, as well as tools to either create these media or put them into usage. Again, we have an m-to-n relationship between methods and media/tools, meaning that for each method usually more than one appropriate type of media and/or several tools can be considered, and most kinds of media and tools can be employed in more than one method.

In practice, sometimes only digital tools are considered and put to work, just because they are deemed to be cool. As well, it is important to clearly distinguish whether using a tool is

in itself an explicit learning objective, or whether the tool is merely the means to achieve some other ILO.

4. Examples

As first example we elaborate on the didactic goal “I want to present factual knowledge to students”. In terms of methods, this can be done by classical classroom teacher-centered lecturing; but also, by using videos or texts. Each of these variants requires a mapping to media and/or tools. Classroom teaching can make use of a blackboard or an electronic drawing facility. Videos and texts can be drawn from various sources, e. g. open educational resources, or can be produced by the teachers themselves. In the latter case a production process must be defined, which itself can require more or less complex tools and equipment depending on the degree of sophistication the teacher wishes to achieve. Note that these implementation steps are not explicitly visualized by Fig. 2, which merely provides a model overview.

For another example, the didactic goals “I want to students to present a piece of work or information together“ and “I want students to cooperatively solve a design task” can be addressed with a method called whiteboarding as described in (Megowan-Romanowicz, 2016). When putting this method into practice, specific media and/or tools must be selected that are applicable in the intended setting. In principle, the example of whiteboarding opens both analogous and digital opportunities to the teacher. Here, analogous means that e.g. flipcharts can be used in classroom if that is the setting of choice. When considering digital settings, a whole bunch of tools opens up as summarized in (Bodnenko, Kuchakovska, Proshkin, & Lytvyn, 2020). Having the palette of tools at hand, the pros and cons can be considered and a selection can be performed as described by Bodnenko et al. Then, the subsequent implementation step leads to either a classroom setting with prepared flipcharts or to a virtual setting with all prerequisites prepared.

5. Conclusions and Further Work

The presented architectural concept relates didactic intentions with methods and methods with tools, each in an n-to-m relationship. Designing teaching and learning activities according to this structure helps to focus on the respective didactic intention in a student-centered manner. Incorporating assessments into the architecture is subject of future work.

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Architecture and digital drawing tablets, bringing back human control over HAL

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Abstract

Architectural imagery and design are nowadays pervaded by computerization, consequently freehand drawing suffered a drastic decline. This paper reviews the advantages and drawbacks of digitalization, examines the reasons of the reborn need for freehand drawing and reports about published evidence of creativity being facilitated by hand movement. A new drawing medium is now available in the form of digital tablets. These allow freehand drawing with more ease and efficiency than on paper but hand movements and feeling are the same as in traditional drawing. Aim of this paper is to provide the basis for a proposal to merge advantages of digitalization with creativity stemming from freehand drawing by the use of modern digital drawing tablets in architecture. The preliminary results of a pilot survey carried out in 8 countries revealed that there is a widespread need for architectural academic courses of freehand drawing on digital tablets, so far not implemented. It is expected that the survey may be completed in the next few months and a wider sample may provide more detailed indications. In conclusion it is proposed that the digital tablets may be the future solution for a fruitful union between the digital and the creative imagery in architecture.

Keywords: *Digital tablet; drawing; architecture; freehand; creativity; education.*

1. Introduction

Digitally driven processes are currently used in architectural design and widely taught as a must in the educational path of new architects. Matter of fact it would be unrealistic not to use Computer Aided Design (CAD) in a modern studio. But with development of hardware and software architects and especially students are increasingly depending more and more on computers. In Stanley Kubrick's 2001: A Space Odyssey, the supercomputer HAL had full command of the spaceship, and was granted full trust to the point that the crew had a passive role, until HAL turned against them (Williams, 1984). Advantages and drawbacks of computerization in architecture are now being debated, and after decades of unmingled enthusiasm, doubts about complete computer trust are arising. A balance in the architect's practice and, above all, in the educational curriculum should be reached so that HAL can be of help, but the crew should be well in command. This paper discusses the issue, and proposes solutions stemming from new technologies.

2. Background

Drawing plays an essential role in architecture, either as planning or representation of an already made building. One of the first testimonials of the imperative need to draw in order to design and communicate architecture is given by a graffiti dating back to the Ġgantija phase in Maltese prehistory (3600 – 3200 BC), found at the Ħaġar Qim site (Amazing architecture in Prehistoric Malta - National Museum of Archaeology, Malta). Until about fifty years ago, the technique of transferring ideas or perceived images to a flat surface, be it stone, clay, papyrus, parchment or paper, had changed little. The hand, guided by the cerebral cortical activity where ideas are formulated or perception elaborated, traced signs which materialized what was an ephemeral inner process of neurological activity and fixed it for an indefinite time on a medium. The resulting craft was to be read by others, but also meant for the author himself to store in a safe memory his mental work, to be retrieved and thought over. Since the mid-1960s development of computers brought the possibility of drawing by inputting XY coordinates; for the first time drawing was not a mind-hand-paper (draw) process, but a mind-computer-paper (print). That meant that the author's craft was processed and stored as bits of electronic states and not accessible any more to the human sight if not by the help of the computer itself. That also meant that difficult engineering calculations could be performed in an eyeblink and with the highest precision. But the link of mind to hand was replaced by the relation of mind to computer. It was all very well for the boring complex calculations, which, in pre-computer era were considered the hardest hindrance to the architect's project. But the core of architecture are art, intuition, fantasy, production of novel and useful ideas, in a word: creativity (Amabile and Pratt, 2016). Computer aided design has now reached goals of unheard sophistication, it is widely taught in universities, it is a tool so essential that no architect could dare to think not to use it in a project. On the

other hand, progress in computer graphics has also meant that photographic quality images could be produced depicting virtual buildings and environments, still "in nuce", as if they were already built objects. Photographic renders are another must of the current architectural profession. In both cases (CADs and photographic renders), once data are input into the computer, the operator loses most of the control. He/she must abide to constraints dictated by hardware and software, often by restricting the range of project ideas in order to feed the computer with something that the machine can handle. This way, the computer/software combination dictates the project, but it is quite the opposite of a creative, divergent thinking, it is a bottleneck. Why should an architect choose to squeeze his brain activity through such a bottleneck? At university courses he/she has been taught how to use CADs and virtual reality, or simulation, software. The architect has learned to appreciate speed, ease of use, precision, stunning special effects. A wide straight road which compels addiction (Guney, 2015), numbing the mind into a simple. So creativity is sacrificed to smoothness and ease of mind. Such attitude of passiveness to computers is something that should raise concern as it will grow in relevance paralleling the evolution in processors and software. The dualism between "poetic" and "functional" drawings (Meisenheimer, 1987) should be overcome in the name of creativity and efficiency.

3. Current state of the art

We are now in an age of simulation, where widespread and cheap computational power creates illusions for our sight, hearing, touch and motion. The architectural world is particularly prone to succumb to such technological drive, mainly under the request of the public. What are the consequences of this whirl of simulations? They are discussed in a fairly recent book: "The death of drawing: architecture in the age of simulation" (Scheer, 2014). The book is centred upon the issue of the present shift from representation to simulation in architecture.

3.1. Representation

Representation is the craft produced by a human being who acts upon a medium as to reproduce his/her ideas borne from perception of the outside world (reality). Examples in figurative art are a drawing or a sculpture. However, the perception of the crafter is not perfect and the true external reality cannot be known (a common trend of philosophy since Plato). Besides, according to individual senses and brain processing (perception), the reality can be perceived in different ways by different individuals, so the resulting representation through craft (i.e. the drawing) will always be approximate and recognized to be so by any beholder. Of course, the representation could be of ideas and not linked to current reality, but always stemming from previous similar experience of perception. Ambiguity is an inherent property of representation and it *"provides rich opportunities for creative expression"* (Scheer, 2014).

The creative process is linked to investigation and choices carried out by the crafter about the reality to be represented.

3.2. Simulation

Simulation is "an artificial environment that creates an artificial experience that is felt to be reality" (Scheer, 2014). Simulation at every level, spanning from movies, television, computer games, theme leisure parks is ever pleasing because it resembles reality but it is not reality; it is a human creation where everything is known and under control. Everything can be done but on condition that it stays within the constraints of the provided frame, be it software, hardware or, as in theme parks, buildings. It is a limited cosmos where nothing is ambiguous. The limits are set by the authors of simulation, so no user can develop ideas outside the work of imagination performed by others. In architecture digitally made 3D renderings of photographic quality are extremely popular and easy to make. With virtual reality software even their internal spaces can be visited in detail. These are the *"blue skyed..lush leafed..populated by groomed and grinning clip-art figures..postcards from the future"* originated by *"Cartesian given"* projects (Jacob, 2017). Most architects praise such products of simulation even on grounds of creativity. By providing flexibility in scenery, many solutions can be tested, precision granted, nice images produced by any architect capable of handling the software, apparently difficult projects are within the grasp of students (Ivarsson, 2010; Khan, 2018; Lawson, 1994). On the other hand there is now a widespread consensus about the limits of CADs and computational architecture, which ought be used with caution not to hamper freedom of thought and not to give way to "fake" creativity (Bernath, 2007; Lawson, 2002) .

3.3. Beholder and student preferences on architectural imagery

Architectural 3D renders are simulations of something not built yet, very appealing, but usually they do not display any artistic touch more than a postcard. When architects, professionals in the building trade and City councilors were asked to give opinions on one side about photographic renders or montage (i.e. simulations), and on the other side on watercolours and perspective drawings (i.e. representations), it turned out that all three groups judged the computer generated simulations as more realistic and accurate than hand made representations, whilst the latter were more "abstract" or conceptualized (Bates-Brkljac, 2009). Such results are something that was to be expected; of course a glossy photograph is more realistic and accurate than a hand drawing, but is that more convincing, emotionally moving or useful as an architectural representation? It depends on the onlooker and on the message that the author of the drawing wants to transmit. The photograph, or its 3D twin, is something aseptic, coldly objective, which does not convey the creative impulse of the crafter. Simulations are said to be something handy to explore the mood of the public concerning projects to be. For this purpose, visual preference surveys (VPS) are commonly

used. They avoid *"the vexing problem of dealing with the slippery notion of esthetic value per se by replacing it with a poll of personal reactions whose results can be handled with familiar statistical techniques. This substitution equates the complex notion of esthetic value with the operational one of visual pleasure"* (Scheer, 2014). Further on, the same author states that *"the very decision to base design on this criterion already denies design any other purpose than providing a pleasing environment, creating an experience with no questioning of content"* (Scheer, 2014). In conclusion, simulations, although useful to practical ends, should be regarded as what they are and reactions to them evaluated carefully. Investigations about student preferences between hand made representations and CAD simulations are perhaps simpler to explore. Summing up the results of a series of surveys (Basa and Şenyapih, 2005; Hanna and Barber, 2001; Islamoglu and Deger, 2015; Ivarsson, 2010; Şenyapili and Basa, 2006), it is possible to conclude that students adopt a fairly pragmatical approach in general, by adapting themselves and their design to the tools provided (Ivarsson, 2010), they acknowledge that computer drawing requires less effort, saves time and is more practical (Şenyapili and Basa, 2006). In the first years of the course computer drawing is less preferred because students have not enough practice yet, so they prefer hand drawing (Islamoglu and Deger, 2015); however, preferences by computer experienced students were split in two halves between hand and computer drawings, and the majority of them considered hand drawing as better expressing their personality (Şenyapili and Basa, 2006).

3.4. Bodily involvement and related physiology

Hand made crafts are a reflection of the author's personality as much as a signature, making onlookers tune up in syntony. From this point of view hand made representations are much more catching for the public than simulations. But it is mainly in the making of a craft that a big difference takes place. The extremely complex movements needed for hand drawing are not only the result of efferent motor activity by the central nervous system, they are also the source of perception. This is an inward bound afferent activity, also called proprioception, that starting from receptors of joints and muscles goes back to the brain to control the execution of the primeval orders (Kandel et al., 2013), but also to stimulate new ideas for new movements. In the process of architectural design, such bodily involvement is supposedly of extreme importance as it should be at the basis of the mental process of divergent thinking and creativity (Guilford, 1956). There is now some evidence that parts of the central nervous system related to movement and proprioception might be linked to creativity (Heilman et al., 2003). Certainly there are many data now available leading to conceive the importance of body activity and senses in the conceptual architect's work on one side, whilst pointing towards a sort of intellectual flatness and levelling effect by the use of computer (Mallgrave, 2011).

4. Desiderata and possible solution: the digital freehand

There is little doubt that drawing by pen and paper in many instances is a slow and sometimes painstaking process. Second thoughts and errors require delicate erasure and remaking. On the other hand, the rewards of freehand drawing are reviving this form of expression, as highlighted in the previous chapters. It should now be possible to reconcile the need of efficiency with creative drawing by exploiting recent progress in hardware and software technology. The sentence: *"We need to change how we think about drawing, moving beyond outdated notions of "hand graphics" and "rendering" to encourage a less rigid and more accessible style of freehand sketching that supports and energizes our best digital technologies."* (Richards, 2013) well expresses such current spirit. Digital freehand is now feasible by the use of digital drawing tablets and software for raster and vectorial graphics. Both items have undergone great improvements in the last years. By far the most important innovation has been the screen drawing tablet, where you can draw directly on a screen, with available sizes from few inches up to an impressive 32". Leaving out the largest sizes, their price is now affordable to any professional or student. The goal is that you should be able to paint and draw on it as if using a pen or a brush. Pens for tablets are now wireless and even battery free, as they are powered by electromagnetic induction by the tablet itself. They are pressure and tilt sensitive. Their dimension and grip are the same as the real thing. There is a wide range of sophisticated software of any price, and even for free. With the right software you can have a whole range of drawing tools, of different shapes, which combined with the sensitive pen, mimic the behaviour of the actual device. Erasing and changing your mind is now extremely easy and fast, so you can sketch and experiment styles or new solutions at will. This freedom is actually expected to increase occurrence of creative thought, as there is no restraint deriving from the effort of redoing an already finished craft.

5. A pilot survey on digital freehand drawing

The architectural academic world seems not to have widely adopted or encouraged the freehand drawing on digital tablets, so the author launched two pilot surveys by email, one addressed to teachers and one to students. By design, the surveys were not limited to a given university or school, as there would have been a strong sampling location bias. The involved countries were Canada, France, Germany, Italy, Spain, Switzerland, United Kingdom and United States of America. The surveys have been launched recently and they are far from complete. Some provisional results are reported hereafter. The teacher survey addressed the following items: 1) which tools do you currently use for free hand drawing architecture, 2) does your School/Institute/University run a course on architectural free hand drawing with digital tablets, 3) does your School/Institute/University run a course on rendering techniques for 3D models, 4) do you think it would be useful to institute a course on digital techniques for architectural imagery production, 5) do you own or have access to a digital graphic tablet.

Eleven teachers responded so far to the questionnaire, 100% use pen or pencil and paper, 18% use watercolor and 63% use digital drawing tablets, just 18% of their institutions run a course on freehand drawing with digital tablets, but all institutions run a course on 3D rendering, and all of them think it would be useful to run a course on digital techniques for architectural imagery. Also, all of them have access to a digital drawing tablet. The student survey had these items: 1) educational level, 2) which tools do you currently use for free hand drawing architecture, 3) does your University run a course on architectural free hand drawing with digital tablets (no CAD), 4) does your University run a course on rendering techniques for 3D models, 5) would you like to attend a course on digital techniques for architectural imagery production, 6) do you own or have access to a digital graphic tablet. Eighteen students answered so far, of these 50% were postgraduate, 44% undergraduate and 5% from a technical school. 77% use digital tablets, 72% pen or ink and 83% pencil and paper. About 20% of their institutions run a course on freehand drawing on digital tablets and 90% were interested in attending a course on digital techniques for architectural imagery. Only 60% have access to digital tablets.

Aim of the survey is to assess how widespread is the use of digital tablets in the academic world and how much teachers and students draw freehand on them. In the next months it is expected that at least a total of 50 teachers and 100 students should answer the questionnaire so that it should be understandable how such usage is distributed. From the scanty data currently, available it is evident that freehand drawing on tablets is still in little use in the academia, which was something predictable by the rarity of paper or web reports on this issue.

6. Conclusions

The space odyssey ends with a message of hope, humanity is reborn to a new life after HAL has been killed and the new hope is humbly communion with Deity (Williams, 1984). In the metaphor all advantages of the mighty computer had turned out in a selfish rebellion that had decreed its death. It may be guessed that excess of computerization could be the executioner of creative architecture. But something is astir and the feeling that poetics should be given way to regain control over plain coordinates is surfacing now. Architects are now realizing that they don’t think with numbers only but first they have to think with the creative part of the brain, the bodily brain. Drawing, easy and free, onto new medium, the digital canvas, will preserve and provide new spirituality to architecture.

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The effects of collaboration scripts on the number and quality of student interactions in a social annotation tool

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Abstract

Social Annotation (SA) tools can be used to facilitate active and collaborative learning when students have to study academic texts. However, making these tools available does not ensure students participate in argumentative discussions. Scaffolding students by means of collaborations scripts geared towards collaboration and discussion encourages students to engage in meaningful, high-quality interactions. We conducted an experiment with students (n=59) in a course running at a Dutch university, using the SA tool Perusall. A control group received normal instructions, while an experimental group received scaffolding through collaboration scripts. The results showed a significant increase in the number of responses to fellow students for the experimental group compared to the control group. The quality of the annotations, measured on levels of Bloom's taxonomy, increased significantly for the experimental group compared to both its baseline measurement and the control group. However, when scaffolding was faded out over subsequent assignments these differences became non-significant. The experimental groups' increased quality of annotations did not remain over time, suggesting that internalization of the scripts was not achieved.

Keywords: *Social Annotation; scaffolding; Bloom; collaboration scripts.*

1. Introduction

When preparing for lectures by reading academic texts, students' understanding of literature benefits from discussing it together (Miller *et al*., 2018). Supporting such discussions can be achieved by using Social Annotation (SA) tools, allowing students to read academic texts online while sharing comments and questions (annotations), thus providing students with subject-oriented interactions (Sun & Gao, 2017). However, the fact that students have available such an environment does not mean they always participate in discussions (Kreijns *et al*., 2003). When interaction is not stimulated, students may focus only on their own argumentation. Research on the use of discussion boards found that engagement in discussions benefits from scaffolding (Vogel *et al*., 2017). It suggests that promoting interactions encourages students to engage in more meaningful discussions (Kreijns *et al*., 2003). This scaffolding can be achieved by means of collaborations scripts (Vogel *et al*., 2017), based on the theory that collaboration skills are internalized scripts, guiding students in the process of collaborative learning. The internalisation process is facilitated by using collaboration scripts (providing instructions and examples) that encourage learners to engage in argumentation and discussion (Vogel *et al*., 2017). Script internalization can be expected, so scaffolding can be faded out which results in students self-directing their collaborative learning behavior without support. Research on collaboration scripts defines both high intensity micro-script scaffolding (containing suggested questions or sentence starters) and low intensity macro-script scaffolding (supporting meta-learning) (Kobbe *et al*., 2007). In the next paragraph, we focus on how one can assess whether more meaningful interactions have actually occurred using Bloom's taxonomy (Bloom, 1956).

1.1 Bloom's taxonomy as instrument for measuring meaningful interactions in SA tools.

Bloom's taxonomy is a well-known instrument to assess whether students have actively processed information and applied cognitive skills such as comparing ideas and evaluating arguments. It defines six levels of cognitive processing, which can be bundled into lower (knowledge, comprehension and application) and higher (analysis, synthesis and evaluation) levels of deep learning (Bloom, 1956). These levels were reorganized by Anderson and Krathwohl (2001) into one of the lower levels (remembering, understanding, applying) or one of the higher levels (analyzing, evaluating and creating). In this study this taxonomy will be used to categorise the quality of student annotations into one of these levels and to assign them to either the lower or the higher level. For example, if a student wrote: 'If I understand correctly, the author is trying to make the point that…' we would score this on the level of Understanding (lower level) or if a student wrote 'I understand the position the author is taking here, however I want to argue that the author is neglecting key elements from theory X which clearly state....' we would score this on the level of Evaluating (higher level). We define three research questions:

RQ 1: Will students, who are scaffolded through collaboration scripts, engage in interactions more often while performing tasks in a SA environment, compared to students who do not receive scaffolding through collaboration scripts?

RQ 2: Will students, who are scaffolded through collaboration scripts, have higher percentages of annotations on levels of higher order cognitive processing of Bloom's revised taxonomy while performing tasks in a SA environment, compared to students who do not receive scaffolding through collaboration scripts?

RQ 3: Will effects of scaffolding through collaboration scripts remain over time when the scaffolding for the experimental group is slowly faded out during the course?

Based on the scaffolding-through-scripts theory and internalization theory, we formulate two hypotheses:

H 1: RQ 1 and RQ 2 will be confirmed. Students receiving scaffolding through collaboration scripts will show higher levels of interactions and a higher quality of annotations, measured with Bloom's revised taxonomy, compared to students who do not receive this scaffolding.

H 2: We expect that RQ 3 will be confirmed and that the higher levels of interactions and quality of annotations persist when scaffolding is faded out.

2. Method

An experiment was set up to analyse annotations students created in the SA tool Perusall during a Media Studies course of a Dutch university that ran in 2019. Over a period of 6 weeks students worked on one assignment per week. The targeted participants were all second-year students (n=102). Each assignment contained the instructions to read the prescribed literature and to create at least 9 annotations in the SA tool. The online learning environment randomly distributed the students over two conditions: control and experimental groups. Before assignment 1 both groups received the default Perusall instructions, explaining technicalities of the assignments and function towards classroom preparation. Before the second assignment the members of the experimental group were provided with collaboration scripts on both a micro- and a macro-level. These were communicated through both the electronic learning environment and by e-mail. After the third assignment scaffolding was faded out in two steps: partially before the fourth assignment and fully before the fifth assignment. The data to be analysed was collected from assignments 1, 2 and 5 and compared for differences on within-group and between-group levels.

2.1. Materials

The collaboration scripts we provided were derived from the previous research by Vogel *et al*. (2017), Noroozi *et al*. (2012) and Kobbe *et al*. (2007), consisting of macro-scripts

explaining to students the importance of argumentation and interaction, and micro-scripts offering sentence starters to start discussions in annotations, such as: *'Instead of writing 'In this segment the author connects to theory X' we ask you to write 'I would like to argue that the author connects to theory X, because…''*.

2.2. Data collection and analysis

We collected data from three assignments: assignment 1 (for baseline measurement), assignment 2 (after the intervention) and assignment 5 (after scaffolding faded out fully). As students could skip one of six assignments, the number of students (n=59) providing data for all three measurement moments was lower than the number of students overall (n=102). The students for which we had full data sets showed an equal division over the experimental group (n=29) and control group (n=30). Each separate annotation received its own ID in the dataset. If an annotation consisted of a respons to another student, that annotation received an additional label, matching the ID of the original annotation (so-called Parent-ID). The interactions between students were labeled 0 when they were first annotations on some part of the text and 1 if annotations were a response to another student. We then calculated a response/first annotation ratio (response score) for each student per assignment on a range from 0 to1, for instance 0.2091 (20,91%). Second, we assigned the annotations to the various levels of Bloom's revised taxonomy. To validate these assignments to the levels, a sample of annotations (n=84) was assessed by three human raters (including the main researcher), assigning each annotation to a level of the taxonomy. Analysis showed moderate to strong inter-rater reliability. The complete data-set was scored by the main researcher, who assigned annotations considered to be on the lower-order levels a label of 0 and those on the higher-order levels a label of 1. We then calculated percentages of annotations per student for each assignment counting as higher-order cognitive processing on a range from 0 to1 (e.g. 0.350 or 35 % of annotations scoring on higher-order levels). From these we computed mean scores for each group from all annotations per assignment for interaction and Bloom-levels.

3. Results

3.1. Interaction between students

While comparing the mean scores (see Table 1) for assignments 1 and 2, we noticed that the experimental group's percentage of annotations as a response to fellow students increased. We also saw that, although decreasing, this mean was still higher for assignment 5 when compared to assignment 1. At the same time a decrease for the control group comparing their means of assignments 1 and 2 can be observed. Because our data showed a non-normal distribution, we combined Mann-Whitney U tests and a Friedman's ANOVA-test with a split file, followed by (post-hoc) Wilcoxon signed-rank tests to examine differences between

assignments and groups, with a Bonferroni-correction of α (0.05/7)= .0071. First we checked for differences between groups per assignment. For assignment 1 the Mann-Whitney U test showed the median response score of the control group did not differ significantly from the median response score of the experimental group. This confirmed there were no differences between groups prior to the intervention.

Table 1. Means, Medians, Standard Deviations and Standard Errors of response scores.

Assignment	Group	Annotations	M	Mdn	SD	SE
1	Control (N=30)	N=245	.275	.222	.270	.049
	Experimental (N=29)	N=275	.335	.316	.258	.048
2	Control (N=30)	N=270	.180	.095	.233	.042
	Experimental (N=29)	N=266	.447	.444	.210	.039
5	Control (N=30)	N=277	.240	.222	.257	.047
	Experimental (N=29)	N=262	.391	.363	.222	.041

The experimental group's median response score of assignment 2 was significantly higher than that of the control group, U= 721, z= 4.375, p< .001, r=.57. For assignment 5 the experimental group's median response score was also significantly higher than that of the control group, U= 620.5, z= 2.832, p= .005, r=.37. The differences between groups, however, can be attributed to both the increased scores of the experimental group and the decreased scores of the control group. Unfortunately we could not verify the reason for the lower scores of the control group. The Friedman's ANOVA showed the percentages of annotations as response to fellow students for each group did not significantly change over time. The follow-up non-parametric Wilcoxon signed-rank tests showed no significant differences for each group between all assignments.

3.1. Scores on levels of Bloom's revised taxonomy

The scores from both groups on levels of Bloom's revised taxonomy (see Table 2) showed that both scored high on 'Remembering' for assignment 1 while scores on levels of higher order cognitive processing were relatively low. While the control group remained at these levels, the experimental group showed an increase of scores on higher levels for assignment 2, especially on 'Evaluating'. We noticed that both groups scored consistently high on 'Understanding'. This was not surprising as the texts were relatively new to the students. Next, we analyzed the percentages of annotations scoring on higher-order levels of Bloom's taxonomy. Here too, combined non-parametric tests (α = .0071) were required.

Table 2. Table of Bloom-scores for the experimental and control group.

	Remembering	Understanding	Applying	Analyzing	Evaluating	Creating
Experimental group						
Assignment 1 (n=275)	102	76	42	22	33	-
Assignment 2 (n=266)	67	75	32	21	70	1
Assignment 5 (n=262)	52	105	27	22	56	-
Control group						
Assignment 1 (n=245)	100	64	35	14	32	-
Assignment 2 (n=270)	135	68	26	13	27	1
Assignment 5 (n=277)	99	98	38	11	31	-

The results show that the scores for the experimental group increased from assignments 1 to 2 and, while somewhat lower, were still higher for assignment 5 (see Table 3). The scores of the control group showed a slight decrease when comparing assignments 1 and 2. The medians of percentages of annotations scored on the levels of higher order cognitive processing in assignments 1 and 5 did not differ significantly between both groups.

Table 3. Means, Medians, Standard Deviations and Standard Errors of levels of higher-order cognitive processing from Bloom's revised taxonomy.

Assignment	Group	Annotations	M	Mdn	SD	SE
1	Control (N=30)	N=245	.195	.163	.156	.028
	Experimental (N=29)	N=275	.201	.167	.200	.037
2	Control (N=30)	N=270	.156	.118	.122	.022
	Experimental (N=29)	N=266	.314	.333	.183	.034
5	Control (N=30)	N=277	.215	.222	.180	.033
	Experimental (N=29)	N=262	.237	.222	.175	.033

With assignment 1 being the baseline measurement, this confirmed there were no significant differences between the groups prior to the intervention. The median score of assignment 2 of the experimental group (Mdn= .333) was significantly higher than that of the control group, U= 671, z= 3.593, p< .001, r=.47. A Friedman's ANOVA test showed that the scores for both the control group and experimental group (the latter partially due to the stricter α) did not significantly change throughout the three measurements over time. The follow-up

Wilcoxon signed-rank tests for the experimental group showed a significant difference between assignments 1 and 2, $T = 307.5$, $p = .004$, $r = .37$. We saw no significant differences for the experimental group between assignments 1 and 5 and between assignments 2 and 5 indicating the effect did not remain over time.

4. Conclusions, discussion and future research

Setting out to research the effects of collaborative scripting, our first hypothesis, suggesting that after scaffolding through collaboration scripts the experimental group will show higher levels of interaction and quality of annotations, could be partially confirmed. The results showed the experimental group did score significantly better on percentages of interactions compared to the control group on assignments 2 and 5. Our study also found a significant change in percentages of annotations categorisable as belonging to higher order cognitive processing in assignment 2 for the experimental group. For our second hypothesis we could not fully confirm that the effects of the scaffolding remained when scaffolding was faded out. Although there was still a difference between groups on levels of interaction on assignment 5, the increase in interactions was not statistically significant on a within-group level for the experimental group across the three assignments. Also, the control group's Bloom-score on assignment 5 was higher then their baseline score. This may be due to both groups showing natural progression throughout the course, not attributable to our intervention. Furthermore, the higher levels of annotation quality for the experimental group, measured with Bloom's revised taxonomy, did not remain when the scaffolding was faded out. A reason for this might be that collaborating requires an investment in time and effort and that the tasks or selection of texts were not complex enough to create a need to collaborate (Kirschner, Paas, & Kirschner, 2011) or the interdependence needed for collaborative learning (Johnson & Johnson, 1999). If the need to collaborate was low, this might also explain why these scripts were not sufficiently internalized to create a lasting effect. We measured the direct effects of macro- and micro-scripts while teacher feedback was only provided on the content-related effects based on the micro-scripts, and not on the collaboration-related performance based on the macro-scripts. Collaboration-related feedback might have stimulated the students in the experimental group to stay engaged in collaboration over a longer period of time and to internalize the corresponding behavior. This leads to two suggestions for future research: 1. To research the effects on the internalization of macro-scripts when tasks are designed with higher complexity levels, and 2. To research the effects of a combination of macro-scripts and teacher feedback on collaboration performance to enhance the internalization of the macro-scripts.

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Model for Profiler Agent during unexpected educational circumstances

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Abstract

Nowadays distance education helps when no other traditional possibility is allowed. But is it a good alternative to replace entirely the traditional education? Could it provide at least the same level of quality or it brings problems that we are not prepared for? The paper presents an observation of a problem with keeping students focused on their education – constant dropping of engagement and unintentional loss of attention during situation of distance learning, and a practical approach to deal with the problem. Appling measures to keep students' attraction led to the need of some aspects' automation – a model for a new intelligent assistant, software agent, was developed, along with the current ones in the existing system. This assistant will create profiles of students, helping with personalized tracking of each student's progress in specific subject, recommending topics to improve knowledge and fill knowledge gaps. It will "live" in the extension of an existing system and cooperate with other agents to accomplish its goals, proactively assisting in students' learning aspects, as well as teachers' efforts to prepare better and more suitable educational materials.

Keywords: *E-learning; software agents; service-oriented architectures; educational portal; personal assistants.*

Introduction

In the last year people have faced situation, that most of them were unfamiliar with – social and physical distance, isolation. We had to switch from a "normal" life to some kind of strange being, making us rethink what are the most important priorities and how we could live, communicate and interact using only technologies, without close personal and physical contact.

As this situation spread over entire world and almost any industry, it has not skipped the education, as well. Everyone involved in educational processes had to learn how to deal with the systems for distance learning – teachers faced the need to prepare their teaching materials and attitude for distance learning and e-learning. It is obvious that e-learning itself is something very useful, but now it seems that it can't replace traditional learning entirely, or at least not without undesired side effects. And probably among the most challenging problems was how to keep students attracted to the matter and education as a whole; they had to learn with fast pace how to educate themselves when no one is around physically to help them (which was one of the positive effects, building problem solving skills for many), but meantime they need to keep their focus on education, not being distracted by the laziness and the comfort of addiction of using their smart devices only for fun. The last has become the main challenge according to our experience, because the students' engagement is continuously dropping as our observations show below. As a result, we had to respond by taking adequate measures, and one of them is the subject of this article.

It turns out that the problem described above is not isolated. Many institutions experience demotivation of students, distraction and lack of attention – and respectively, how the manage it. Their studies on the problem are described in (Hornsby, 2020; Reynolds, et al., 2020).

Many systems helped teachers and students keep in touch in education – like Google Classroom (Google, 2014), Moodle (Dougiamas, 2002), to name a few. Many universities have developed their own systems to cover their specific needs, among them is Plovdiv University "Paisii Hilendarski" (Plovdiv, Bulgaria), where we have implemented and extended Liferay (Liferay Inc., 2000) based portal named DeLC (Doychev, 2013), with several satellite extensions, subjects of many studies (Stoyanov, et al., 2012; Stoyanov, et al., 2005).

Distributed eLearning Center (DeLC) is intended to support the educational process for both parties involved – students and teachers, and it has proven its capabilities for more than ten years of use. For students, it provides better education quality and knowledge improvements, filling gaps in understanding the course materials; for teachers – improvement of their lectures and teaching methods, and mostly in students' examination. Many aspects concerning DeLC's work are constantly monitored and this portal is periodically a subject of improvements, which is true for the teaching materials as well.

During its lifecycle, the architecture was extended with different subsystems, among which is IntelliDeLC – to provide a personalized e-learning environment with reactive and proactive behavior (Stoyanov, et al., 2011; Cholakov, 2013; Stoyanov, et al., 2012). The proactivity improves the usability and friendliness of the system to the users, which means that the software can operate „on behalf of the user" and „activate itself" when it „estimates" that its intervention is needed. In DeLC, proactivity is ensured through „reinforcement" of the service-oriented architecture with intelligent components – which are software agents. These agents (also called assistants) "live" and operate in the back-end agent-oriented server.

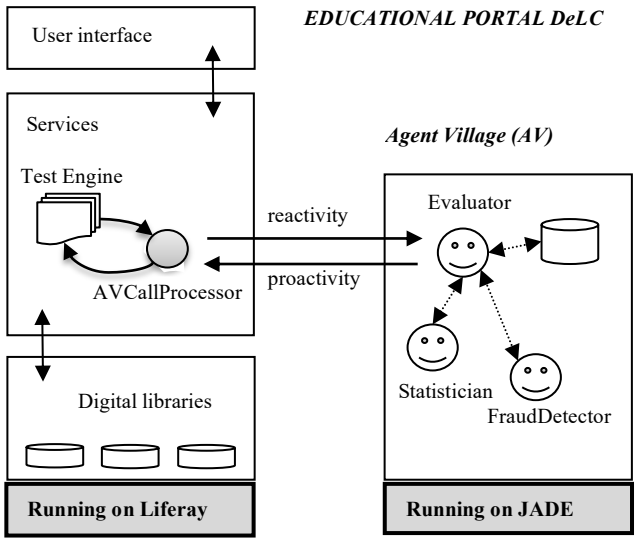

Figure 1. DeLC architecture with Agent Village extension.

Their environment is referred to as Agent Village (AV). The DeLC architecture is simply depicted on figure 1.

1.1. Agent Village

The Agent Village is the environment where the assistants (agents) are deployed and operate. It is created and running on JADE framework (Telecom Italia, n.d.). The communication between agents is based on ACL messages (FIPA, 2021). Outside Agent Village, the agents' services are wrapped and available as SOAP web services. More details on this topic are published in (Cholakov, 2013).

1.2. AVCallProcessor

This module serves as a mediator during the communication between DeLC and Agent Village. It is deployed in the portal as a system service and makes all requests to agents transparent for the portal. The communication works as follows: when DeLC needs a service from the Agent Village it simply calls a method from AVCallProcessor, which generates a SOAP request to Agent Village, where this request is transformed to an ACL message, understandable by the agents; on the way back, the result is formed by the corresponding agent as an ACL message, which is transformed by Agent Village as a SOAP response, transferred to AVCallProcessor, which parses the response and generates the result in expected format by the portal.

1.3. Evaluator Agent

The Evaluator Agent (EA) provides expert assistance to the teacher in the assessment of electronic tests. While the test engine in DeLC has a system service for automated assessment of "multiple choice questions", this assistant helps in analyzing answers in short free-text questions by rating the answer, but always leaving the last word to the teacher. When the test engine needs external assessment, it initiates a request for expert assistance, and then the reactive behavior of the EA is applied. The agent uses knowledge base to search for matches, generated from keywords and phrases for each test question. Latest approbation of this agent was published in (Cholakov, 2020).

1.4. FraudDetector

The FraudDetector agent helps trying to recognize any attempts for cheating in the answers, given by the students. Among these attempts are copy/paste results from Internet search engines and using portal's chat system to share answers. This assistant cooperates with Evaluator and if its receptors detect a probability of a cheating, it informs Evaluator, which, on the other hand, informs the assessing teacher that this answer requires a special attention, because it is a suspicious one. This agent relies on its own knowledge base, which is generated from: the words that forms each question; the keywords for each question; the words from the students' answers; the messages between students in the portal's chat system, which are marked by an operator as cheating. More on this in (Cholakov, 2013).

1.5. Statistician

Statistician stores information about all processed answers with full history of the details from all calculating methods, used by the Evaluator agent. This assistant needs a feedback how many points are finally given by the teacher for each answer. Thus, it accumulates a knowledge base for each teacher and can decide which of the methods best suits the assessment style of the currently assessing teacher.

2. The problem

During the pandemic measures we had to switch to distance learning entirely. Prolonging this period showed that the students' interest to educational process is constantly dropping – figure 2 depicts this statistic from three semesters.

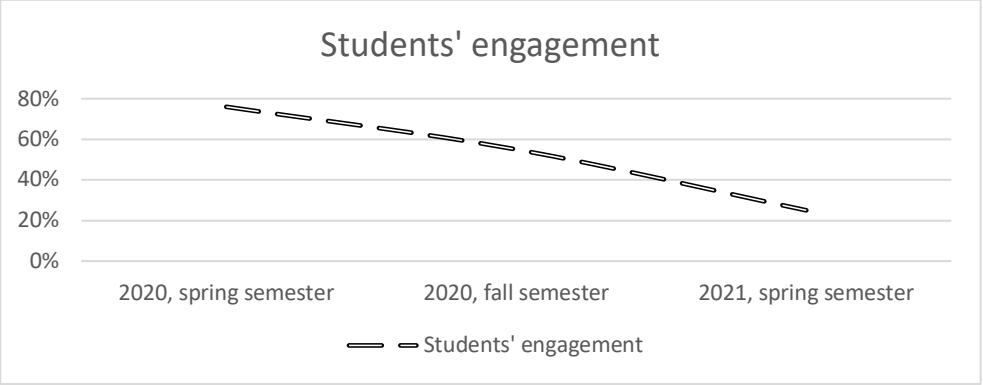

Figure 2. Students' interest during last three semesters.

The statistics shown above take into account an average students' attendance, classwork, as well as taking part actively during lections and labs in a particular subject - "Database management systems", in four different specialties, but the situation is similar to these ones in other subjects. So, we needed to react in a timely manner not to lose them along the way. As part of our weekly tasks, we started putting students on tests and provoking quizzes after each new topic, more often than usually. As a result, now students have more tasks, but these tasks do not consider individual progress and gaps, because they are class based. Controlling each student individually turned out to be a heavy process, as we have an average of over two hundred students per semester per subject, which means that we need some automation to help keeping the quality of education.

3. The idea

Since we have automated the process of exams evaluation, which is individualized per student, can we have something similar to personalize the quizzes and weekly tests, based on previous results? And end up monitoring students progress, as others do (Dongming, et al., 2014; Costa, et al., 2019).

Apparently, we need software assistant, that could create personal profile for each student per subject, which should be capable to recognize knowledge gaps and choose appropriate materials and quizzes for each. The assistant's model, called Profiler, that emerged from the business analysis, shows next necessary features:

- Tracking progress for each student per subject – this information could be extracted from the tests results, available in portal's database – and thus profiling each student. Using data mining could reveal patterns of behavior while learning, not obvious for teachers, but useful for analysis and further directions – which implies active cooperation with Evaluator agent, which has knowledge about past student's results;
- Based on the profile above, the assistant should create personalized tests with content that seems to be not very well learned by the student – this should keep student on track. It could recommend materials – lectures, books' chapters, depending on individual progress, and that requires each topic to have related educational resources. This functionality implies using of AI methods to determine the level of knowledge perception;
- To honor student's efforts, the assistant could take part in final evaluation of the grade, because it will keep information in the profile about student's results during the entire semester;
- Analyzing the average progress for each topic of the materials, this assistant should give a feedback to teacher as well, to propose materials updates when necessary.

We consider this functionality as a good base to start implementation, although there are still some points to analyze. The architecture of Agent Village will be extended with the new agent as shown on figure 3.

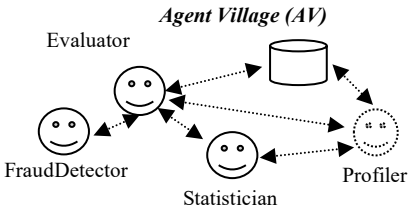

Figure 3. AV extended architecture.

Getting deeper into business analysis of the topic revealed that the problem has psychological aspects – beyond the scope of a simple development of single component (Profiler agent), and they should be taken into account in requirement specification. That's why using Agile methodology for this development seems a natural choice – dividing the task into several small iterations (sprints) will help in getting first impressions faster, and give more time to receive opinions from specialists in human behavior. Such approach would produce more reliable results after each iteration and would help in producing more useful software component, eventually.

4. Conclusion

Keeping high education quality level during distance learning is crucial for both parties involved – students and teachers. Applying new measures to engage students with the

educational process puts new challenges. To automate some frequent tasks, we need to use machine assistance – in our case to develop new software agent, responsible for profiling and control of students about their progress in particular subject. This assistant should help students get better knowledge and it could bring even more value – generating psychological effect that the education goes on, it is not suspended, and students must give their best in this process. The expectations are this agent to help proactively students in learning, as well as the teachers in preparing lectures content, and provide monitoring over students' progress. Now, as we have the requirements, the development process could start.

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Suitability of Blackboard as Learning Management System to assess oral competence: Students' perceptions and results

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Abstract

Learning a foreign language involves the practice and development of linguistic competencies through a series of communicative activities. Assessing each of these competencies face to face can provide an accurate profile of the student's level of language proficiency. But assessing them online, particularly oral skill, poses a challenge for both students and professors. The change of scenario and use of digital tools may intimidate students and deprive the interview from naturality and warmth. In this paper, the suitability of Blackboard Collaborate as Learning Management System to assess English speaking skill is studied together with other factors influencing students' online performance. 81 students from 5 different undergraduate programs in Engineering and Applied Sciences were assessed, following the threefold pattern of IELTS speaking test questions (International English Language Testing System). Their results and responses to a final survey are contrasted so as to check the positive of negative effect of online testing on the students' state of mind and eventual achievement. Blackboard platform proves to be as a suitable online framework for optimal performance, and the examiner's attitude is equally a conditioning factor in students'success.

Keywords: *Assessment; speaking skill; oral competence; Learning Management System (LMS); online platform; Blackboard.*

1. Introduction

The achievement of learning goals in foreign language learning must be checked by means of consistent assessment types and reliable tools which reveal the students' actual level of linguistic competences. Apart from the numerous ways of standardized testing which are currently widely applied in order to certify individuals' proficiency level in a language, new forms of formative assessment have sprung at university level to check students' language learning. Standardized tests have found in online formats a suitable and profitable way to give access to greater number of students to certified exams together with a means of facilitating and shortening the grading time. Both easy access and time-saving procedures, as well as proven validity, are nowadays among the most valued features in standardized testing. Focusing on English as a foreign language (EFL) at Higher Education (HE), learning of a foreign language is usually incorporated into the curriculum as part of undergraduate programs in the form of English for specific purposes (ESP). No matter what specific field of study English is taught, foreign language (FL) is learnt in a much more contextualized and personalized environment. Learning goals are not restricted to linguistic skills but they also include a carefully selected range of competencies to be developed throughout the learning period. Students' practice of the language with a communicative purpose, guided by the specialized professor, proves to be a valuable source of information and reciprocal feedback. Foreign language learning in this context is a natural process where interpersonal communication is an important part and where not only linguistic skills are developed but other non-linguistic skills. These university scenarios where ESP is learnt make it easier for professors to assess students and, in turn, the latter find them safe environments to be assessed.

The growth of universities and spreading of students into different campuses meant a challenge for higher education programs. In particular, many universities, forced by the Covid-19 pandemic, risked themselves to transform most -if not all- their programs into an online modality. This fact has meant not only a great investment of resources and effort, but also a launching of online courses supported by different Learning Management Systems (LMS). In the case of foreign languages, the theoretical content of which is scarce compared to the practical content, this transformation has posed a real challenge. LMS offer many utilities for the presentation of contents and, very often, features to let students practice the language both orally and in written form (Rodrigues and Vethamani, 2015). But online platforms lack the closeness and warmth of personal face-to-face communication (Jordan and Duckett, 2018). As regards skills and competencies involved in FL learning, educational researchers recognize the difficulty to assess them, especially oral ones, in online environments (Babo, Azevedo and Suhonen, 2015).

2. Objectives

The main objectives of this study are the following:

1. Check if Blackboard is a reliable LMS to assess oral competence of English for Specific Purposes (ESP) students.
2. Check if Blackboard is technically efficient for speaking assessment
3. Find out which other factors -apart from the platform efficiency- may influence students' speaking performance.
4. Know the students' perception of possible advantages of Blackboard compared to face-to-face speaking assessment.

3. Context and test group

ESP is a 6-credit obligatory subject taken by all university students over a semester at UCAV (Catholic University St Teresa of Avila, Spain). An intermediate level of English (B1-B1+) (according to the Common European Framework of Reference for Languages, CEFR) is to be achieved in each of the undergraduate programs. It is academic English with specific language referred to the different fields of study. Participants in the present research were all students taking English as a foreign language (EFL) in Forestry, Agricultural and Mechanical Engineering (60%), Environmental Sciences (17%) and Psychology (23%). Test group consisted of 81 undergraduate students, 54 were men (66.6%) and 27 women (33.3%). Table 1 shows age composition of the test group.

Table 1. Test group composition by age.

Age range	**19-29**	**30-39**	**40-49**	**>50**
Percentage	44.3%	30%	22.9%	2.8%

All 81 students took a speaking test at the end of the semester, as part of their FL final exam, via an online platform.

ESP courses were delivered online using Blackboard as Learning Management System (LMS). The specific version supporting instruction was Blackboard Learn 3800 (Blackboard Collaborate Ultra), which offers a wide range of functionalities for FL teaching and learning and, in particular, the development and assessment of oral competence. The choice of Blackboard Learn 3800 was due to the fact that it is the LMS used at the Catholic University St Teresa of Avila. Following the distinction that some researchers make within the oral competence, we will specifically focus on the speaking subcompetence of the foreign language, henceforth speaking skill (González-Such, Jornet Meliá and Bakieva, 2013).

4. Methodology

A mixed-method approach (Englund, Olofsson & Price, 2017) was adopted collecting quantitative and qualitative data. Qualitative data were collected from examiner's observation during the speaking tests, registered session reports, and student responses to open-ended questions included in an anonymous online questionnaire. Quantitative data were provided by a web-based survey of closed questions and from speaking test results.

4.1. Procedure

Speaking tests of 81 undergraduate students took place in six different sessions. They were performed individually, in the format of a structured interview between the candidate and the examiner, who was the same professor in all sessions. The students, in turns, entered the virtual classroom on Blackboard platform and the examiner asked the candidate three questions of three different types: (a) open questions referring to personal background or experience; (b) prompts for the candidate to speak on a topic for two minutes; (c) opinion-questions about more general topics. Each performance was recorded and its length was between six to eight minutes on average. A rubric was used for the assessment of a variety of features which are indicators of oral proficiency (González-Such *et al*, 2013): lexical (vocabulary suitability to the topic and context), morphosyntactic (language usage and discourse structures), phonological (pronunciationa and intonation), sociolinguistic (adequacy to the context and register, and fluency).

After all speaking tests were completed, students were invited to answer an online survey delivered through Google Forms. The survey should be answered anonymously and consisted of 16 items:14 multiple choice and 2 open questions. 70/81 students answered the online survey, which represents a high response rate (86.4%).

5. Results

Students' responses in the survey reveal that for 37% of students, it was the first time they had taken a speaking test in FL. Moreover, 83% of students had never taken a speaking test through an online platform.

Examiner's reported observations on Blackboard technical features are summarized in table 2. They will shed light about how they may have positively or negatively affected students' speaking test.

Table 2. Observations on Bb technical features during speaking tests.

Technical features	Performance	Incidents
Image	Synchronic visual interface	Scarce. Only due to blockers in student's browser
Sound	Synchronic sound with no delays	Very few. Due to student's faulty Internet connection
Whiteboard	Usefulness for presenting a topic to talk about	None
Chat	Parallel communication support in case of need	None

The few incidents (a total of 6) which occurred when some candidates entered the virtual classroom, were sorted out by resorting to change the student's device or moving to another location where internet coverage was better or broadband was available. On those particular cases, access to Blackboard from an iphone never failed. Table 3 shows the range of devices used by students to access the virtual classroom for the speaking test.

Table 3. Digital devices used for speaking test.

Device	%
Laptop	65.7%
PC	22.9%
Mobile phone	10%
Tablet	1.4%

As it was described above, each of the 81 students was asked three different questions in the course of a semi-structured conversation. Presented in a progressive level of difficulty, they aimed at rating the student according to a rubric. They ranged from simpler questions referring to the candidate's personal background, preferences and experience, which build up the person's self confidence (Mishra, 2014), to more complex questions to express their opinion about general issues. Each of the indicators of oral proficiency was scored from 0 to 5 and the total final overall score was calculated and provided on a scale over 10. Speaking tests results 2020-21 are shown in Table 4.

Table 4. Online Speaking Test Results 2020-21.

Students' Program	Mean	Median	Mode	SD
Forestry, Agriculture and Mechanical Engineering	6.9	6.25	9	1.9
Environmental Sciences	8.1	8	8	1.4
Psychology	6.6	6	7	1.8
Test group globally considered	7.2	7	6	1.8

Though mean scores vary depending on the program, figures show high levels of performance. Standard deviation values are low. Only 6 out of 81 students did not achieve the minimal level of speaking competency required for an intermediate level of oral proficiency in English. This represents only 7,5% of test group in contrast with 92,5%, percentage of successful students. In order for results from online speaking tests and face-to-face speaking tests to be compared, scores from speaking tests taken by Engineering, Environmental Sciences and Psychology undergraduate students -globally considered- in academic years 2017-18, 2018-19 and 2019-20 are shown in table 5.

Table 5. Face-to-face Speaking Test Results 2017-2020.

Academic year	N students	Mean	Median	Mode	SD
2017-18	24	6.39	6	6	1.96
2018-19	29	6.85	6.4	6.4	1.64
2019-20	27	7	6.8	6	1.72

When questioned about which modality was preferred for taking a speaking test (online or face-to-face), 7,1% were indifferent and 68,6% of respondents expressed their preference for online mode. Table 6 summarizes the reasons for students' test modality prefences.

Table 6. Reasons for student test-mode preferences.

Face-to-face	n	Online	n
Communication is more natural	3	It is more comfortable and practical	16
Communication is less cold and impersonal	5	It makes one feel more comfortable	4
Communication is more real	3	One feels less nervous	13
The possibility of technical failures adds anxiety to exam situation.	4	Being at home or personal environment reduces anxiety	6
Possibility of more non-verbal communication	2	It is highly time-saving	9

Regarding the examiner's non-verbal feedback and attitude during the speaking test, 95,7% of students stated that her friendly and supportive attitude helped them in their speaking performance. The second open-ended question in the survey was *"In general terms, do you think that Blackboard virtual classroom is a suitable means to take a speaking test?"*. Students' responses reveal that they do consider Blackboard Collaborate Ultra (Bb) a suitable LMS for taking oral exams because of the following reasons:

(a) Optimal audio and video quality

(b) Easy to use, intuitive

(c) Simple to connect and access

(d) Secure for an exam: audiovisual intercommunication with no interruption

(e) Comfortable and time-saving

(f) Agile and dynamic, with useful features

6. Conclusions

The discussion of the results and the main conclusions of the study are organized according to the research objectives. In relation to Objective 1 "Check if Blackboard is a reliable LMS to assess oral competence of English for Specific Purposes (ESP) students", from both the examiner's observation and the student's reponses, it can be concluded that it offers a secure online environment for an oral exam. Audiovisual intercommunication with no interruptions makes it possible continuous interpersonal communication. Likewise, it enables the synchronic completion of different tasks in order to assess the candidate's speaking proficiency at a lexical, grammatical, phonological, discourse and sociolinguistic levels. As other researchers have also pointed out (Irawan, 2020), the possibility of recording the session on the platform lets the examiner replay the video of students' speaking performances in order to focus on students' utterances and speech details. This recording feature facilitates a more accurate assessment of student's speaking skill.

Regarding Objective 2 "Check if Blackboard is technically efficient for speaking assessment", synchronic image and sound with no streaming delays optimize interpersonal communication during the exam. 68,6% of students expressed their preference for taking their speaking exam through Bb platform and 98% recognized its optimal performance during the exam as well as its easy and comfortable use and access. This latter statement is interesting to consider since -as it was shown in the students' age range- not all of them may have a highly developed digital competence, necessary requirement to master and feel self-confident at using a digital platform (Hussein, 2016). Lastly, the platform versatility makes access possible from every digital device, which adds convenience to its use.

As regards Objective 3 "Find out which other factors -apart from the platform efficiency- may influence students' speaking performance", answers to open question 1 in the survey (i.e. "*Which modality do you prefer to take a speaking exam: face-to-face or online?")* reveal at least three. Firstly, speaking to the examiner through a camera interposes a "safety barrier" which makes students feel less tense and nervous. 27% of students who prefer online speaking tests mentioned this favourable factor. Secondly, 12'5% of students who shared the same online preference, indicated the fact of being located in a familiar place or at home as a contributing factor to relaxation and higher fluency at talking in FL. Thirdly, and most important, 95,7% of all 70 respondents recognized in the examiner's friendly and supportive attitude a decisive and beneficial factor to lessen psychological barriers in order to speak more confidently in the foreign language. As it was stated by one of respondents in the

survey, "*closeness between student and examiner depends not so much on the digital platform but on the examiner's attitude".*

Finally, in relation to Objective 4 "Know the students' perception of possible advantages of Bb compared to face-to-face speaking assessment", the alleged reasons are -in order of priority- the following: (a) comfort and practicality; (b) talking on the screen facilitates a higher concentration on the tasks and reduces nervousness ; (c) it lets students save a great amount of time since they need not travel or miss other academic or professional activities; (d) the possibility of being examined from home or a familiar environment eases the associated exam situational tension; (e) it lets students feel more comfortable and self-confident. Overall, online platform Blackboard Collaborate Ultra proves to be a suitable LMS for optimal speaking performance and assessment, and the examiner's attitude is equally a conditioning factor in students' oral competence achievement. Considering that for 83% of students it was their first speaking test through an online platform, survey responses reveal a high level of satisfaction with the experience as well as with their exam results, which are slightly better than those corresponding to face-to-face speaking tests in previous years. Even though further research should be carried out in order to extend both the number and academic profiles of undergraduate students to be tested using Blackboard, it can be concluded that speaking assessment through Blackboard may provide a positive washback to students (Center for Applied Linguistics, 2021). This successful testing experience is a source of self-confidence and self-motivation not only for oral communication in the target language, but also for the development of technical and software-specific skills which lead to further successful online assessment.

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An Overview of a Blockchain Application in Education Using Hyperledger Project

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Abstract

During the last years, blockchain has been getting interest by both academic and professional researchers. This is primarily due to the innovative techniques in which records are effectively stored in a distributed manner. Started as a value transfer mechanism, blockchain now has several applications in a vast array of fields including healthcare, banking, and Internet of Things (IoTs). Despite the considerable amount of interest given to these fields, little is known about the possible applications of blockchain in education. Because of COVID-19 outbreak and the rise in the need of online and automated solutions in academia, this paper proposes an overview of a blockchain solution in education. This technology relies on the unique features it offers, such as decentralization, data integrity, and security. The presented solution aims to reduce the paperwork needed to perform tasks, secure the stored data, increase transparency, as well as to offer new recruitment possibilities and statistics capabilities to the current educational system.

Keywords: *Blockchain; education; transparency; reliability; security; academic career.*

1. Introduction

First emerging in 2008, by Dr. Satoshi Nakamoto (Nakamao, 2008), Blockchain's first implementation was a peer-to-peer shared ledger for cryptocurrency (Herbert et al, 2015). The focus of the technology was to decentralize systems and remove third-party intermediaries; thus, allowing direct peer-to-peer transactions (Barenji et al, 2018). This was possible thanks to the peer node network. In these networks, each of the peers hold a replica of the full ledger, execute operations on the ledger when achieving consensus, and share the user's transaction to other peers (Pappalaro et al, 2018). Regularly, each peer needs to make sure that the current local ledger is identical to the versions across the peer network (Gupta et al, 2019). Based on the growing interest and popularity of bitcoin, researchers started realizing the potential of such technology. Hence, many blockchain solutions are being developed in various fields (Gatteschi 2018), and therefore, the number of these solutions is rapidly grown. According to Gatteschi, et al, blockchain evolution can be categorized into three stages:

- Blockchain 1.0: refers to the usage of blockchain in cryptocurrency and simplifying transactions.
- Blockchain 2.0: introduces smart contracts, which are defined as programs that allow transactions under specific business rules; in other words, smart contracts enforce specific conditions on the transactions before being appended to the blockchain data structure. This addition revolutionizes decentralized solutions as smart contracts fulfill the needs that systems had for third parties.
- Blockchain 3.0: blockchain covers various areas and sectors; including governments, health, and education. Today. although the veracity and variety of literature on blockchain's application to educations has increased (Chen et al, 2018), it is still scattered and fragmented.

On the other hand, education is a fundamental factor of development. Besides improving people's quality of living, education also leads to broad social benefits to both individuals and societies (Ilhan, 2001). In fact, there is a strong evidence that the cognitive skills of the population are powerful indicators of individual earnings, distribution of income, and economic growth (Hanushek et al, 2007). Yet, education still suffers from several issues that limit the full utilization of the sector. Some instances of those issues are: redundant document exchange, scattered information, falsification of grades, and degree fraud.

Our solution consists on the development of a blockchain system whose participants are the students, schools, universities, affiliated companies, and the ministry of education. This centralization of information will provide new analytic features while granting a secure and immutable platform. Moreover, applying this technology to this field will enable a

personalized and adequate follow of the learners. Applied on a large scale, this technology can offer standardized practices and policies which will considerably facilitate the communication and exchange of documents between the different participants. This paper presents, first, an overview of the blockchain technology, then introduce the current applications in education highlighting the capabilities of the blockchain technology, finally propose an application which focus on reducing the overhead as well as increasing transparent and security.

2. Related Works

The importance of education in the development and advancement of a country is undeniable (Johansson et al, 2010); hence, there have always been attempts to find innovative methods to apply various technologies in the field. Blockchain is no exception, in fact it was used in several higher education applications. Most of those solutions rely on a bitcoin blockchain approach (Fasso et al, 2020). NazarAl et al. suggested a platform for creating, verifying as well as sharing certificates. This method is led by Media Lab Learning Initiative at the Massachusetts Institute of Technology (MIT). Their methodology consists on solving issues related to the digitalization of academic certificates; however, the proposed solution does not investigate the potential capabilities of blockchain in a global higher education credits/grades management system.

Additionally, The National University of La Plata (UNLP) has started the development of a blockchain based framework that aims at verifying academic achievements; however, no academic paper releasing further details about the project has been published (Arganaraz et al, 2019). Argentinian College (CESYT) has adopted a similar approach in order to issue students' diplomas by utilizing Bitcoin-based Blockchain and cryptographic features; however, their approach lacks generalization and can hardly be implemented to follow students' complete academic careers as it does not offer the possibility to obtain credits for completed academic milestones.

Moreover, several institutions have shown interest in applying blockchain technology to manage student's academic affairs; for instance, partnering with the French Bitcoin startup Paymium, The Parisian Leonardo da Vinci Engineering School (ESILV) announced in 2016, a bitcoin-based certification mechanism (Das 2016). In 2015, using Blockchain technology, The Holverton School, a software engineering school in San Francisco, has allowed employers to verify applicants' academic credentials in order to reduce degree fraud (Coleman, 2015). However, both implementations have not yet been applied.

3. Methodology

In this section, we will be using Hyperledger's schema to describe the blockchain network implementation. We will start by defining the model's structure, the chaincode, and the access control rules, then illustrate the system's architecture, and finally, state the advantages that our system offers over current systems.

3.1. Hyperledger Project

Hyperledger project has been released by the Linux Foundation in 2015. The project consists on an open source blockchain ecosystem that speeds up the development process of blockchain solutions by providing a distributed ledger (Dhillon et al, 2017). The power of Hyperledger project resides in its intent to provide a modular and extendable blockchain architecture that can be applied to various fields and diverse environments.

3.2. Model

3.2.1. Participants

The participants represent the different actors that take part of the educational business network (Cachin, 2016). This implementation makes use of the following 6 participants:

- Student: enroll in an institution, earn a grade in a class, and receive a diploma/certification
- Teacher/Professor: evaluate students' performance and access class statistics
- Parents/Tutors: access a student's view and request statistical information about a student's academic performance
- Institution: ranges from primary schools to universities, they enroll students, offer classes, and issue degrees
- Employers: Verify the authenticity of a degree and employee's academic information
- Administrator/Ministry of education: issues accounts, access educational statistics and request changes to alter the chaincode

Figure 1 shows a typical participant definition. In this case, we define a student-participant identified by his/her national identity number, a unique string identifier, which is reprented in the figure by "nin".. The student participant tracks the students' personal information as well as his/her academic career.

```
participant Student identified by nin {
  o String nin
  o String firstName
  o String lastName
  o String email
  o String address1
  o String address2
  o String fatherNin
  o String motherNin
  o String lastName
  o Date dateOfBirth
  o String currentInstitution
  o String[] currentClasses
  o String[] classesTaken
  o String[] institutionsHistory
  o String[] certifications
  o String[] diplomas
  o String publicKey
}
```

Figure 1. Typical Participant Definition.

3.2.2. Assets

Assets denote anything of value; this includes both physical and non-physical assets (Cachin, 2016). This implementation requires an asset per classes being taught and diploma/certificate obtained. These assets can be divided into two main categories:

- Classes: track detail of the courses, the students' enrollement, the faculty lectures, the students' grades, as well as a timestamp.
- Diplomas/Certificates: track documents' details, issuing institution, students' distinction, and a timestamp.

Figure 2 illustrates the definition of the course asset. In this implementation, we use a template to generate the class details, a timestamp in order to track temporal information about the class, the students' grades and their letter grades, reference the student passing the class, the instructor lectures the course and the institution offering it.

```
asset Course identified by certId {
  o String certId
  --> CourseTemplate courseTemplateId
  --> Institution institution
  --> Professor professor
  --> Student student
  o String letterGrade
  o Float grade
  o String hash
  o Date timestamp
}
```

Figure 2. Typical Asset Definition.

3.2.3. Transacctions

The transactions refer to the actions that can be executed by the participants in order to affect the assets held in the registry (Cachin, 2016). In this system, we define two operational transactions:

- Completing a Course: It can be whether passing or failing a class. In case of a successful completion, the asset is passed to the students containing their grades.
- Graduating: This transaction refers to the completion of academic milestones set by the administrator in the chaincode the attainement of a certificate or diploma.

Figure 3 shows the graduation transaction of a student. In this transaction, we transfer the ownership of a diploma-asset from an institution to the students completing the requirements.

```
transaction RecordDegree{
  --> Degree degree
  --> Student student
  --> Institution institution
}
```

Figure 3. Typical Transaction Definition

3.3. Chaincode

The chaincode refers to a blockchain smart contract. It is a program that handles the business logic agreed upon by the network participants and takes care of initializing and managing the shared ledger through the transactions defined above (Cachin, 2016). This implementation defines the following functions:

- Student Creation and Update,
- Professor Creation and Update.
- Institution Creation and Update.
- Access to Statistics.
- Student/Professor Enrollment in institutions.
- Student/Professor Enrollment in courses.
- Student Completing a Course.
- Reception of Diploma.
- Evaluating a Student.
- Course Creation.
- Diploma Creation.
- Hiring a Professor.
- Verification of the Authentication of Degrees.

The implementation consists of changing the owner of the certificate, setting the degree type, the institution affiliated to, initializing the timestamp to the current date and time , and finally update the asset from the asset registry using a promise. Figure 4 illustrates an overall structure and a design architecture of the described blockchain network. It shows the participants involved in this field, the assets that are in play, as well as the possible operations and actions that can be executed by the different actors.

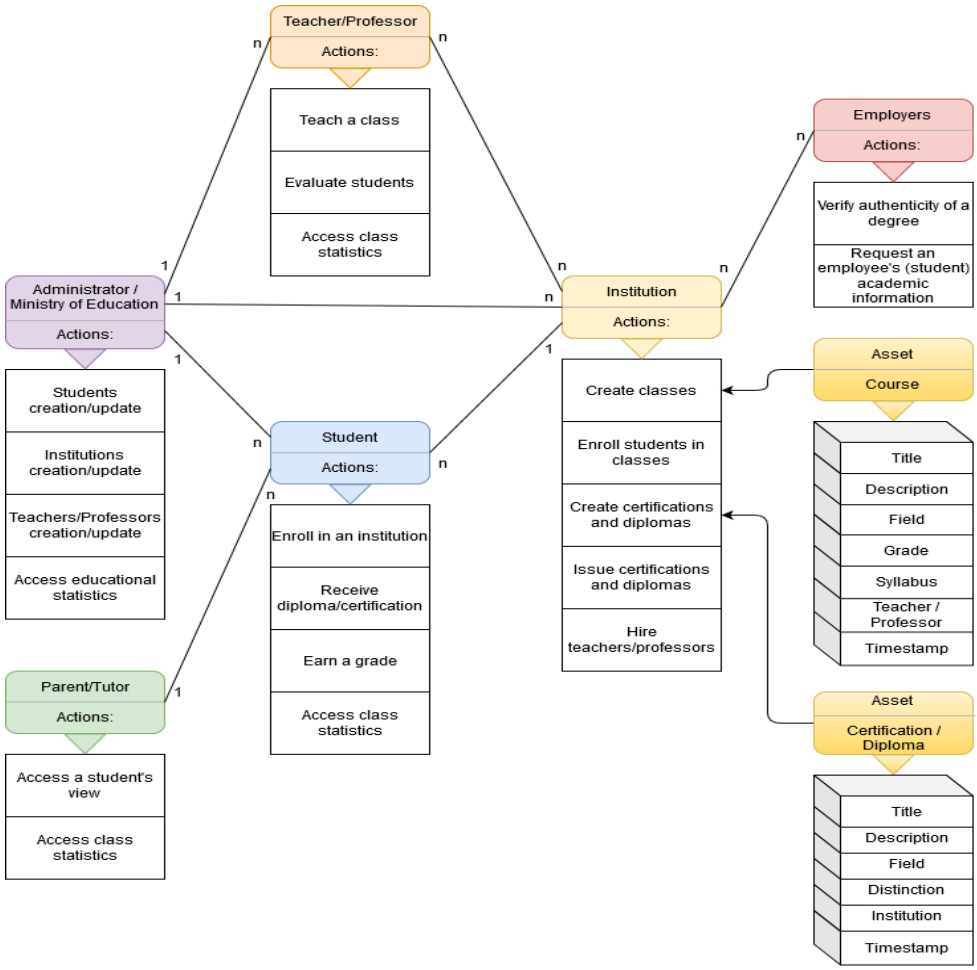

Figure 4. Overall Structure the Proposed Blockchain Network.

4. Future Work

Although this implementation covers the main aspects of the educational field, there are few aspects that deserve to be handled in order to present a more complete image of the academic life. We cite the following as possible improvement to the system:

- Handle student clubs' positions and extracurricular activities.
- Allow inductrial employers to have access to class records in order to offer targeted hiring options.
- Include student's class work which can allow the generation of an entire academic portfolio.
- Incorporate machine learning capabilities to the statistical data collect in order to predict various information, such as: the time needed for a student to graduate, predict students' grades, and suggest statistically optimal career paths.

5. Conclusion

Blockchain is essentially constituted of a distributed ledger system and a world state database. This technology makes the use of cryptographic techniques and consensus validation algorithms to leverage decentralization, immutability, and complete traceability. When applied to education, those unique properties can offer several valuable improvements.

Blockchain technology as well as the described system offers numerous advantages over the currently adopted systems. Those advantages can be summarized as the following:

- Facilitate the application processes as institutions have access to the complete student academic records.
- Eradicate degree fraud as employers can trace employees' career paths.
- Unfalsifiable student grades thanks to immutability and cryptographic aspects of blockchain.
- Centralize data in one platform which offers numerous statistical capabilities.

Considering the current situation of COVID-19 outbreak in the world and the rise in the need of online and automated solutions in academia, this paper proposed an overview of a blockchain solution in education. The presented solution, which can be considered as a first step into applying blockchain into education, offers focused tracking of different student stages; starting from the student's first class to their job recruitment; thus, facilitating major procedures, providing useful statistical capabilities, and countering fraudulent activities.

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Post-editing Machine Translation in MateCat: a classroom experiment

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Abstract

Advances in machine translation resulted in an increase of both volume and quality of machine-translated texts. However, machine translation still requires humans to post-edit the translation. This paper proposes a product-based approach of a post-editing (PE) experiment that was carried out with a total of 10 MA translation students. The goal of this study comprised both the analysis of the post-editing results performed by student translators involving a machine-translated text in MateCat and the subsequent error markup. By comparing the quality reports obtained at the end of the post-editing process, we analysed the linguistic quality results and observed a heterogeneous error distribution, considerable divergence in severity level ratings and a huge span of TTE (time to edit). This study aims at making a contribution to the integration of post-editing activities into the translation technology classroom for students without prior experience in PE.

Keywords: *Machine translation; post-editing; MateCat; translation technology classes.*

1. Introduction

Advances in Machine Translation (MT) are profoundly changing the translation profession, turning post-editing of machine output into a dynamic and widely-known practice. During the last five years, there has been an enormous upswing through the use of machine learning. Google and DeepL came up with Neural Machine Translation systems that by simulating neurons of the human brain, have established new standards in MT. Nowadays, computer-aided translation tools and translation management systems allow the integration of MT into their translation workflows to enhance productivity. The fast-growing volume of machine-translated documents increasingly makes post-editing (PE) services indispensable, by which a human translator checks a machine-translated outcome for its lingusitic and textual quality.

With regard to an ever more demanding market that values translation quality and speed, Translation Quality Assessment (TQA) has therefore gained a new relevance. There has been a lot of research in the field of TQA linked to MT, trying to establish criteria for measuring quality and error analysis. Due to its huge impact on the translation activity itself, translation technology classes should integrate PEMT activities into their standard curriculum, in order to meet the requirements of today's job market. "In an increasingly competitive market where quality-focused translators come under intense pressure from clients to sustain quality standards while offering more attractive rates and faster turn-around times, models and tools to support translation quality assessment (TQA) are a necessity" (Doherty et al., 2018, p. 95).

2. Human judgement of machine translation

Both industry and research have come up with a variety of quality evaluation metrics that aim at finding a standard for assessing translation quality produced by machines through objective and measurable indicators (cf. Vilar et al., 2006; Lommel et al. 2014). "Automated metrics emerged to address the need for objective, consistent, quick, and affordable assessment of MT output, as opposed to a human evaluation where translators or linguists are asked to evaluate segments manually" (TAUS, s.d.). Due to the fact that human language is a complex, subtle and ambiguous system, it is a rather challenging undertaking to evaluate machine translation. Both the manual and automatic approach aim at establishing valuable parameters for quality evaluation.

In manual evaluation, a machine-translated text is analysed in terms of its grammatical correctness, its semantic adequacy and its suitability for text convention patterns. These parameters, known as *fluency* and *accuracy*, are usually given special attention. Whereas

fluency evaluation is achieved on the basis of the target text, *accuracy* is *assessed* by comparing the source and the machine-translated target text. In automatic evaluation, the MT output is compared to a number of reference translations, assigning them quality scores. In this approach, automatic metric scores correlate with human translations.

3. MateCat

MateCat is a web-based CAT tool which can be used for free by translators, project managers, LSPs and enterprises. MateCat provides matches extracted from a public Translation Memory (MyMemory) that performs machine translation through a combination of Google Translate and Microsoft Translator. Users may also create personal TMs for confidential use. MateCat allows for a quantitative-based method of TQA according to an industry standard that calculates the quality level of a translation with regard to the number of words reviewed. Consequently, the project manager is provided with a quality score on the project's outcome. Based on this score, the project manager may carry out changes to the project to increase productivity (cf. MateCat, s.d.). Figure 1 gives an example showing the post-editing effort for a segment by a participant involved in the experiment.

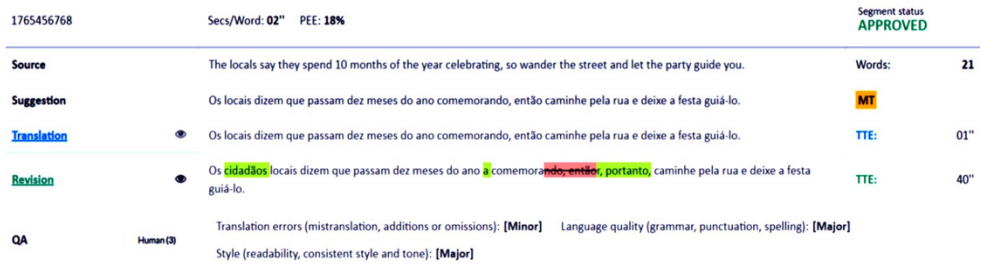

Figure 1. Example of post-editing a segment in MateCat.

4. Method and Study Design

The goal of this study is to analyse the usability of MatCat for introducing students to PEMT in the translation technology classroom. We want to find out to what extent student translators are able to define and categorise MT errors and assess them on the basis of a severity scale. In this experiment, students had to identify translation errors on their own and to decide which category the error could be allocated to. The error was then rated according to its impact factor as *neutral*, *minor* or *major.* The idea behind the experiment was to carry out an authentic PEMT activity, where the participants were asked to make all the necessary decisions on their own. The study was conducted with a group of 10 MA students of Specialised Translation who are familiar with MT and CAT tools. The

participants all being native speakers of Portuguese, were given an English source text (ST) of 447 words from the domain of tourism, which was machine-translated through MateCat. The ST did not contain any specific terminology, to make sure that the students were able to master this activity without using additional research tools. Students were then asked to evaluate the translation quality on the basis of the integrated issue grid that MateCat provides:

a) Style (readability, consistent style and tone);
b) Tag issues (mismatches, whitespaces);
c) Translation errors (mistranslation, additions or omissions);
d) Terminology and translation consistency;
e) Language quality (grammar, punctuation, spelling).

According to the severity levels of *neutral*, *minor* and *major*, participants had to rate each segment of the machine-translated text.
Figure 2 represents the example of a quantitative total error analysis performed by one of the participants.

QR Job summary

ID: 3602282	English US > Portuguese	100%	Reviewed Words 447	Translator Not assigned	Time to edit 00:15:19	PEE 14%	55.93 Quality score Fail Threshold 20

Issues	Neutral Weight: 0	Major Weight: 2	Minor Weight: 0.5	Total Error Points 25
Style (readability, consistent style and tone)	1	2	4	6
Tag issues (mismatches, whitespaces)				0
Translation errors (mistranslation, additions or omissions)	3	7	2	15
Terminology and translation consistency		1		2
Language quality (grammar, punctuation, spelling)		1		2

Figure 2: Total Error Analysis in MateCat

5. Results

The comparison of PE results obtained through a classroom experiment involving 10 MA student translators revealed the following data in terms of time to edit (TTE), post-editing effort (PEE) and error evaluation. The calculation of TTE, based on the time a translator spends on each segment, amounted in an average of 9min2s, showing, however, a huge variance among the students, ranging from 3min23s to 29min48s. PEE refers to the effort in

updating machine translation suggestions, and is automatically calculated based on the formula "total error points * 1000) / reviewed words".

The challenge of this PE experiment consisted not only in post-editing a machine-translated text, but also in defining and categorising errors. The final quality report revealed a huge span among students' error evaluation and the respective ratings. Since some segments contained several errors that overlapped, students had difficulties in assigning such overlappings to different categories, resulting in a huge variance of the total error grid. Another difficulty encountered was the delimitation of the severity-levels: *neutral*, *minor* and *major*. Given the generic character of these categories, students had more problems in classifying the errors that are less obvious, leading to a number of divergent answers. Table 1 gives a detailed overview of students' error analysis, revealing a rather heterogeneous classification result.

Table 1. Overview of Students' Error Analysis.

Participant	Style			Tag issues			Translation errors			Terminology and translation			Language quality			Total error points
	NE	M	MI	NE	MA	MI	NE	MA	MI	NE	MA	MI	NE	MA	MI	
1	2	5			1			3		1	6	1		3		36.5
2	1	2	4				3	7	2		1			1		25
3								8	1		5	2	1	2		31.5
4							1	2		1	4			1	1	14.5
5		1		1			1	4	1		4					18.5
6							1				11	3		3	7	33
7			4				1	5	7	2		2			2	17.5
8	2		1		1		3	1	2		1	8				25.73
9		1						2	2		1				3	10.5
10					1	1		12			5	3		2	2	43

Participants were faced with several challenges when carrying out the PE activity. Although the total error distribution was fragmented, we observed a rather homogeneous error distribution in a few segments. The following machine-translated segment was identified as a major translation problem by 80% of the participants involved in this experiment. The MT output was considered inappropriate and categorized as major translation error. 20% classified the translation problem as *Terminology and Translation consistency error* with minor and major severity-level ratings, respectively. The PE results obtained show that students had no difficulty in detecting a semantic translation error, as shown in the following example. However, they revealed difficulties in trying to correct the MT

suggestion. Examples P7 and P8 show that the participants did not succeed in conveying the original meaning, coming up with wrong translations.

ST: Terceira is Portuguese for "third", and fittingly this is the Azores' third largest island […]
MT: Terceira é a palavra portuguesa para "terceira", e apropriadamente esta é a terceira maior ilha dos Açores [...]
PE P1: É a terceira maior ilha dos Açores [...]
PE P2: A Terceira é, tal como o nome indica, a terceira maior ilha dos Açores [...]
PE P3: Terceira, tal como nome indica, é a terceira maior ilha dos Açores […]
PE P4: Terceira, apropriadamente é a terceira maior ilha dos Açores [...]
PE P5: Terceira é, tal como o nome indica, a terceira maior ilha dos Açores […]
PE P6: Terceira é apropriadamente a terceira ilha dos Açores [...]
PE P7: Terceira tem um sentido especial no seu nome: é a terceira maior ilha dos Açores [...]
PE P8: "Third" é a palavra portuguesa para "terceira", e apropriadamente esta é a terceira maior ilha dos Açores [...]"
PE P9: Terceira, tal como nome indica, é a terceira maior ilha dos Açores […]
PE P10: Terceira é apropriadamente a terceira maior ilha dos Açores [...]

The analysis of the results also showed that 30% of the participants let themselves influence and intimidate by the machine results, accepting translations based on the Brazilian variant of Portuguese. As can be observed from the following examples, the machine translation suggested the use of the pronoun você that in European Portuguese is usually avoided in a written text, whereas it is widely used in Brazil. Although familiar with these sociolinguistic differences, some students did not consider post-editing the segment, violating text convention patterns. We assume that this would not have occurred when translating the text without machine support.

ST: If you want to slip into a gentle pace of life, this is the island for you.
MT: Se você quer entrar em um ritmo de vida tranquilo, esta ilha é para você.
PE P1: Se quiser entrar num ritmo de vida tranquilo, esta ilha é para si.
PE P5: Se quer entrar em um ritmo de vida tranquilo, esta ilha é para você.
PE P8: Se você quer experienciar um ritmo de vida tranquilo, esta ilha é para você.
PE P9: Se quer entrar em um ritmo de vida tranquilo, esta ilha é para você.

It could also be observed that in segments with many errors, students were more attentive towards the correction of lexical errors, often neglecting grammatical aspects, such as the use of articles, or keeping accented characters from the Brazilian Portuguese.

6. Discussion

Due to the impact of MT on today's translation practice, it is of utmost importance to train future translators on PE. Over the last years, more and more Higher Education institutions have implemented PE modules/courses into their standard curricula, in an attempt to keep

track with industry innovations and changes. By preparing future translators for their professional life through a set of project-based activities involving translation technology tools, they learn "to make their own informed decisions about the type of work they can and want to do in the future, and to negotiate rates or deadlines with possible clients or employers" (Guerberof Arenas & Moorkens, 2019, p. 232). The present study collected PE data for the language pair English - European Portuguese and aimed at making a contribution to the research on PE activities for a subsequent integration into the translation technology classroom.

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Emerging technologies for learning in occupational safety and health: the experience of the videogame "Becoming safe"

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Abstract

In the paths for transversal skills and orientation (PCTO), italian students are considered like workers and therefore they must receive adequate information and training on occupational safety and health (OSH). These methods allow the students not to be excluded from the preventive measures of the health and safety at work by directing them towards self-protection. Today, this process can be supported through the use of digital tools such as videogames. The study describes a participative research and co-design work in 7 Italian high schools of agricultural, construction and manufacturing sectors, in order to co-create an educational tool (videogame) to promote OSH during the PCTO. The format could be a support for training and usable both in the classroom and in internship, according to the indications for the serious game's design. The study applied qualitative and quantitative methods: survey (277 students), word cafés/focus groups (50 students), 10 semi-structured interviews and 3 WhatsApp groups (12 students) to facilitate the participation and the engagement of teachers, students and OSH experts. Learning by playing has always been an activity, technologies today make it easy and funny, while gaming can offer cognitive and operational elements suitable for recognizing and therefore preventing the occupational risks.

Keywords: *Gamification; occupational safety and health; school; learning; videogame.*

1. Introduction

The EU Strategic Framework on Health and Safety at Work 2014-2020, (EC, 2014) states that "OSH awareness begins at school" and calls on the Member States to take greater account of OSH issues in school curricula, particularly in vocational training courses. The COVID-19 emergency highlighted the crucial importance of health, including the field of occupational safety and health (OSH). In the context of a definition of the education systems, the European Union introduced digital competence among the 8 key elements for lifelong learning of European citizens, demonstrating the centrality of digital in lifelong learning (EC, 2018). The European Commission, faces to the challenge of digital innovation, recently decided to promote a single Digital Education Action Plan which has 3 priorities: 1) Make better use of digital technologies for teaching and learning; 2) Develop digital skills and skills relevant to digital transformation; 3) Strengthen education through better data analysis and forward-looking analysis (EC, 2018). The Italian paths for transversal skills and orientation (PCTO) are promoted by schools for transversal activities to enhance the formative value of ongoing orientation. The focus is on the educational value of the concrete work experience as lever for a wider and more flexible knowledge overcoming the distance between education and professional training (Gentili, 2016). It is an opportunity to promote PCTO paths, which encourage young people to have work activation processes and conscious social identity since the alternation between work and study uses everything' student to acquire skills in the work context which will then be redefined and systematized at school (Stabile, 2019). In this context, a study conducted in France in 2018 found that for young workers, who received OSH teaching at school, the occupational accident rate is 50% lower than for young workers who did not (INRS, 2018).

2. The role of gamification in training from serious game to digital tools

Studies on gamification focused mainly on human machine interaction, analyzing its effectiveness and the factors that influence learning, such as motivation and attention (Vezzoli, 2018). The gamification is connoted as an approach that refers to the use of typical elements of the game such as mechanics, structure, aesthetics, thought, metaphors in contexts not of game (Deterding, 2011; Faiella, 2015). The concept of gamification is often used in relation to different situations concerning the widespread use of videogames to arouse and maintain the interest of students in learning contexts, with the aim of involving them and encouraging them to achieve increasingly ambitious goals, following the rules and having fun at the same time. It is therefore highlighted how gamification can be a methodology directly aimed at increasing engagement and promoting greater motivation during the performance of a task. The purpose of each game is to influence the psychological and social behavior of the player. Some elements present in the games (badges, points, levels, avatars, etc.) push players to increase the time devoted to the game itself and to be predisposed to

continue it (Díaz Cruzado, 2013). Gamification also allows to satisfy the needs identified in the field of self-determination theory (Deci, 1985), which concern: the relationship, as a universal need for contact with others; competence, as a requirement to perceive oneself as effective and able in a given environment; autonomy, as a need to control one's own life. In line with the theory it could provide, it would be driven by an improvement of itself, rather than by the search for an external gratification (rewards) (Deterding, 2011). Other features of gamification refer to the possibility of being able to adapt it to the context, that is to be customized, to meet the educational needs of students and the needs of teachers (Gooch, 2016) and to identify models of response to these needs and also to implement educational intervention, monitoring and evaluation (de Santana, 2016). This methodology helps students to take initiatives and become more proactive too (Bowker, 2016), encouraging them to face new and challenging situations without fear of failure (Chung-Ho, 2013). Games, thanks to their cognitive and affective mechanisms, make it possible to achieve collateral learning and learning through learning by doing experience, on which the development of skills and competences is based (Benassi, 2013). Serious games, games with an explicit and well-defined educational purpose, not primarily designed for fun, but without excluding it (Abt, 1987), are innovative tools to promote also opportunities for growth and psychological well-being and could be introduced as positive technologies that influence both individual experiences and interpersonal relationships fuelling positive emotions, promoting engagement and improving social integration and connection (Argenton, 2014). Serious games and games are generally closely related to positive emotional experiences and a wide variety of pleasant responses that make the game the direct emotional opposite of depression (McGonigal, 2011). They can arouse pleasure for knowledge, stimulating curiosity and the desire for novelty in a protected environment where people experience the complexity of themselves and develop mastery and control, strengthening independence, self-confidence and self-esteem (Oatley, 2006). They promote the pleasure of victory and, by supporting virtual interactions with real people, feed social pleasure, encouraging collaborative and competitive dynamics through communication and sharing opportunities, even outside the context of the game (Reeves, 2009). To interact with young people today, it is important to use methods that are appropriate to this target group and that stimulate their interest. In this sense, digital gives a lot of opportunities offerring the possibility to experiment new tools and languages.

2.1. Technology for learning: the value of videogames

In Italy, in 2018 16.3 millions of people (aged 6- 64) played videogames: the 37% of the Italian population within this age range (54% men and 46% women) (Aesvi, 2019). According to Italian Interactive Digital Entertainment Association (IIDEA) the 2020 was the year of records for videogames: the turnover developed by videogames reached 2 billion and 179 million euros, with a growth of 21.9% compared to the previous year. The number of

gamers remained unchanged, with 16.7 million people enjoying themselves with a joypad in hand, i.e. 38% of the Italian population aged between 6 and 64. Indeed, the vast majority of psychological research on the effects of "gaming" has been focused on its negative impact: the potential harm related to aggression, addiction, and depression (Granic, 2013). Some studies consider the benefits that videogames could have in several domains: cognitive (e.g., attention), motivational (e.g., resilience in the face of failure), emotional (e.g., mood management), and social (e.g., prosocial behavior). Moreover, an increasing number of serious games applied in education are emerging because the educational elements can be integrated into the gameplay, which will be subconsciously acquired by the players during the gaming process. (Zhonggen, 2019). Easiness of use, elements of surprise in the story-script, open-ended situations have been found as influential factors for the effectiveness in learning outcomes, especially among young players.

3. Materials and methods

Starting from international and national literature's review, a participative research and co-design work in 7 Italian high schools - agricultural, construction and manufacturing sectors - was realized to co-create an educational tool (videogame) in order to promote OSH during the PCTO program. The study applied qualitative and quantitative methods. The study actively involved students in the design of the gameplay mechanics as well as in making the main decisions regarding its educational contents. The participative co-creation followed these steps: a qualitative inquiry in 4 Italian high schools to engage 12 teachers and 50 students in individual interviews and focus group discussions about their representations of risks in general and in the workplace, but also about their learning and teaching experience; these meetings created a smaller voluntary group of 12 students as "peer ambassadors", who had the task to make other interviews to their friends and other acquaintances and to interact with researchers (face-to-face and via instant messaging platforms) about the videogame design; a quantitative survey by questionnaire, in collaboration with the OSH experts, addressed to 277 students (63% boys and 37% girls) of the last three years of 7 high schools, in order to deepen and verify the knowledge of their representations of risk and learning activities on occupational safety and health, and evaluate their gained skills in risk prevention; the development of the videogame "Becoming safe", in collaboration with the developers of a software house, who were invited to participate in the beta test as well; the organization of a first competition encouraging team participation, with 75 students of 2 high schools and a user survey about the satisfaction and commentaries on the videogame, through a questionnaire addressed to those 75 first players and by direct observation of their team gameplay; the final version of the videogame, adjusted following the observational and quantitative findings, with a game competition and final award among 39 students of 2 schools, one of which participated since the beginning of the project.

3.1. The Becoming safe project

The research project was in collaboration between the University of Bologna and the National Institute for Insurance against Accidents at Work (Inail)[1]. A methodological path, aimed at co-creating a serious game, engaging all the different actors of OSH education - students, teachers, professional experts - was designed. No significant differences in academic achievements were found between digital learning and serious game use, but it is meaningful that significantly more positive attitudes toward serious game assisted learning were revealed compared with traditional paper-based learning, since they encouraged participation (Zhonggen, 2019). The structure of the videogame encourages entertainment and interaction to actively engage the players' agentive behaviors. The game is suitable both for individual and team play and therefore can be played cooperatively or competitively and it can be played on different devices (PCs, tablets, smartphones) [2]. It was designed as a learning tool and a support to mandatory training, to be used in and out the classroom, developing a good practice for OSH culture in accordance with technical and legal issues. Becoming safe is a management simulation game set in a 3D environment with a third-person overhead view, a choice that allows the player to navigate the game easily and move rapidly through the different scenarios. The goal is to win a race against time to prevent accidents, protect workers and build a safe workplace. Each student can play the role of a junior OSH manager, initially guided by a senior manager who explains the basic rules and regulations that have to be followed to guarantee the workers' safety (Pietrafesa, 2020).

4. Results

About 300 students from 7 technical institutes (42.6% construction, 28.9% manufacturing, 28.5% agricultural) and 12 teachers participated in the research. 10 teachers of the total sample took part in the semi-structured interview and 50 students who participated in 4 world café/focus groups, 3 Whatsapp groups were created for the involvement of 12 students. Finally, 277 students (63% boys and 37% girls) from the last three years of the Institutes involved (III year 22.7%, IV year 44.1%, V year 33.2%) answered to an anonymous *ad hoc* questionnaire: 92.5% of students report that they have already participated in PCTO, but only 27.1% (19.6% boys and 31.4% girls) received OSH training. This training was certainly considered useful by 62.8% of young people, while compliance with the regulations guarantees to work safely for 69.7% of the sample (Table 1.).

[1]Bando di Ricerca in Collaborazione (BRIC) 2016-2018 - ID 48 - financed by Inail in collaboration with Dipartimento di scienze politiche e sociali dell'Università "Alma Mater Studiorum" di Bologna – Scientific responsible Prof.ssa Pina Lalli - AUSL Modena, AUSL Viterbo e ASUR Marche A.V. 4 – Fermo.

[2]https://site.unibo.it/sicuri-si-diventa/it/gioca

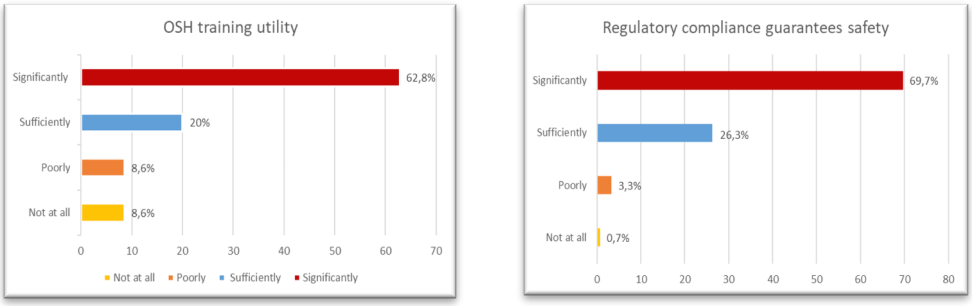

Figure 1. OSH Training utility in compliance with regulatory.

About 50% of the partipants considered the training with direct experience in the field to be the most effective training, followed by direct testimony of workers (12.30%) and briefing in the classroom (12.30%), while only 5.5% indicated slides and explanations as the more effective method for OSH training (Table 2.).

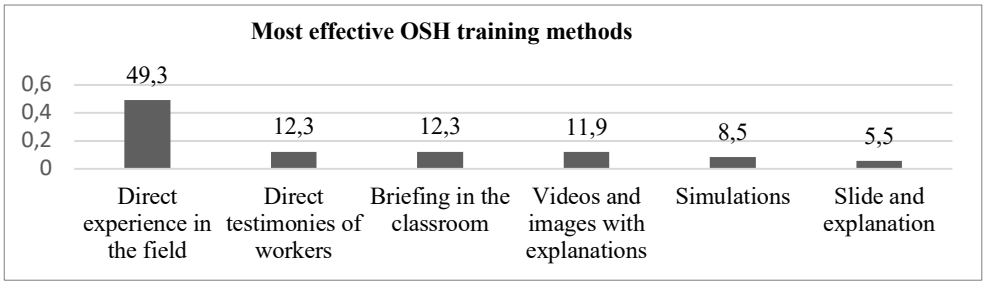

Figure 2. The most effective OSH training methods.

According to the respondents, people at work were mainly at risk for lack of attention (61.3%), for quickness (56.8%), for relaxation (36.5%) and for their own habits (31.1%). As for the social representations of risk, the students associated it mainly to danger (67.5%), injury (39%), get hurt (30.3%), unexpected (28.9%) and distraction (27.4%). 90% of the students liked the videogame as a whole, 55% thought it would be very useful to learn while having fun, 43% to know the rules of safety at work, 42% to become more aware of the risks at work and, finally, 26% to remember the OSH rules at work, in particular those concerning the uses of the personal protective equipment (PPE), which played an important role in the game narrative. Almost all of the participants appreciated the game very much (47%) and quite (43%), while only 10% liked it fewer.

5. Conclusions

Digital technologies can unlock new learning opportunities in the classroom by giving students access to a wider range of resources, by complementing the teacher in learning processes (computer-assisted learning) and by providing other advantages to students, such as access to motivational and informational resources associated with access to tertiary education programs. The evidence on the advantages of ICT resources in schools remains mixed. For real attitudinal change to take place and for new forms of action to be integrated, young people must first understand the importance of care and, as Morin assumed understanding that is a process that involves going beyond information, and it refers to identifying with others and empathy (Morin, 2002). Through the active behavior of the learning subjects, the ability to make conscious choices develops, an attitude develops, a "mental habit", a social and emotional mastery.

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Male infertility diagnostic laboratories during COVID-19 pandemic: development of a novel teaching/learning strategy

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Abstract

Objective: To design and implement a laboratory teaching/learning strategy applied to male infertility diagnostic during COVID-19 pandemic.

Methods: Seventy-five students attending Module 3 (M3): Male Infertility Diagnostic Laboratories, of curricular unit Laboratories in Biomedicine 5 were divided into 8 groups to reduce students' number in class. M3 was organized in 2 Wet labs (WL; laboratory training) and 2 Dry labs (DL; theoretical-practical classes). At the end of M3, students completed a satisfaction survey.

Results: Results showed that most students were satisfied with topics addressed, time dedicated outside the class, evaluation, and overall organization of WL and DL. The protocols provided and general conditions of WL were considered satisfactory. Only positive classifications were attributed to the learning goals, relevance of knowledge acquired, and opportunities to ask about evaluation. Qualitative data suggested that the dynamics, innovation, and organization of classes, allied to the knowledge and motivation of professors, provided the appropriate learning environment.

Conclusions: The methodology implemented in M3 during COVID-19 pandemic represents a valid strategy to encourage and motivate students learning, stimulate teamwork, communication, and autonomy in the laboratory. Preparing dynamic, attractive, and motivating classes increases student's general satisfaction, improving the efficiency of the learning/teaching process.

Keywords: *COVID-19; male infertility; diagnostic tools; practical classes; laboratory instruction; students' motivation.*

1. Introduction

As all the globe, Portugal is facing the novel coronavirus disease 2019 (COVID-19), with the academic activities suspended since the first lockdown in March 2020. Despite e-classes being very helpful during the lockdown, and the positive feedback given by the students to them (Gohiya & Gohiya, 2020), some virtual learning activities, such as practical classes, are difficult to implement. Traditional laboratory disciplines, such as biochemistry and medical laboratory sciences were suspended during the lockdown. As laboratory practice is a valuable part of (bio)medical sciences, in which students can practice theoretical concepts learned in lecture-based classes, gain experience in the laboratory environment, and acquire basic technical and social skills for their future careers, virtual laboratories emerged as a powerful educational tool in the Era of COVID-19 (Uchejeso, Chinaza, & Obiora, 2020; Vasiliadou, 2020). Virtual learning enables professors to demonstrate practical techniques and allows students to conduct experiments at home, using virtual platforms (Allen & Barker, 2021; Uchejeso et al., 2020; Vasiliadou, 2020). However, this new methodology cannot replace entirely the traditional laboratory experience.

In October 2020, most educational institutions in Portugal started to re-open following strict governmental and institutional guidelines and as some of them restarted in-person classes (e.g., practical classes), some challenges had to be surpassed to assure students, faculty, and staff safety. Besides wearing personal protective equipment, as face coverings, washing hands often, and ensuring good ventilation, practicing social distancing is an important measure to reduce the spread of COVID-19 during in-person classes (Dickie & Remus-emsermann, 2020). Thus, teaching/learning methodologies needed to be restructured to follow these norms. The University of Aveiro (UA) decided to reduce the number of students attending classes and laboratory instructions that could not be delivered remotely, allowing participants to maintain social distancing and not to share objects and equipment.

The UA offers a 3-year Biomedical Sciences bachelor, that includes in the 3rd year (1st semester) the Laboratories in Biomedicine 5 (LBM5). The learning goals for LBM5 were to teach students the tools used in molecular and cellular diagnosis, allowing students to develop laboratory competencies. LBM5 is divided into 3 modules taught by researchers in the field. M3 focuses on male infertility diagnosis and usually consists of 4 practical classes in the laboratory (Wet Lab; WL), each with 3 hours duration. Due to COVID-19 contingencies, the number of students had to be reduced to half. The main objective of this study was to design and implement a new practical teaching/learning strategy applied to male infertility diagnostic in the COVID-19 pandemic and clarify if this methodology contributed to maintaining student's motivation and interest without compromising their health and safety. We intended to promote communication and teamwork skills among students during laboratory training, boosting their scientific and research knowledge and stimulating their interest for the human reproduction field.

2. Methods

2.1. Students and professors' background

Seventy-five 3rd year students were enrolled in M3. Students were familiar with a student-centered learning approach, as problem-based learning is implemented in the bachelor course (Bate, Hommes, Duvivier, & Taylor, 2014) and they all had laboratory experience from previous classes. The professors belong to the Signal Transduction Lab, Institute of Biomedicine (UA), being researchers in the male (in)fertility field. All professors had considerable laboratory experience, particularly in tasks developed throughout M3.

2.2. Module 3 design

With 4 weeks duration, M3 was delivered as part of the regular curriculum and focused on male infertility diagnostic. Learning objectives, content, and total contact time were not changed. The professors developed an additional component, based on a theoretical-practical approach – Dry Lab (DL) - to follow the restrictions imposed. The module design and evaluation were re-organized, comprising 2 laboratory classes (WL), and 2 theoretical-practical classes (DL). All information concerning M3 was organized in a Padlet mural (www.padlet.com). The teaching/learning activities of M3 are integrated in Figure 1.

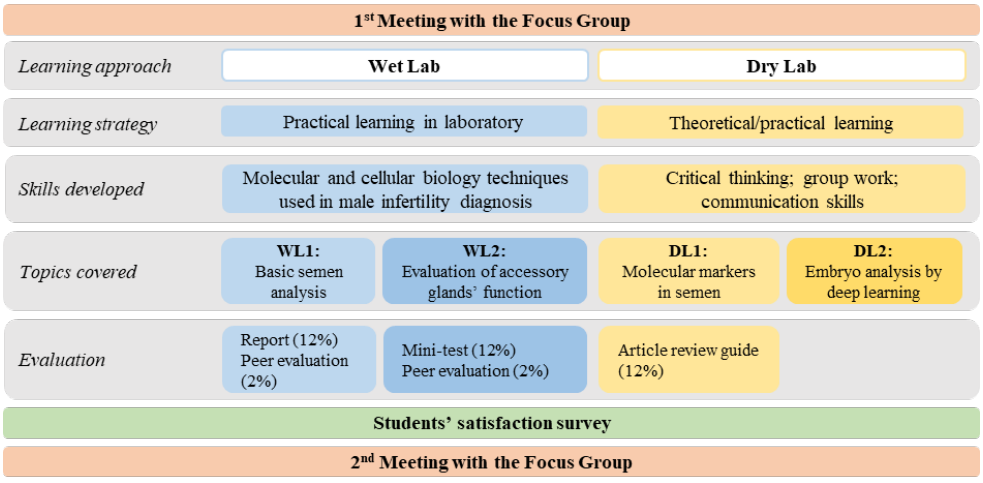

Figure 1. Overall organization of Module 3. Learning approaches and strategies, skills developed, topics covered, and evaluation were presented. WL, Wet lab; DL, Dry lab.

Considering that students are consumers of education, they have the right and the responsibility to be involved in curricular reform and give their feedback freely (Hsih et al., 2015). Therefore, a focus group was created for M3 conception and evaluation process, composed of 4 randomly selected students. Before M3 started, professors and the focus group met to discuss possible new approaches, topics of interest and evaluation methods. The

students' involvement in the course preparation and organization allowed professors to adapt the learning approaches and topics addressed to the main interests of the students, improving their motivation. In the end, the professors met again with the focus group to summarize issues raised, recognize aspects to be improved in the following years, and discuss potential solutions targeting the identified opportunities for improvement.

To assure that the number of students *per* class did not exceed 10, the 75 students were divided into 8 groups, each one attending 2 WL and 2 DL. The WL aimed to provide practical training in cellular and molecular diagnostic of male infertility, focusing on basic semen analysis (WL1) and molecular markers of accessory glands (WL2). The lab activities were preceded by a theoretical contextualization and during the expository part, students were encouraged to interact by asking questions. Protocols were provided at least 1 week ahead enabling the students to prepare the activity. In WL1, the protocol included the necessary steps to semen macroscopic and microscopic analysis (motility, concentration, vitality, and morphology). In WL2, the protocols were taken from the Fructose Test (FP09 I29 R01) and Citric Acid Test (FP09 I37 R01) kits to evaluate the accessory gland function, through the analysis of these molecular markers. The professors guided the students throughout the protocol steps, explaining the details associated and the technical procedures. The students were encouraged to independently think and learn with peers. During the class, students used personal protective equipment (mask, gloves, and lab coat), each pair of students had their own material, reagents, equipment, and workbench, thus maximizing the distance between stations and avoiding sharing objects. Also, the contact surfaces were frequently cleaned and disinfected, as recommended (Dickie & Remus-emsermann, 2020). After each class students were evaluated by reports/mini questionnaires that comprised several multiple-choice questions, open questions, and data analysis related to the topics and the results obtained during the WL. Only the mini test was an individual assessment. In the end, students were asked to evaluate their peers' performance in WL – peer evaluation. This evaluation tool aimed to determine the quality of teamwork, being an individual reflection of students' dedication, working, and communication.

The DLs were mainly based on scientific papers and imaging analysis, providing to students the scientific tools, methodologies, and soft skills required to work in a clinical or research laboratory in the male reproductive field. In DL1, focused on identifying molecular markers in semen, the students were challenged to analyze papers using the platform Perusall (https://perusall.com/). Perusall allows students to read, generate comments and discuss ideas with other colleagues, creating a virtual scientific discussion that stimulates their critical thinking, written communication, and group work. A guide for the analysis of the paper was provided by the professor to be filled in pairs as an evaluation exercise. In DL2, the students became familiar with embryo analysis using deep learning. Due to the novelty of the topic, several research papers were provided to the students before the class for their autonomous

preparation. During the class, an introduction to the fundamental concepts of deep learning and how this technology is being applied to *in vitro* fertilization was made. Then, a hypothetical problem was provided to students that had to design a putative workflow for analyzing embryo images using this tool. Finally, a class discussion was held for the different pairs to share their work and for the professor to give tips on the best approach to take about the proposed problem. The main objective of DL2 was to improve the students' ability to identify a study question, to analyze critically scientific information, and to build protocols to be applied in the research context.

2.3. Data collection and analysis of the survey

As a quality control exercise, students fill out a structured questionnaire classifying the teaching/learning experience. To generate a comprehensive picture of the students' perspectives, the survey combines a quantitative and qualitative approach. Each topic to be quantitatively assessed by the student included several questions related to that issue, rated on a Likert scale (1–7). Answers of "1" indicate the most negative response (Completely dissatisfied), while "7" the most positive (Completely satisfied). We also asked students to identify 2 positive aspects, 2 aspects that need to be improved, and what they liked most in M3. To assure student's anonymity no personal data were collected.

3. Results and discussion

To the professors, more fundamental than the student's grades was to understand if the new design of M3 fulfills students' expectations. Therefore, the results presented in this article focus not only on students' performance but also on their opinion and satisfaction about several aspects of M3 (Figure 2) and its importance to their future.

3.1. Students' performance

All students were able to fulfill the tasks proposed in each component. The average grade of M3 was 16.9 (from a 0 to 20 scale) with 38 students (52%) having classifications ≥ 17.0. Only 6 students were graded < 15.0 and only one student performed poorly (10.7). In peer evaluation, the average grade of students was 18.6 (from a 0 to 20 scale) with 53 students (72.6%) having classification higher than 18.7. Only 2 students were graded ≤ 15, and 1 student was not classified. The article review guide (DL1) allowed us to access the impact of DL on soft skills development (critical thinking and effective communication).

3.2. Survey analysis

From the 75 students that participated in M3 in the curricular year 2020/2021, 4% (n=3) did not answer the questionnaires.

3.2.1. Quantitative results

Quantitative data analysis showed that most students were satisfied with the topics addressed (99%), protocols provided (97%), general conditions existent in the lab (96%), including the material and reagents available, contribution/relevance for their education (96%) and overall organization (99%) of WL (Figure 2.A). Concerning evaluation and time dispended outside class, 4% and 3% of the students are somewhat dissatisfied, respectively.

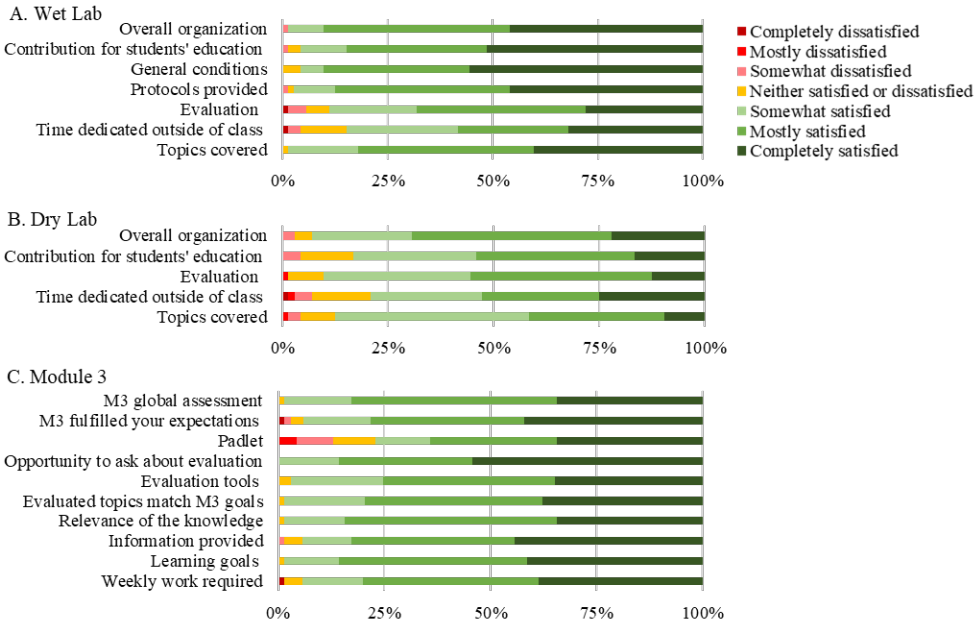

Figure 2. Students' evaluation of (A) Wet and (B) Dry Labs, and (C) Module 3.

The DL (Figure 2.B) received more negative evaluations than the WL. Some students were dissatisfied or neither satisfied nor dissatisfied with the time dedicated outside of class (21%), with the contribution for their education (17%), and with the topics covered (12%). Nevertheless, they attributed predominantly positive classifications to all the questions. Generally, most students agreed that the weekly work required was appropriate (94%), the module learning goals were unambiguously provided (99%), important information was provided in time (94%), the practical and theoretical knowledge acquired was relevant for their education (99%), and the evaluated topics correspond to the previously stated goals (97%) (Figure 2.C). All students were satisfied with the opportunities to ask about how the evaluation was performed. Overall, the module fulfilled the expectations of 94% of the students, with 99% of them satisfied with M3. Finally, regarding professors, all students are somewhat, mostly, or completely satisfied with their motivation, knowledge on the topics covered, availability to answer questions, and global performance.

3.2.2. Qualitative results

Students were asked to indicate 2 positive and 2 aspects that could be improved. They indicated that the contents covered in classes were interesting, actual, relevant, and the necessary knowledge bases were provided (21 students). Almost 30% of students indicated as a positive aspect of the module the professors, particularly their knowledge on the topics addressed, motivation, enthusiasm, clarity, and availability to help students and answer their questions. The students also considered that the variety of methodologies used increased the dynamic of the classes stimulating their interest, motivation, and concentration. They also enjoy work in groups and the analysis of scientific papers that improve their critical thinking. Regarding student's views on ways to improve teaching and M3, 26 students did not answer or indicated that they had nothing to point out. The aspect that most students think needs to be improved was the DL (contents covered, time required for preparation). The platforms used (Padlet and Perusall) were recognized as aspects to improve. Some students considered difficult to find information in Padlet and suggested accessing it through the University e-learning platform. Concerning Perusall, the students mention they need more time to explore all its functionalities.

Regarding what students like the most: the WL, as well as the topics covered, considering infertility an interesting and captivating topic; the availability, motivation, and interest of the professors that motivate the students for the classes and the organization of the module were also the aspects more appreciated by students. Quoting some of the students' comments about M3, "Congratulations, the module is really well designed and will certainly benefit the future students"; "Congratulations to the professors, a module taught with enthusiasm is very motivating for those who are learning"; "The environment provided by the teachers in the laboratory was very good, an environment where you can work and learn well". These data suggested that the approach adopted represents a valid and enjoyable strategy to encourage, captivate and motivate students to learn about male infertility, stimulate teamwork, communication, and independence in the laboratory.

4. Conclusion

Results showed that the dynamics, innovation, and organization of the classes, allied to the knowledge, motivation, and availability of the professors, provided the appropriate environment to learn. However, the lack of data from students attending the traditional methodology does not allow the comparison of student's satisfaction before and after the implementation of this methodology, which represents the major limitation of this study. To minimize the contacts and guarantee compliance with social distance without compromising students' interaction, cooperation, group work, and discussion of ideas, students were divided into pairs that remained throughout the module. Thus, we were able to promote teamwork, social interaction and collaboration among the students maintaining their safety. The focus

group was of great importance, since it allowed students to contribute and shape their education, increasing their motivation and engagement. Investing in preparing attractive and motivating classes increases students' general satisfaction and the learning/teaching process becomes more efficient. The positive results presented should encourage others in a similar situation to follow this approach.

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Therapeutic communication skills in palliative care nursing education: an exploratory study using a role-playing tool

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Abstract

This study aim to explore the experiences of nursing final-year students on the care of the person in a palliative situation and their family using the role-playing technique. Qualitative, descriptive research developed in October 2020 with 30 third-year nursing students from a palliative care nursing course, in Portugal. Individual debriefing reflections and thematic analysis of the information were conducted. Two main themes emerged: 1) facilitators; and 2) barriers of role-playing in a simulated palliative care context. We concluded that type of simulation allows students to deal with complex palliative care situations from an individual and realistic perspective.

Keywords: *Caring; palliative care nursing; role-playing; nursing students; metacognition.*

1. Introduction

In the context of the pandemic COVID-19 that we are going through, one of the actions that have been valued by teachers and educational institutions is the adoption of active teaching-learning methodologies in nursing education. The use of active strategies contributes to overcoming the pitfalls of traditional education model, centred on the positivism approach, focusing on strengthening instrumental ability without teaching with a transforming perspective. The educator has the role of transferring knowledge. The student has a submissive posture in which the content is acquired without reflection and/or critical understanding (Sebold *et al*., 2018). Active methodologies seek to empower students so that they can manage their training process. For the implementation of changes in the teaching paradigms in health and nursing, the relevance of critical pedagogy and emancipatory education stands out, from which it is possible to foster critical reflection and the collective and dialogical construction of knowledge, based on the integration of theory-practice based on a concrete social reality (Canever *et al*., 2017).

Among the active pedagogical strategies, role-playing is configured as a relevant teaching method for educational and recreational purposes. A facilitator elaborates a fictitious situation in which students assume other individuals' social role and experience clinical problems that they experience (Sebold *et al*., 2018). They make it possible to awaken the critical-reflexive look and train skills that make them capable of transforming reality in the professional future (Nemec, Brower & Allert, 2020). Therefore, it is a student-centred strategy and allows learning in a pedagogical environment, supported by reflection and guided by a facilitator.

Role-playing can be used as a low-fidelity clinical simulation of the standardized or simulated patients [people acting in prescribed roles] type, as long as it follows clinical simulation principles (Negri et al., 2017). In this situation, “the experience and learning occur through other individuals, students, or actors taught/instructed by the facilitator to consistently portray the patient according to the intended reality” (Sebold *et al*., 2018, p.2707). Studies that used role-playing as a learning strategy emphasize its importance for self-knowledge, the humanization of care, the improvement of communication and other social interaction skills, as well as the articulation from theory to real care situations (Smith *et al*., 2018; Yu & Kang, 2017).

Nursing students rarely have experience with the dying population due to faculty viewing these cases as undesirable and as “not good teaching cases” (Sadhu *et al*., 2010, p.157). Nursing schools have not adequately incorporated Palliative Care (PC) into the curriculum to increase PC content and skills awareness. Sadhu et al. (2010) asserted that students lack knowledge of PC. Students cannot be expected to be experts in any capacity due to lack of experience in the clinical arena; however, schools and hospitals are holding students and new

graduates accountable for this material and expect an adequate competency level despite lack of training and teaching subject. To better prepare students to care for dying individuals, the implementation of PC experiences within the nursing curriculum is critical (Randall, Garbutt & Barnard, 2018).

Given the role-playing contributions to nursing education, the interest to use the strategy to problematize with nursing students the meanings and practices related to nursing care for people in palliative situations arose. This option is justified not only by the centrality and importance of care as a central core of professional nursing practice but also by the need to develop attitudes and interpersonal skills to perform care beyond the instrumental component.

1.1. Objective

We performed a pilot study to explore nursing final-year students' experiences on the care of the person in a palliative situation and their family using role-play technique.

2. Methods

This is a descriptive study with a qualitative approach developed in October 2020. We chose qualitative methodology as a reference for the study since it is the one that best illustrates the process of understanding to be achieved.

2.1. Recruitment

The authors recruited third-year students from a palliative care nursing course. Participation was voluntary, and students had no previous experience with this type of simulation. Thirty subjects consent to take part and participated in a scripted role-play scenario.

2.2. Role-play simulation

In preparation for the simulation session, students were divided into three groups of 10 senior nursing students. Each group was assigned their room with a table and chairs for each participant and had one faculty facilitator. Facilitators are provided with a timeline, a guide for debriefing, and an evaluation rubric. After a 5-minute introduction and orientation to the activity, learners began reviewing the case scenario (discussing palliative actions with terminal illness patients and their families). The students then briefly reviewed their roles and started their role-play. The facilitator observed and took note of whether the students addressed the scenario-specific competencies. Three students were asked to play the role of

nurse (1) who had provided palliative care to a patient (2) and were making a joint visit to provide psychoemotional support to his wife (3).

Following the simulated role-play session, facilitators used group feedback and debriefing to reflect and critically appraise the learning outcomes (see Table 1). This strategy allows participants to offer additional ideas and insights from the seemingly neutral point-of-view of an "outside" and to provide feedback on the learning goal that was negotiated at the beginning of the encounter (Jackson & Back, 2011). Besides, the facilitators led the discussion among all groups to enable the students to generalize the situations and outcomes after gaining experiences, so that they could use the experiences in practice. Students were encouraged to write a reflexive diary to explore and reflect on PC issues addressed in simulated scenario, using Gibbs' reflective cycle. Reflection helps a professional become more self-regulated, conscious, and self-critical (Braun et al., 2013; Mann, Gordon & MacLeod, 2009). Schön (1991) defined clinical reflection related to action as "reflection-in-action", whereby students reflect on their own experiences during practice and then, after the simulation experience, reflect on the actions they took, critically examining what they did and learned, or what worked and what did not work.

This study is based on the students' analysis of the students' written reflections produced at the curricular unit or PC Nursing. Doing this helps us better understand the phenomenon studied, role-playing, and explain the feelings, concerns, and fears that students experience when carrying out the role-playing.

Table 1. Learning outcomes of the simulation session

1. Promote self-reflection in the context of working with patients/families on PC;
2. Recognize the importance of teamwork in PC;
3. Demonstrate the use of appropriate therapeutic communication;
4. Demonstrate skills on the conduction of sensitive conversations;

2.3. Data analysis

To encode and analyze the data, they were categorized according to the information extracted from students' reflections. The data was analyzed using using thematic analysis as a research method and was reviewed independently by two team members to identify recurring themes (Braun & Clarke, 2006).

3. Results and Discussion

The analysis showed that 22 of the students were female, and eight were male; all were aged 20-35. The information obtained in individual reflections were grouped according to a thematic axis in two thematic units: recognizing the facilitators and barriers of role-playing in a simulated palliative care context.

a) Facilitators in the learning experience

Overall, students evaluated this learning experience positively and felt the simulated role-play session was useful and enjoyable. During the simulation session, the students actively participated in the whole activity to exchange knowledge and experiences. Some positive points were identified: a) the ability to interpret the indicated clinical case; b) identification of priorities in PC Nursing; c) a confident and humanized attitude towards the patient/family; and d) the application of prior theoretical knowledge during the simulation, articulating theory and practice. In this sense, the simulation provides meaningful learning, co-created from a teaching-learning space, to effectively contribute to implementing a nursing practice centred on the person and their condition.

Students who participate in palliative care simulation experiences that allow them to hone their communication skills report feeling better prepared to care for dying patients in their first year of professional practice (Glover *et al*., 2017; Glover *et al*., 2019). One of the participants said: *It helped me feel a little bit more self-confident [...].* With the use of role-playing, it was possible to experience situations arising from nursing's daily practice. This practice-based simulation enabled the construction and development of knowledge and practical skills in a meaningful way, fulfilling the role of active methodology in the teaching-learning process. Another participant wrote: *We can put the acquired knowledge into practice to better approach specific situations [...].* It is, therefore, a problem situation that the student can analyze, reflect and articulate his/her knowledge, giving it meaning and adapting it to the experiences already experienced and his/her discoveries. This form of learning is called significant and causes modification/transformation in the individual who experiences it, either in the individual's behaviour, in the future orientation he/she chooses or in his/her attitudes and personality. It is intense learning, which is not limited to progress in a quantitative way in terms of knowledge but intensifies the meaning of the lived experience with a reflection on the action.

b) Barriers in the learning experience

Insecurity, anxiety and doubts about dealing with the terminally ill person were raised as negative points; how to take care of the family, and the difficulty of communication. A student participant says: *Insecurity, overwhelming situations and inexperience are a clear obstacle to putting into practice the skills needed in interpersonal relationships. That is why*

role-playing is so very important [...]. However, it was mentioned by the students that simulating, before immersing themselves in clinical practice in a real context, allows for the training of skills necessary to perform nursing care and to deepen theoretical knowledge. Simulation makes the experience closer to the real, being considered an adequate teaching practice when providing immersion and the lived experience. Learning is individual and collective, allowing to reduce anxiety and foster the development of confidence in the actions performed. In the face of inappropriate conduct, it can be reviewed and redone without compromising the patient's safety. We suggest that students might need a solid foundation of understanding their own beliefs and conceptions of death and dying upon which to base their learning about palliative and end-of-life care. Students who have recent experience, or are experiencing, a threat to the life of a close relative or friend or who are caring for someone who is dying may find their core beliefs and conceptions of death and dying being challenged.

Death is seen as a difficult topic of discussion. The feelings and emotions associated with death and dying underscored the importance of psychosocial care of all students involved. Besides, the issues of denial, grief, fear and acceptance were stressed as part of the learning of the psychological processes of death (Glover *et al*., 2019). One participant stated: *We learn a lot from classmates and criticism from the group and teachers. The topic of death is so complex ... I don't know what to say to patients and families.* This recurrent theme of death and dying revealed the importance of include this topic in the teaching-learning processes at PC Nursing.

3.1. Limitations

We recognize that this study has several limitations. The sample size was small and the work was conducted within a single institution. The differences between male and female students in the way that they approach learning was not analysed. Each nursing student's knowledge would vary depending on the time spent with the palliative patient cared for and clinical experiences offered, which could create a limitation on PC exposure. Another limitation to this study included the personal experiences of each particular nursing student in PC. Personal experiences could consist of having a family member, friend, or acquaintance who accessed PC services. Personal experiences with PC could create either a negative or positive outlook on PC for the student, depending on the individual experience.

4. Conclusion

This role-play activity allows students to practice therapeutic communication and shared decision-making, both with patient and family presence and in premeeting rounds with the health care team. PC exposure during student training helps trainees recognize the impact of high-quality interprofessional conversations on the care patients want and ultimately receive.

This study demonstrates the benefits of role-playing in teaching palliative care communication skills and the value of including multiple disciplines in this educational process. Role-playing appears to be a promising intervention for teaching palliative care communication skills in an interdisciplinary setting. This simulation strategy encouraged students to empathize with the dying patient and provided an opportunity for students to become aware of their own biases, fears and emotions. Therefore, the role-playing reveals to foster metacognition and reflection-in-action in a safe environment. Future research should be continue to explore this practice for teaching multiple skills in an interdisciplinary approach and should be developed with a gender perspective.

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Novel implementation of experiential learning in health and wellbeing in a university setting

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Abstract
Healthy UCD is a health promotion initiative in University College Dublin (UCD) which aims to create a sustainable healthy campus for all members of the UCD community. In recent years, Healthy UCD has worked with staff from across the university to provide opportunities for experiential learning to UCD students in areas related to health and wellbeing. The initiative currently has involvement in three modules: 1) Practice Placement – a core MSc in Clinical Nutrition and Dietetics module where students plan and implement a university-wide Healthy Eating Week, 2) Event Management – a core module undertaken by second-year BSc Sport & Exercise Management students, and 3) Student Health & Wellbeing – an undergraduate elective module which challenges students to reflect on issues which affect their own health and wellbeing and that of those around them and then develop a student-focused Healthy UCD campaign. This paper will outline how experiential learning is implemented in these modules, how students are assessed, and the perceptions of students who complete these modules.

Keywords: *Experiential learning; wellbeing; health promotion; university; education.*

1. Introduction

University College Dublin (UCD) is the largest university in Ireland, located in the capital city, Dublin, with over 33,000 students and 3,700 staff (full-time equivalents) ("University College Dublin - UCD by Numbers," 2021). Healthy UCD is a health promotion initiative designed to create a sustainable healthy campus in UCD for all members of the University community ("Healthy UCD," 2021). Healthy UCD has an active steering committee with representation from across the university, a director of Health Promotion, and a budget that covers salary for one research assistant/health promotion officer. The initiative has fostered a close liaison with staff from key areas across the university, and with the Students Union and the Student Societies. Since its establishment in 2016, Healthy UCD has worked to make opportunities for healthy living available to all members of the UCD community through initiatives to promote healthy eating, physical activity and mental wellbeing. In more recent years, the Healthy UCD team has worked to provide experiential learning opportunities to UCD students in these areas.

Experiential learning, as defined by Kolb (1984), describes learning as a continuous process where individuals are actively involved in new experiences, reflect on these experiences and theorise about them, before applying this knowledge to new situations. This style of learning therefore lends itself well to a university setting as students can learn through the planning and implementation of a project or initiative, evaluate how successful it was, and apply their new knowledge to further university experiences or in their future career.

Helping students to become career-ready is commonly cited as a motivation for introducing experiential learning in a university setting in previous descriptions of its application. Some studies also place emphasis on the benefits students perceive they obtain from this type of learning. One such study conducted in Singapore introduced experiential learning-based modules aimed at preparing students for a work environment and compared these to traditional modules within the same university (Seow, Pan et al., 2019). It was found that students who completed the experiential learning-based modules had a greater improvement in problem-solving skills compared to those who did not (although the difference was not significant) and that feedback from students suggested they perceived the experiential learning approach enhanced their learning experience. Another study examining experiential learning in a retailing laboratory reported that the approach developed skills valued by employers such as critical thinking, analytical and decision-making skills whilst also maintaining student motivation and satisfaction (Franco Valdez & Valdez Cervantes, 2018).

Healthy UCD is currently involved in three modules available to students in UCD. It coordinates and delivers one elective undergraduate module entitled “Student Health and Wellbeing” and contributes to two core modules taken by postgraduate students undertaking an MSc in Clinical Nutrition and Dietetics and undergraduate students undertaking a BSc in

Sport & Exercise Management. Experiential learning forms a large component of these modules and is a significant contributor to assessment in each one. This paper aims to outline how experiential learning is implemented in these modules and the benefits to both students and the wider university.

2. Modules where Healthy UCD provides experiential learning opportunities

2.1. Practice Placement (non-acute)

The MSc in Clinical Nutrition and Dietetics is a postgraduate programme that develops competent practitioners who, upon successful completion, are eligible to apply for state registration as a Dietitian. In a core practice placement module ("Practice Placement (non-acute) (PHPS40910)," 2021), the students work with Healthy UCD to prepare and deliver a campus-wide week-long event 'Healthy Eating Week' which is held each academic year ("Healthy UCD | Healthy Eating Week 2019," 2021; "Healthy UCD | Healthy Eating Week February 2020," 2021; "Healthy UCD | Healthy Eating Week November 2020," 2021). The students decide on the content of the information to be disseminated and are tasked with designing the event to maximise reach and engagement by staff and students across the campus. They are assessed under the following competencies, which are mapped to the standards of proficiency required to register as a Dietitian in Ireland: i) the planning, delivery and evaluation of a health promoting project, ii) the planning and delivery of group education, iii) the production of appropriate written communications and reports, iv) effective communication and collaboration with colleagues, including modification of communication when appropriate, v) the building and management of professional relationships, vi) presenting to a professional audience, and vii) understanding the role of a dietitian within the public health setting.

Healthy Eating Week originated in 2017 as an event organised by Healthy UCD staff with input from student volunteers and societies. In 2019, a decision was made to convert Healthy Eating Week into an experiential learning component of the Practice Placement (non-acute) module for MSc in Clinical Nutrition and Dietetics students. Since then, two student-led editions of Healthy Eating Week have taken place, differing in their mode of delivery due to the circumstances in which they took place. The first of these took place in the 2019/2020 academic year in a traditional in-person format, with the theme of “mythbusting” chosen for the week. A variety of events were organised and delivered by students on the UCD campus including a talk given by a sports nutritionist, a panel discussion on food sustainability, taste-testing of branded and unbranded foods, and posters designed to look like a social media feed dispelling common food myths displayed around the campus.

The students organising Healthy Eating Week in the 2020/2021 academic year faced an additional challenge during their learning experience: due to Covid-19 public health

restrictions and campus closure, with all university business moved online (except for essential on-campus activity), it was necessary for them to deliver a virtual event. To achieve this, the students utilised the Healthy UCD website and social media channels to host content in creative formats. Rather than choosing an overall theme for the week, the 2020/2021 students selected an individual theme for each day of the four-day event, namely 'All things breakfast', 'Eat well for less', 'Keep it movin' (nutrition and exercise) and 'Snack attack' (healthy snacking). Content was delivered through infographics, videos, articles and podcasts. The virtual nature of this event required the students to develop a suitable evaluation plan to capture engagement with the virtual event and utilised website and social media analytics along with a questionnaire aimed at those who engaged with Healthy Eating Week content.

Feedback from these students has included an improvement of their understanding of a health promotion role, greater understanding of good leadership and the importance of assigning specific tasks to team members. All students achieved health promotion nutrition competencies as well as competency in communication, team-working and professionalism from designing, implementing and evaluating this initiative. The competencies are mapped to the proficiencies required by the state regulator of Dietitians in Ireland and were assessed by registered dietitians.

Students involved in the 2020/2021 edition of Healthy Eating Week prepared an evaluation report of their event, highlighting key outcomes. This included Healthy Eating Week material being seen by 3,085 Instagram accounts across the event and growing Healthy UCD's following by 14.4%, along with views from an average of 2,267 accounts on Twitter on each day of the event. Over 150 people took part in competitions across the event including a healthy baking competition and end-of-week quiz. Students also completed a feedback form giving their own views on the event. The majority felt that the event was a success (95%), and that they were sufficiently supported by Healthy UCD and their tutors throughout (65%). However, 60% of the group felt that they needed more time allocated to Healthy Eating Week preparation in their programme of study. Also in 2021, Healthy UCD piloted engagement with marketing students from the UCD School of Business who reviewed the social media activity from Healthy Eating week as part of their coursework and have provided recommendations for how to improve in the future.

2.2. Event Management module – theory and practice

This 2-trimester undergraduate core module introduces the process of preparing for an event to 2nd year BSc Sport & Exercise Management students, taking into consideration a wide range of practical and logistical issues ("Event Management, Autumn Trimester (SMGT20010)," 2021; "Event Management, Spring Trimester (SMGT20210)," 2021). The project involves the group working in teams to develop a comprehensive bid document in

Trimester 1 to promote and deliver a Healthy UCD event as an assessed part of their module. In Trimester 2, a winning bid is selected, with inclusion of the best suggestions from the other bids. The students are responsible for planning, delivering and evaluating this wellbeing event with Healthy UCD as their "real life" client. The students are assigned roles on teams responsible for operations, activities and communications and are awarded academic credits based on their performance.

Similar to Healthy Eating Week, students in this module must create engaging content and use novel methods of engaging with the UCD community. Previously, students have organised live, in-person activities under the banner of "Wellbeing Wednesday" held in the student centre in UCD, such as lunchtime yoga classes and competitions in bowling and rowing, with prize sponsorship sought by the students themselves. An online edition of the 2021 event was held which, similar to Healthy Eating Week, was rolled out using the Healthy UCD website and social media channels under the theme of "Wellbeing Your Way". This included live online seminars on healthy eating and mental wellbeing, along with fitness classes and a competition which invited members of the UCD community to submit photos capturing what wellbeing means to them. Each seminar and fitness class received an average of 460 views across all platforms during the event, while 104 members of the UCD community took part in an online quiz held at the end of the event. The students completed an evaluation after their event and reported achieving their goal of increasing Healthy UCD's Instagram following by 5%. However, this target was not reached for Twitter; students advised they had learned the importance of tailoring content for different social media platforms in order to improve engagement. Other key learnings reported included an understanding of the responsibilities of running a professional event and how to deliver such an event while operating both in small groups and as a larger team.

2.3 Student Health and Wellbeing – an undergraduate elective module

The Health Promotion Strategy for the University led to the development of Healthy UCD, but also introduced the idea of module development in this subject area ("Healthy UCD | Healthy UCD Strategy," 2016). The module Student Health & Wellbeing was introduced as an undergraduate elective module, with 50% of places held specifically for first year students, which enables students to reflect on some of the issues that affect their own health and wellbeing and that of their family and friends ("Student Health & Wellbeing (PHPS10010)," 2021). Students are encouraged to look at what drives lifestyle-related behaviours and the broader socio-ecological influences that often shape our decisions. Participants in this module research and design a campus health promotion initiative as their final assessment; a non-marked pitch presentation allows the students to discuss their ideas with the module coordinator and other Healthy UCD staff, with a final presentation subsequently assessed. Examples of such initiatives presented by students include outdoor mindfulness areas, an anonymous online mental health support group and supports for sustainable travel to campus.

The module was first introduced in Spring 2020 with 38 participants. This has risen to the maximum of 50 registered students in Spring 2021, with additional students on a waiting list. Due to the success of the module, the number of students will be increased for 2022.

3. Discussion

Use of experiential learning by Healthy UCD has been very successful. By requiring students to plan and implement a real-life event, they gain valuable experience which they can later apply when they enter the working world. The events run by students enrich the university community, providing all students and staff with opportunities to learn more about wellbeing and come together to explore common interests. The growth in interest and participation levels in the modules that include experiential learning opportunities and the health-promoting events that result from them show that this learning method is well received by students and that there is scope for experiential learning to be introduced in more modules.

Evaluation of the learning experience is vital for both students and the facilitating staff to enable the students to reflect on their own learning and for staff to provide improved guidance to subsequent students taking part in the modules. For example, it has been repeatedly observed that students can place more importance on development of the content for events than on promotion and spend the majority of their time and energy on the former whilst potentially neglecting the latter. While the content of an event is vital to attract people's interest and deliver an interesting event, this approach has sometimes led to certain events not attracting the level of participation or attendance that they deserve. After observing this, Healthy UCD staff have placed more emphasis on promotion and communication during planning meetings in an attempt to ensure that the students' dedication is rewarded with high participation levels in their events. Additionally, feedback from students themselves, such as the view that more preparation time is needed for Healthy Eating Week, will be taken on board in the future to further improve the learning experience.

Universities play a key role in society. They have an opportunity to influence students at a critical juncture in their lives – the transition to adulthood. Therefore, this is the ideal time to encourage them to create healthy habits and foster an interest in health promotion which will stand to them throughout their future lives and careers. This societal role of the university is recognised through the Times' Higher Education Impact Rankings which assesses and ranks universities according to how they work towards implementing the United Nations' Sustainable Development Goals (SDGs). UCD is currently ranked 22nd out of 1,115 higher education institutions assessed. Of particular note are its high positions for SDG 11: *Sustainable Cities and Communities,* where UCD is ranked 16th, and SDG 3: *Good Health and Wellbeing,* where UCD is ranked 62nd, having increased its ranking in this category by 18 places since 2020 ("Impact Rankings 2021," 2021). The activities of Healthy UCD

contribute towards these excellent rankings, including its implementation of experiential learning in health and wellbeing courses. The UCD strategy for 2020-2024, “Rising to the Future”, also acknowledges both the role of Healthy UCD and the SDGs in its key themes of Creating a Sustainable Global Society and Building a Healthy World ("UCD Strategy 2020-2024," 2021). UCD is ranked in the 250-300 band in the Times Higher Education World University rankings ("World University Rankings," 2021). Recent research has shown that the more positive actions a university disclosed relating to its SDG achievements, the better its position in the overall ranking was likely to be (De la Posa, Merello *et al.*, 2021). The provision of experiential learning and engagement in health & wellbeing therefore provides gains both for students and for universities, through promotion of sustainability and good health and simultaneous advancement of international standing and reputation.

Several challenges have arisen for both staff and students involved in Healthy UCD’s experiential learning initiatives, the most notable being the sudden shift to online learning necessitated by the Covid-19 pandemic. Students and staff were required to adapt at short notice to deliver the learning experiences and events remotely in a fully virtual setting. This has provided students with a different learning experience where they cannot rely on traditional methods of communication and engagement with the university community through in-person events but encourages creativity in how their plans are promoted and implemented.

To conclude, experiential learning has been successfully implemented in three key health and wellbeing related modules in UCD. The experience gained through participation in these modules has been favourably viewed by students, while Healthy UCD has successfully increased awareness of its work through module involvement, thereby furthering its aim to create a sustainable healthy campus for all in UCD. Regular evaluation and feedback from students are key to further develop experiential learning in these modules and potentially others to ensure an optimal learning experience for students where they feel fully supported. University campuses provide an ideal location for experiential learning which should be exploited for the benefit of students and society.

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'Face-to-Face vs. Flipped': A Comparative Study on Academic Outcomes and Learning Preferences in First Year Allied Health Students Undertaking Anatomy and Physiology

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Abstract

A mixed-mode or ''flipped'' model of learning focusses on supporting a high level of student engagement, student motivation, and the transferability of specific course content. A blend of online resources and face-to-face (F2F) learning facilitates meaningful interaction between peers, while building a capacity for self-directed and lifelong learning. Within the School of Medical Science, Anatomy and Physiology (A&P) content was 'flipped' for delivery at a new campus to align with the traditional F2F offering. Lectures were delivered online, while tutorials and practicums were F2F.. Collaborative learning opportunities utilizing active learning pedagogies was appealing and was integrated during the re-alignment of A&P which was delivered to a cohort of allied health students undertaking their first year of their program. This study assessed how this type of learning was received by students (from the same program) undertaking the same course in an on-campus F2F delivery. Students completed surveys relating to their experiences in learning activities applied in: lectures, tutorials and practicums. In addition, academic outcomes (theoretical and practical) across the two modalities were also evaluated. Overall, students undertaking the mixed-mode delivery performed significantly better in theoretical assessments, while performance in practical assessments was comparable between both deliveries. Student preferences to learning and teaching activities was mixed, however all students highly valued the use of "mini-quizzes" in lectures, tutorials and practicums.

Keywords: *Flipped; mixed-mode; allied health; undergraduate; anatomy and physiology.*

1. Introduction

The Anatomy curriculum has undergone dramatic transformations in the 21st century to include modifications of in-person teaching, clinical placement, problem-based learning activities and gross anatomy teaching using cadaveric specimens (Leung *et al.,* 2006; Parker, 2003; Shead, 2020). Learning anatomy dates back to the early Renaissance period, with the Greek root for '*anatomy*' is to '*cut up'* (McLachlan & Patten, 2006*)*. For centuries, clinicians undertook many hundreds of hours studying and reviewing the distinctive contours and forms of the human body via human dissections. Becoming a qualified health professional was paramount to having an advanced understanding of human form and function (Khalil *et al.,* 2018; Granjeiro, 2019). The global emergence of the pedagogical 'flipped' classroom' model has challenged anatomy educators in transitioning away from the traditional didactic 'teacher' to a student-centered approach. Blended learning represents a mixed delivery of educational resources delivered via a combination of F2F delivery and online resources - essentially a complete transformation of accessibility of information for students outside of the traditional classroom setting (Norberg *et al.,* 2011). Many Universities saw the adoption of blended learning models as a means of offering educational platforms to a more diverse student population, while promoting a cost-effective option in the long-term (Garrison & Kanuka, 2004). Blended learning provides students with learning experiences that are flexible, collaborative and independent – all of which are advantageous in creating meaningful learning experiences. Based on the active learning strategies that form the foundation of 'flipped' classroom instruction, the overall goal of a 'flipped' classroom was to improve student outcomes compared to the traditional F2F delivery. Several studies have supported this theory and showed positive gains in student performance in medical education (Street *et al*., 2015; Stockwell, 2015). While 'flipping' does not always improve student performance (He, 2019), it does suggest that not all disciplines are potential candidates for 'flipped' instruction. At Griffith University (within the School of Medical Science), first year A&P courses have always followed traditional F2F delivery. While the courses were (and still are) popular with students, there was a distinct lack of flexibility and accessibility. The flexible model for Foundation Year Health (FYH) was introduced, and A&P course content was redesigned into a mixed-mode ''flipped'' classroom approach (online lectures, F2F tutorials, tutorial workbook and online assessment). In 2018, the "flipped" delivery of A&P was delivered to a cohort of allied health students at another campus, with the two courses (F2F and mixed-mode) running contemporaneously. Notwithstanding individual differences in teaching format and the student cohort, the main point of difference between the courses was the mode of lecture delivery. Therefore, the overall aim of this study was to assess student outcomes and preferences to teaching and learning activities across the two deliveries in a unique cohort of allied health students.

2. Methods

2.1. Participants

Study participants were allied health science students enrolled in an undergraduate program of either a Bachelor or Physiotherapy or a Bachelor of Occupational Therapy. Students were enrolled in courses 1016MSC (Anatomy and Physiology Systems 1) and 1017MSC (Anatomy and Physiology Systems 2) in 2019 in the first year of their undergraduate study. Students were invited to participate in a survey (via email) that related to their learning preferences in the course.

2.2. Course Model: Learning Activities and Assessment

Course content was aligned across both campus offerings (NA campus - mixed delivery) and (GC campus – F2F) (Table 1). Students enrolled in the F2F offering attended ~3 hr lectures/weekly; 10 x practicums (~3 hrs each); 1 hr tutorial/ weekly (non-compulsory). Students enrolled in the mixed-mode offering participated in: ~1.5 hr online lectures/weekly; 10 x practicums (~3 hr each); and ~2 hr tutorial/weekly (compulsory). Assessment was undertaken in-person at both campuses including 2 x theoretical examinations (MCQ + SA responses) and 2 x practical examinations. The mean (%) scores of all summative assessment items were examined across both modalities for all allied health students enrolled in Anatomy and Physiology Systems 1 and 2 (NA campus ~ 119 students; GC campus ~ 96 students).

Table 1. Learning Activities over 12-week Trimester.

Learning Activities	Face-to-face	Mixed-Mode
Lectures	~3 hr/weekly (in-person)	1.5 hr/ weekly (online)
Tutorials	~1 hr/ weekly (non-compulsory)	~2 hr/weekly
Practicums	~3 hrs (x 10)	~3 hrs (x 10)
Total Time (hr)	~77 hrs	~72 hrs

3. Results

Student preferences for teaching and learning activities were categorised across lectures, tutorials and practicums for each offering (Fig. 1 & Fig. 2). Students ranked the 'effectiveness' of each of the learning activities used in the course on a scale from 1-5. (*'1' Extremely Effective - '5' Least effective*). 83% of students undertaking the mixed-mode delivery of A&P indicated that the "use of analogies" in online lectures was extremely effective, while 64% indicated the use "mini-quiz's" as being an equally effective learning activity. Student preferences in F2F lectures were mixed (Fig. 2A), with 50% of students indicating that the inclusion of "mini-quizzes" during lectures was 'extremely effective',

followed closely by 33% reporting the "use of analogies", and 25% for "animations/audio-visuals".

Figure 1. Student Learning Preferences in Anatomy & Physiology (Mixed-Mode offering). Students' preferences to learning activities (on a 1-5 scale) used in online lectures (A); tutorials (B) and laboratories/practicums (C).

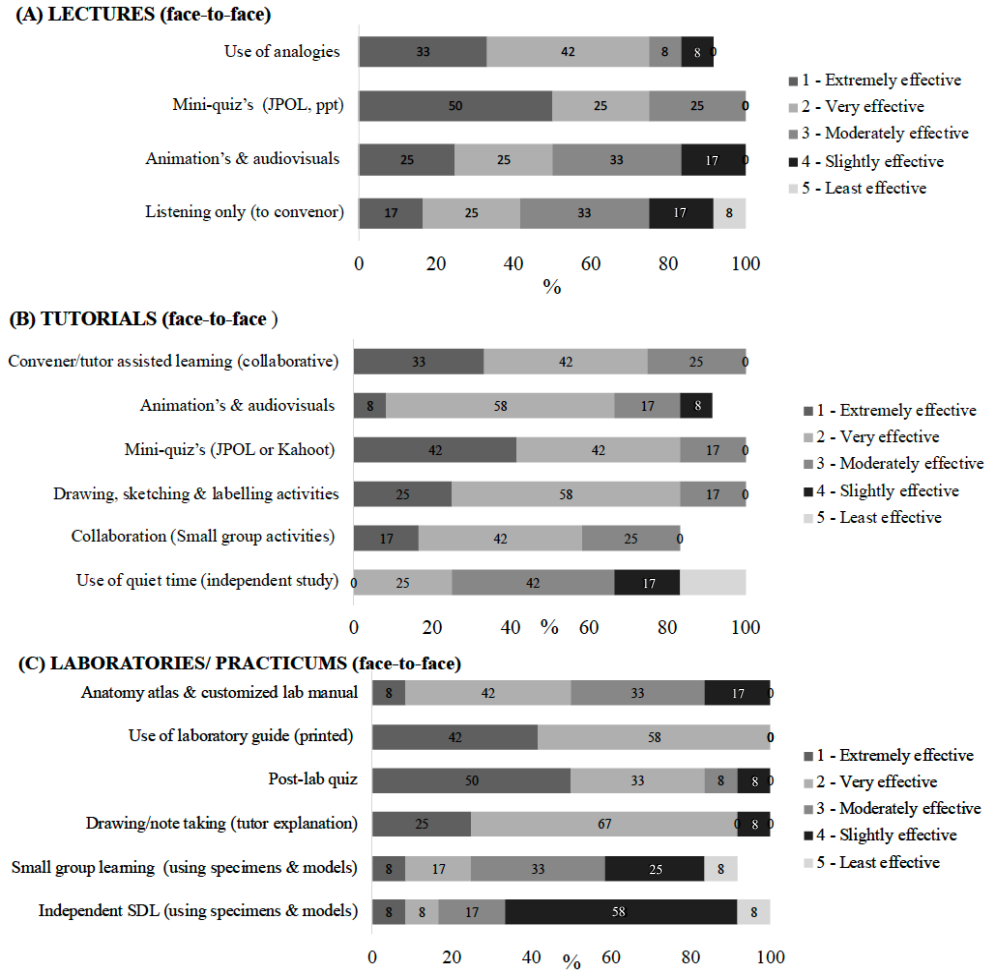

Figure 2. Student Learning Preferences in Anatomy & Physiology (F2F). Students' preferences to learning activities (on a 1-5 scale) in F2F lectures (A); tutorials (B) and laboratories/practicums (C)

Other variables evaluated were: self-reported attendance, usage of course and non-course resources and study group attendance (Fig. 3). Attendance (Fig. 3A) was high in the survey respondents, with most students indicating they attended 75-100% of all classes. Attendance at peer assisted study sessions (P.A.S.S) was higher (Fig. 3B) amongst students who attended the F2F offering (~40%; 'very frequent') vs. mixed-mode (~20%; 'very frequent'). Students undertaking the mixed-mode offering reported a greater use of non-course resources (~33%; 'frequent' & 20%; 'occasional') (Fig. 3C). Comparatively, in the F2F offering, only 9% of students reported 'frequent'. Non-course resources listed by students across both modalities included: Crash course, Khan academy, YouTube, visible body, Ninja Nerd, Flash cards and Amoeba Sisters.

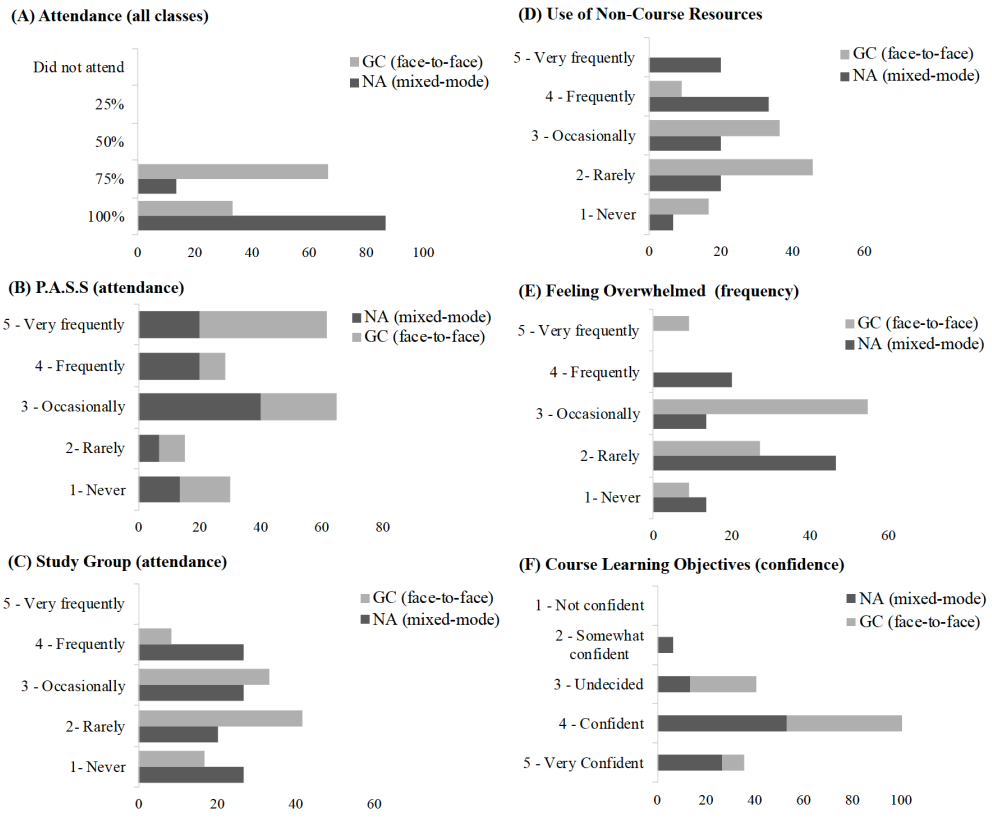

Figure 3. Student attendance (A); P.A.S.S attendance; study group attendance (C); use of non-course resources (D); feeling overwhelmed by course resources (E); & confidence in course learning objectives (F).

The mean mark for theoretical assessments for both A&P courses (1016MSC/1017MSC) was significantly higher for students undertaking the mixed-mode delivery (Table 2 & Table 3) compared to students undertaking the F2F delivery (mid-trimester & end-of trimester exam).

Table 2. Assessment Outcomes for Anatomy and Physiology Systems 1.

Assessment Items	GC (face-to-face)		NA (mixed-mode)		
	M (%)	SD	M (%)	SD	P
Laboratory/Practical Exam 1	79.9%	14.8	79.1%	16.8	0.7170
Mid-Trimester Exam 1	67.6%	15.1	74%	12.7*	0.0010
Laboratory/Practical Exam 2	76 %	15.9	75.8%	15.6	0.9034
End of Trimester Exam	65.4%	17.6	72.1%	15.7*	0.0038
Overall course weight (%)	71.1%	14.4	75.2%	14.0*	0.0377
students with grades (n)	*94*		*118*		

*Note. Mean (%) (+SD) *, P <0.05*

Table 3. Assessment Outcomes for Anatomy and Physiology Systems 2.

Assessment Items	GC (face-to-face)		NA (mixed-mode)		
	M (%)	SD	M (%)	SD	P
Exam 1	67.3%	14.6	75.5%	13.0*	0.0001
Laboratory/Practical Exam 1	66.2%	14.2	68%	13.3	0.3719
Exam 2	61.9%	17.6	73.7%	13.7*	0.0001
Laboratory/Practical Exam 2	74.3%	15.9	79.7%	12.6	0.0098
End of Trimester Exam	58.8%	17.5	64.5%	14.1*	0.0139
Overall course weight (%)	63.6%	16.1	71.5%	11.5*	0.0001
students with grades (n)	*80*		*110*		

*Note. Mean (%) (+SD) *, P <0.05*

4. Discussion

The mean result for theoretical assessments for students undertaking the mixed-mode delivery (for 1016MSC) was significantly higher compared to students undertaking the F2F delivery (mid-trimester and end-of trimester exam), while the mean result for the practical examinations was comparable between both modalities (F2F vs. mixed-mode). For course 1017MSC (Trimester 2), the mean result for all assessment items was significantly higher for students in the mixed-mode delivery vs. the F2F offering. These outcomes suggest that a mixed-model 'flipped' of learning does improve students' performance in summative assessments, and that this modality may well be suited to A&P courses. Improvements in student performance may be attributed to the availability of self-directed study material and effective use of in-class discussion that accompanies collaborative and student directed learning. Teaching and learning strategies that aim to expand student's application of knowledge and develop higher order thinking skills, preparing them more adequately for high-level cognitive questions which are used in theoretical assessments (Anderson, 2001; Day, 2018). Didactic lectures are limited to providing students with learning opportunities

to apply knowledge in a collaborative setting, thus may contribute a negative impact on their performance in theoretical assessments (Lochner, *et al.,* 2016). Student preferences to teaching and learning activities were mixed amongst students attending F2F lectures. 50% of students indicating that the inclusion of "mini-quizzes" during lectures was 'extremely effective', closely followed by the inclusion of "analogies" (~33%) and "animations/audio-visuals" (~25%). Although didactic lectures are widely criticized (McLaughlin, 2001) advances in technology have enabled tertiary educators to reinvigorate their practice and presentation style to enhance the student learning experience (Gurpinar, 2011). Tutorial attendance is compulsory in the 'mixed-mode' offering of A&P, thus students are frequently immersed in active learning environments which provide opportunities to apply knowledge using concepts introduced in online lectures. Student preferences to teaching and learning activities used in tutorials was mixed, with most activities ranked as "very effective". Students highly valued: "collaborative" learning (with tutors/convenor), "mini-quiz's", "drawing and labelling" activities and working in "small groups". Contrary to the mixed-mode offering, tutorials in the F2F offering are not compulsory and are shorter in duration (~1 hr). Students indicated that most teaching and learning activities used were "extremely effective" or "very effective". The use of "mini-quizzes" was highly regarded, with 42% of survey respondents denoting them as a "extremely-effective" activity. Students across both modalities of A&P valued the use of formative quizzes in lectures, tutorials and practicums as an effective learning tool. Students who regularly undertake quizzes as formative assessment achieve better outcomes in summative assessment items (Kromann, 2009; Kibble, 2007; Roediger et al, 2011). Practice questions are advantageous in that students can use them as performance indicators to measure their learning. Attendance at peer assisted study sessions (P.A.S.S) was higher amongst F2F students (~40%) vs. mixed-mode (~20%). A lower attendance may be attributed to mixed-mode students attending tutorials that are longer in duration (~2 hr/wk.), compared to GC students (~1 hr/wk.). In addition, F2F students attend all classes in-person, making P.A.S.S sessions more accessible. Students undertaking the mixed-mode offering reported a greater use of non-course resources. The most commonly utilized non-course resources listed by students across both deliveries were: Crash course, Khan academy, YouTube, visible body, Ninja Nerd, Flash cards and Amoeba Sisters. Jaffar (2012) suggests that more frequent use of non-course resources is expected amongst students undertaking blended courses, as lecture material is online and additional digitalized content is more accessibile.

5. Conclusions

Students undertaking the mixed-mode delivery performed significantly better in theoretical assessments compared to students in the F2F delivery.. Student preferences to teaching and learning activities was mixed across lectures, tutorials and practicums. A trend emerged that

students (across both modalities) highly valued the inclusion of 'mini-quizzes'. This evaluation of student preferences to teaching and learning activities can assist in tailoring A&P course design to support student learning.

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Clinical Simulation in pediatrics and neonatology using EDISON: an educational innovation project

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Abstract

Introduction: Clinical simulation is a tool that allows creating controlled and safe spaces that mimic reality, where students can acquire skills and abilities prior to facing real situations.

Methodology: This is a two-phases study. The first quasi-experimental phase where 3 questionnaires were used; two of them to assess knowledge (pretest - posttest) and the other one to assess the satisfaction of the training action. The second phase was analytical, where the effectiveness of a training intervention in a confinement context based on the use of audiovisual materials created through EDISON was evaluated.

Results: In 2019 the average satisfaction of the students was 9.22 (SD 0.72) out of 10. The most valued item was the one related to the domain that the instructors had regarding the knowledge imparted, showing 9.79 out of 10. The students' knowledge improved in 9 of the 11 questions.

Conclusions: The satisfaction of the students and the knowledge acquired were remarkable, being clinical simulation a methodology that helps to consolidate the knowledge and skills put into practice.

Keywords: *Cardiopulmonary resuscitation; pediatrics; clinical simulation; university teaching; educational innovation.*

1. Introduction

The Educational Innovation program in basic and advanced Cardiopulmonary Resuscitation in pediatrics and neonatology in a realistic context is included within the subject "Nursing in Child and Adolescent Health" (NCAH), taught in the 2nd year of the Bachelor's degree in Nursing at the Faculty of Nursing and Podiatry (FNP) of the University of Valencia. It is part of a project on Educational Innovation and Improvement of teaching quality (Uv.es, 2017).

In this educational program taught in the 2018/2019 academic year, several clinical situations of the pediatric and neonatal critical context were designed, in which the students of the NCAH subject had to face various scenarios where they could dynamically implement the knowledge, skills and attitudes acquired throughout the academic year.

In order to make decisions, students must be previously exposed to clinical situations where they can discuss possible solutions. For this reason, the incorporation of clinical simulation in nursing teaching is important, since in this way the future professional will be able to face effectively the complex and changing dilemmas that will arise throughout their practice. professional, and thus improving the quality and safety of patient care (Tortajada-Lohaces, et al., 2018).

Nursing teachers cannot expect their students to learn to solve situations in their future daily practice, only through the observation of the teacher or "passive" documents based on presentations. Students must be exposed to clinical situations where they can discuss possible solutions, to later make decisions. Therefore, it is important to incorporate clinical simulation together with 3D environment tools in nursing teaching (Guimond, *et al.*, 2011; Urra, *et al*. 2017).

This type of teaching methodology is important for training in the proper management of an emergency situation, since it is very difficult to train and evaluate during the real emergency. When a critical situation occurs there is no time to stop and think about what the next step will be, for this reason it is essential to practice the action protocol, to know what actions to carry out. And the only way to practice an emergency situation without endangering the patient's life is through a realistic environment generated in 3D when we are in a confinement situation (De la Horra, 2010). The fact that students in more advanced courses use the EDISON tool to deal with topics such as pediatric and neonatal CPR (coordinated by specialist health professionals) will allow them to provide them with the essential skills to be the ones who train the 2nd year course students themselves.

2. Aims

1. All 2nd year nursing students must know how to correctly perform CPR in children after the Infant and Adolescent Health Nursing course.

2. To strengthen the knowledge about pediatric CPR of all 2nd grade students and also enhance the knowledge of 3rd and 4th grade students who participate as monitors.
3. To ass the knowledge about pediatric CPR before and after the educational intervention (simulation and EDISON online), as well as student satisfaction with this teaching methodology.

3. Metodology

This Teaching Innovation Project (TIP) designed in two phases was accepted by the "Vice-Rectorat d'Ocupació i Programes Formatius" of the University of Valencia in 2019 to be carried out in two academic years 2019-2021, which the project code is UV-SFPIE_PID19-1096189 and a founding of 1000 euros.

1.1. First Phase

In the first phase, the methodology of previous years was followed (García-Molina et al., 2019, 2018), being a quasi-experimental study (not controlled), in which three questionnaires were used (pre-test and post-test knowledge; satisfaction) of evaluation as a method to collect the information regarding the acquisition of competences and student satisfaction in relation to the simulation.

The questionnaire to assess satisfaction was anonymous and consisted of 20 items, which had to be scored from 0-10 according to the degree of satisfaction that students had in this regard, being 0/10 the "lowest degree of satisfaction" and being 10/10 the "degree highest satisfaction".

In this way, different aspects related to the laboratory were evaluated: usefulness of the laboratory, methodology, organization and resources, teaching team and general evaluation.

On the other hand, the evaluation of knowledge was carried out using two tests: one before starting the laboratory (pre-test) and the other one at the end (post-test). Both questionnaires, like the satisfaction questionnaire, were anonymous, and contained 11 questions. The format was multiple-choice questions, in which only one answer was correct. The order of the questions in the post-test was different from the order of the questions in the pre-test.

To develop this phase of the project, in the academic year 2018-2019, 18 CPR simulation laboratories of 2 hours duration were carried out, in which 160 students of the 2nd year of the subject NCAH participated. In addition, 6 students of 3rd and 4th year of the Nursing degree and 13 nurses participated as monitors of the simulation.

Prior to the simulation laboratories, a theoretical class on pediatric CPR was given to the 2nd year students and, from April 8 to May 10, 2019, the simulation laboratories were carried out. Approximately 15 2nd year students participated in each laboratory and 3 clinical cases

were carried out in which the scenario created for this purpose was that of a subway accident where there were multiple victims.

Each case was tutored by a member of the innovation group, the distribution being:

1. Advanced CPR on a 2-year-old pediatric patient: NCAH professor.
2. CPR instrumentalized in premature newborn: 3rd or 4th grade student assigned to innovation.
3. Basic CPR in a 2-month-old infant: 3rd or 4th grade student assigned to innovation.
4. Evaluation of tutors: faculty professor assigned to innovation.

The monitor/tutor in each case was responsable of evaluating the students' intervention. The external evaluator was responsable of evaluating both the 2nd grade students and the monitor/tutors assigned to the innovation through a check-list, and at the end of the laboratory an analysis of the evaluation was carried out as a whole (debriefing).

1.2. Second phase

The second phase of the study, in the 2019-2020 academic year, was influenced by the COVID-19 confinement. The innovation staff redesigned the methodology for this second phase. Simulated demonstration videos on CPR techniques were provided, previously recorded and edited by the teaching team of the subject. In addition, both supporting documentation and videoconferences were offered synchronously, and all 2nd year students were allowed to record the class. These classes were offered by 4th year students, tutored by a teacher of the subject. These didactic resources were offered to all students.

In order to assess the value of applying attractive virtual environments created using EDISON in CPR education, audiovisual materials organized as a “video book” were created (an exemple in https://mmedia.uv.es/html5/u/pa/pagarmo3/61706_06_soporte_vital_avanzado_pediatrico_iii.mp4). This option can be found in the “AulaVirtual” (based on the MOODLE environment). "Edison" (https://www.brainstorm3d.com/products/edison/) is an interactive tool for creating presentations that increases the attention of students and helps the transmission of the message by immersing the teacher in their presentation in a 3D environment. It is a template-based application that allows teachers to transform the learning process by seeking to create a different educational experience, which allows both students and teachers to interact with augmented reality graphics immersed in customizable virtual environments and complete the lessons with predefined 3D elements. The teachers were able to explain complicated concepts in a simple, visual and practical way. Once the template is loaded, the program inserts the teacher, captured by the laptop's camera, into the augmented reality scene, which can be customized using the different resources and objects available.

As the video book was made in Spanish, it was decided to use it in the groups where Spanish was the language used in the classes and teaching materials. 2 groups (Spanish) were taught in the Virtual Classroom with a video book (WVB), while other 3 groups (Valencian) had not a video book (NVB), using the rest of the resources that the other 2 groups also had. The effectiveness of the video book was measured through the questions on CPR that were formulated in the final exam for the subject in June 2020. The same 10 questions were asked to all students within a 55-question exam. They were assessed whether there were significant differences between the groups, both in the 10 questions on CPR, and in the entire examination. The satisfaction of the student was not evaluated as in the first phase.

4. Results

In the first phase, the results of the satisfaction survey are reflected in Figure 1, where the score for each of the items appears. The average grade awarded by the 160 respondents is 9.22 (SD 0.72) out of 10. The item most valued by the students was 16 (mastery of the contents taught by the teacher) showing a result of 9.79 out of 10. On the other hand, the item showing the lowest score was question number 11, which refers to whether the physical facilities facilitated the development of the laboratory, showing a result of 8.49 out of 10.

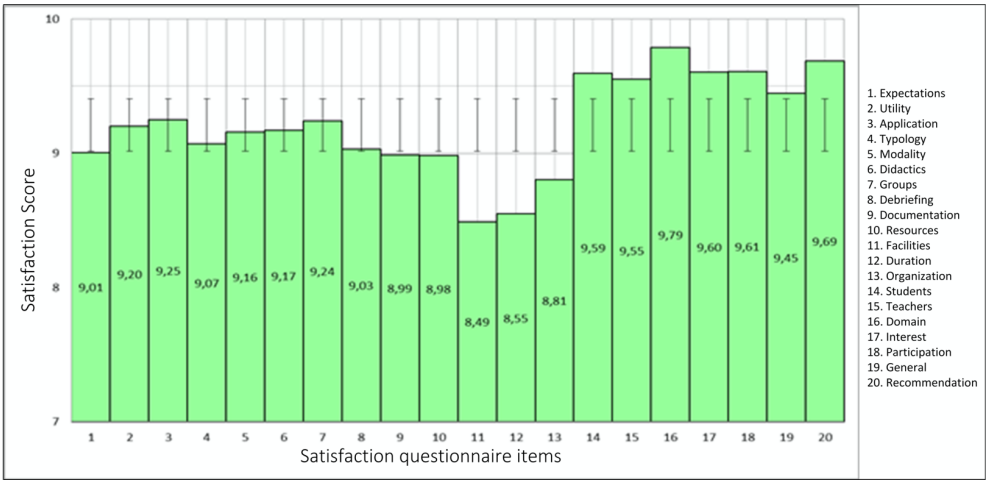

Figure 1. Satisfaction survey results. Source: own elaboration.

Regarding the results obtained in the pre-test and the post-test, which are shown in figure 2 and 3, which show the percentage of correct answers and mistakes in each of the questions.

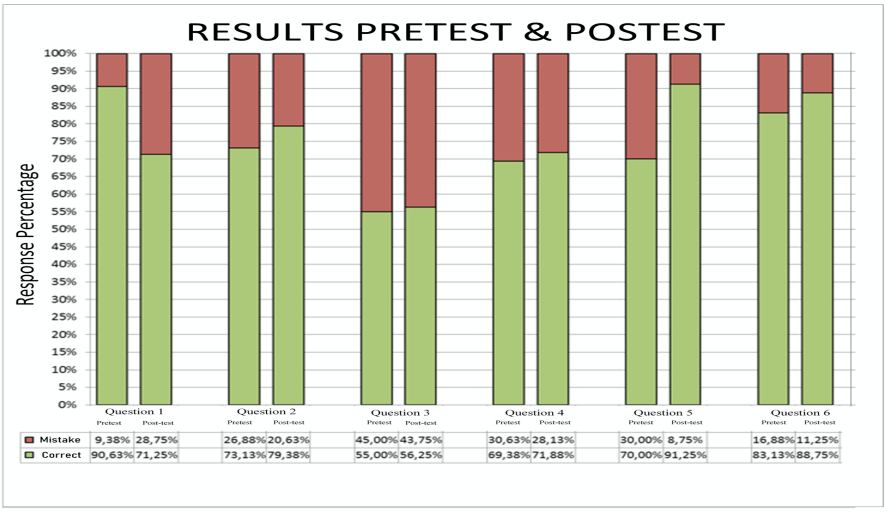

Figure 2. Pre-test vs post-test results. First 6 questions. Source: own elaboration.

Figure 3. Pre-test vs post-test results. 5 questions until 11 questions. Source: own elaboration.

On average, the students improved their knowledge in 9 of the 11 questions. The question that received the most correct answers from the pre-test was question number 1 (compression-ventilation ratio in children under 2 years of age), in which 90.63% (145 people) of the students were correct. Instead, the question showing the least correct answers in the pretest was question 7 (intubation time), which was correct by 34.38% (55) of the students. However, this question was the one in which the most improvement occurred,

raising the percentage of correct answers to 63.13% (101) corresponding to question 10 of the post-test.

Regarding the post-test, the question showing the most correct answers was question 4 of the post-test (no. 9 of the pre-test) (frequency to reassess a 6-year-old girl during CPR) showing a percentage of correctness of 93.13% (149). And the question showing the fewest correct answers in the post-test was question number 5 (chest compression depth in a 5-year-old child), this question was correct by 56.25% (90), showing a minimal variation with respect to its counterpart in the pre-test (question 3) in which the percentage of correct answers was 55% (80).

296 students participated in the second phase of the project. 37.8% (112) of the students received WVB training. The final average mark of the 55-question exam was 8.44 (SD 0.55) for the WVB group, while it was 8.62 (SD 0.54) for the NVB group.

There are significant differences ($p < 0.00$) in the numerical grades obtained between WVB students and NVB students, the numerical mean of SVL students being higher. However, when transferring these numerical scores to the categorical rating, the WVB students obtained a higher percentage of the rating of Excellent and Notable (99.11% of the ratings) than the NVB students (98.65%) without differences significant (Table 1).

Table 1. Distribution of evaluation between the group with a Videbook and without a Videobook.

Label	CVL	SVL	Total general
Good (6-6.9)	1 (0.89%)	3(1.63%)	4(1.35%)
Remarkable (7-8.9)	10 (8.93%)	19 (10.33%)	29 (9.80%)
Excellent (9-10)	101 (90.18%)	162(88.04%)	263 (88.85%)
Total general	112	184	296

Source: Own elaboration.

When evaluating in which questions there were significant differences in the score obtained, it is observed (Table 2) that question 31 obtains a lower mean score in the WVB group than in the NVB group.

Table 2. Questions of the 10 evaluation items with relevant differences.

CPR questionnaire questions	WVB	NVB	p
Compression-ventilation relationship in CPR	0.1982	0.1913	0.05
CPR medication administration guideline 1	0.1946	0.1804	0.08
CPR medication administration guideline 2	0.1054	0.1478	0.00
CPR medication administration guideline 3	0.1964	0.1859	0.02

Source: Own elaboration.

The rest of the questions of the evaluation questionnaire did not obtain significant differences in the mean score obtained between both groups.

The innovation staff considers that using Video Books will improve the quality of teaching in the groups where they will be included. However, it is true that the form of evaluation through online exam questions was not ideal in order to fully evaluate the tool. It would have been engaging to carry out a qualitative assessment of the results through interviews with the students of both groups (with and without Videobooks).

Moreover, authours suggest designing a specific questionnaire in order to evaluate the effectiveness of specific training interventions (such as video books), and not only through questions in the final exam of the subject.

5. Conclusions

Clinical simulation helps to enhance and consolidate the knowledge and skills in the field of Basic and Advanced Pediatric and Neonatal Life Support.

The satisfaction of the students and the knowledge acquired were remarkable. To improve their satisfaction, it is mandatory to adapt the physical space where the simulation laboratories are carried out and modify the simulation times.

Using Videobooks the application of the Inverted Classroom methodology and the creation of realistic scenarios in a context of home confinement is useful. EDISON is a useful tool for the application of the Inverted Classroom methodology and the creation of realistic scenarios in a context of home confinement. However, adjustments are required to the Videobooks to enhance the digital experience and thus the assessment of CPR knowledge.

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Is it more than employability? Revisiting employers' perception of graduates' attributes

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Abstract

Higher education is confronted with two broad missions, either prepare graduates for the world of work, or prepare well-rounded students that combine broad-spectrum qualities of citizenship, responsibility, and professional expertise. The employability skills have been widely studied, while the attributes related to holistic education are still scarcely investigated. This paper examines the skills and other attributes that employers seek when hiring graduates. It confronts the perceptions of employers regarding the skills associated with employability and the abilities and characteristics linked to holistic education. This is an exploratory research based on original and qualitative data collected in 2020 through interviews with employers (n=8) from different sectors in Portugal. Empirical findings indicate that all employers prioritise employability skills, such as communication, teamwork, and learning abilities. We found more dispersion regarding the attributes of holistic education and a large consensus was found for interdisciplinarity, self-reflection, and personal and social responsibility. The data show that the attributes that help to address society's problems and challenges still seem to be regarded as quite irrelevant in the recruitment process.

Keywords: *Employability skills; holistic education; employers' perception; Portugal.*

1. Introduction

In recent decades graduates' employability has been recognised as the core mission of higher education institutions, which should develop certain skills and attributes to prepare them for the world of work and smooth their transition into the labour market (Boden and Nedeva 2010; Sin and Amaral 2017). Higher education thus has an instrumental role and should contribute to individual success and economic performance. Is this a consensual mission of HE? More recent proposals include the development of the "whole student" (Quinlan 2011) and the citizen professional (Doherty 2011) to highlight the mix of expertise, citizenship, and the personal and social responsibility needed to address society's problems.

How do employers view these new proposals? The answer is still missing in the literature. While a considerable literature has been devoted to employability skills (see Suleman 2018 for a survey), the demand for other attributes associated with holistic education deserve scrutiny. This paper addresses this gap through an analysis of the skills and other attributes required by employers when hiring graduates. More specifically, it confronts the perceptions of employers regarding two broad types of attributes: the skills associated with employability and the abilities and characteristics linked to holistic education.

An extensive literature has proposed catalogues of employability skills. For example, Andrews and Higson (2008) made a distinction between soft and hard skills; and Branine (2008) advises that employers seek person-oriented rather than job-oriented skills. Some add more types of skills and overcome the limitations of a dichotomic proposal. Olivier *et al*. (2014) found six broad clusters of skills: i) foundation skills, which include written and oral communication, problem solving, and critical analysis; ii) adaptive capacity, which involves the ability to adapt to new situations and foreign workplaces, to learn autonomously, develop new ideas, and innovate; iii) team working and interpersonal skills; iv) IT skills; v) employability skills related to coping with pressure and stress, being flexible and adaptable, and meeting deadlines; and vi) technical and domain specific skills. Despite those efforts to create a catalogue of employability skills, little has been reached. The bundle of employability skills includes communication, teamwork, analytical and critical thinking, learning abilities, IT skills, organization, and planning skills (Suleman 2018).

Another stream of the literature examines the attributes related to holistic education. This departs from the idea of "wholes" and focuses on relationships: "the relationship (…) between mind and body, (…) between various domains of knowledge, (…) between the individual and community, and the relationship between self and Self. In the holistic curriculum the student examines these relationships so that he/she gains both an awareness of them." (Miller 1988 in Miller *et al*. 2019: 5) Two major contributions help to define the attributes of holistic education. One is provided by the Chicago declaration, in 1990, which defined the basic principles of holistic education, notably to view students as individuals;

acknowledge the role of experience; develop holistic education, taking care of its implications in the educational process; recognize the new role of educators and the importance of their own inner growth; give freedom of choice; educate for human development, participatory democracy, global citizenship and earth literacy; and spirituality within education, keeping in mind that education should nourish the healthy growth of the spiritual life (GATE 1990).

Another stream can be attributed to Jacques Delors (2003), who described the four pillars of education. Although not applying the label of holistic education, the pillars seem closely related to it. They include learning to know, which refers to knowledge and cognitive abilities; learning to do, linked to professional qualification and skills utilization; learning to live together and with others, to underline the interdependency and shared goals and projects; and learning to be, insofar as education must contribute to the development of the whole person (spirit, body, intelligence, sensitivity and social responsibility).

In addition to these pioneer contributions the literature provides several proposals that include attributes of holistic education, notably global citizenship (UNESCO 2014); entrepreneurship (Oganisjana and Matlay 2012); interdisciplinary knowledge (Stukalina 2008); leadership and self-reflection/self-awareness (Quinlan 2011); personal and social responsibility (Reason et al. 2013); ecological awareness (GATE 1990); and moral intelligence (Clarken 2010). This helps in designing the catalogue of attributes of holistic education.

2. Data and methodology

This is an exploratory research based on original and qualitative data collected through interviews with employers (n=8) in Portugal. The sample includes firms from different sectors of activities (see Table 1 for details of the sampled firms). Two methods based on Suleman's (2018) proposal were used to identify the skills and other attributes required of an ideal candidate in the hiring process. One is unsupervised method, i.e., the interviewee freely enumerated the skills required; the other is supervised, in which each interviewee was asked to select seven attributes from a catalogue of skills and other attributes. We asked the interviewees to provide specific examples in which two candidates reached the final step of selection. The goal was to determine the major attributes that allow a candidate to get the job, and of course whether those attributes are related to employability skills and/or holistic education.

The data were collected between March and June 2020, mainly via Skype due to the pandemic situation; only two interviews were face-to-face. The characteristics of the firms and sociodemographic information of interviewees are in Table 1. All interviewees were involved in recruitment processes, although holding different job positions. They are therefore aligned with the company's vision regarding talent search. As can be noted, the

sample includes medium and large firms from different sectors, but the IT is the most represented. Although interesting, the findings should be examined with caution given the size and diversity of the sample.

Table 1. Characteristics of the firms in the sample.

Firm	Sector	Size (group)	Multinational	Age of the group (years)	Interviewee
F1	IT	170	Yes	15	HR Specialist
F2	IT	90	No	8	Business Manager
F3	IT	23000	Yes	22	Recruitment Coordinator
F4	IT	205	Yes	32	HR Specialist
F5	Industry	12000	Yes	101	HR Generalist
F6	Financial	8000	Yes	26	HR Manager
F7	Hospitality	1200	No	17	HR Technician
F8	Pharmaceutical	2000	Yes	62	Global HR Lead HRIS

3. Empirical findings

Table 2 shows the skills and attributes demanded for graduates. The different methods used to collect these data allowed us to discriminate which requirements are well-established in the employers' perception and those that are probably outside the priorities of employers. It must be noted that a mix of specific and soft skills appears as a requirement for almost all employers when they freely enumerate job requirements. Furthermore, it seems that the employability skills are mentioned spontaneously (unsupervised method) and/or chosen (supervised method) consistently by the interviewees. Those skills are consolidated as key requirements, and to some extent suggest a preference for ready-to-work candidates. This bundle includes both specific and general, or hard and soft skills: "*We need people who can talk to the customer; they need to know how to talk to the clients and their teammates"* (F1); "(...) *being able to understand the relevance and importance of teamwork and not just working on their individual part are very important things when working in multidisciplinary teams"* (F8); "(...) *What we pay attention to (...) [is the] way of thinking, analytical thinking. (...)"* (F3); *"(...) they need to show interest (...) and willingness to learn and develop*" (F5).

We now turn to the skills that were not reported by some firms. This is especially notable in the case of IT skills, which were not mentioned or chosen by the interviewees of the firm in the manufacturing sector, the hotel business, or pharmaceuticals. On the other hand, it can be noted that in the IT and Finance sectors the interviewees insisted on it. Other skills are also absent in the priorities of some of the sampled firms (e.g. foreign language).

Table 2. Empirical findings.

Skills/ Attributes	F1 IT	F2 IT	F3 IT	F4 IT	F5 MANUF	F6 FIN	F7 HOS	F8 PHAR
Communication	UNS; SUP	UNS; SUP	UNS; SUP	UNS; SUP	UNS; SUP	SUP	SUP	UNS; SUP
Team work	SUP	UNS; SUP	UNS; SUP	UNS; SUP	UNS; SUP	UNS; SUP	SUP	UNS; SUP
Analytical and critical thinking	UNS; SUP	UNS; SUP	UNS; SUP	SUP	SUP	UNS; SUP		SUP
Learning abilities	UNS; SUP	SUP	UNS; SUP	UNS; SUP	UNS; SUP	UNS; SUP	UNS; SUP	SUP
IT user or programming	UNS; SUP	UNS; SUP	UNS; SUP	SUP		UNS; SUP		
Organisation and planning		SUP		SUP	UNS; SUP		SUP	UNS; SUP
Foreign language	UNS	UNS; SUP	UNS; SUP			UNS; SUP		SUP
Interdisciplinar knowledge		UNS	UNS	UNS	UNS	UNS		UNS
Global Citizenship				UNS	UNS	UNS		UNS
Entrepreneurship	UNS	UNS		UNS; SUP			UNS; SUP	
Leadership						UNS		UNS; SUP
Self-reflection ability	SUP	UNS		UNS; SUP	UNS	UNS; SUP		
Moral intelligence					SUP		UNS; SUP	
Personal and social responsibility	SUP	SUP	SUP		SUP		UNS; SUP	
Ecological awareness								

UNS: Unsupervised; SUP: Supervised method.

We found some dispersion in the attributes related to holistic education. Firstly, all cells regarding ecological awareness are blank. In other words, no interviewee considered it to be a key attribute in the hiring process. Secondly, the consensus herein is less evident than the one around employability skills reported in Table 2.

Thirdly, attributes such as interdisciplinary knowledge and global citizenship were mentioned by more than half of the interviewees, but the extent and mix are unclear. The pharmaceutical and one of the IT firms prioritise recruitment of engineering graduates, but noted that it should be in different specialisations within engineering: "*The preference is*

usually chemical engineering because it is effectively the area that provides them the best [knowledge] background, but we do not exclude other areas". For other firms interdisciplinarity means openness to hiring from different fields of education and subsequently prepare the graduate(s) with specific skills through workplace training: "*We have seen more people who have degrees in other completely different areas*; (…) *There are also those who have other types of courses and who later have [specific] training*, (…) *and this turns out to be very good*" (F2).

Global citizenship was mentioned spontaneously by four companies, indicating the sense of knowing how to live and work with others: "(...) *the conscience of the other, that is, non-discrimination* (…)" (F8), or having a purpose at work and the ambition to have a positive impact in the world: "(…) *understand to what extent you want to use that little bit of knowledge that you take with you and how you want to use it to have an impact - preferably, positive*" (F4). However, the interviewees did not include it when confronted with a catalogue, i.e., global citizenship was excluded from the seven most important attributes required of graduates by all the sampled firms.

Self-reflection is an attribute that collected considerable agreement (five firms) and it is viewed as an indicator of candidates' maturity and ability to learn from experience: "(…) *also understand what the person wants in the future and understand if they already have their path lined up in their minds*" (F2).

Finally, other attributes related to holistic education obtained far less agreement. This is the case of leadership, moral intelligence, and personal and social responsibility. The first is perceived as an attribute that enables the candidates to help their firms succeed: "(…) *it means that we won't have people following others blindly. People must have a critical sense and from here on they can create greater things*" (F6). Moral intelligence means having a sense of integrity: "*good candidate*"; the interviewee assumed that technical skills can be acquired at the workplace: "*We think that we often need good people and that the technique we are able to teach on job*". This interviewee also reported, freely, that personal and social responsibility are key attributes of a whole candidate: "(…) *an added value, we are constantly evolving and the business has to adapt to new realities and value other variables that were not previously considered or seen as a priority*" (F7). Four other firms also considered personal and social responsibility as an attribute of desirable candidates – three firms from IT and the single manufacturing firm.

4. Conclusions

This study examined employers' requirements when hiring graduates and sought to relate them with the two major missions of higher education: employability/world of work and holistic education. Employers seem to search for ready-to-work candidates, endowed with a

balanced set of hard and soft skills (Andrew and Gibbs 2008) and cognitive abilities. Consequently, the skills associated with employability achieved broad consensus among the sampled employers (Olivier *et al*. 2014). However, some firms prioritised IT skills (F1, F2, F3, F4, F6), while others omitted it (F5, F7, F8). We question whether it is deemed to be irrelevant or that it is taken for granted in the context of widespread digitalisation. We suspect that this skill is outside the core business. The same holds true for foreign language.

The attributes related to holistic education achieved less consensus. We underscore that moral intelligence (Clarken 2010), personal responsibility (Reason *et al*. 2013), and environmental awareness (GATE 1990) were not spontaneously mentioned by most respondents as attributes valued in candidates. However, the literature suggests that the commitment to social and environmental concerns, as well as ethical practices on behalf of organisations, are not only a requirement that must be met in accordance with numerous national and/or global regulations, but also add value to organizations and help to build a positive image and obtain stakeholder involvement (EC 2018; SHRM 2012).

These findings deserve further scrutiny and caution should be taken in their interpretation and generalisation. We have a small sample, concentrated in few sectors, and this is an exploratory research. Nonetheless, we collected data through two methods, unsupervised and supervised. The latter could raise interviewees' awareness for non-recurring attributes. However, although directly confronted with attributes of holistic education, a few interviewees indicated them to be important attributes. The most striking finding pertains to the ecological awareness; no one attributed importance to it. Is it irrelevant to employers? Is it taken for granted? These issues must be studied, as they are relevant for the implementation of sustainable management models in companies and to the current mission of higher education institutions.

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The practicality of curricula towards improved employability

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Abstract

The Covid-19 pandemic has resulted in a plunge of worldwide economies and consequently, new economic models must be evolved in order to come out of such an unfavourable situation. Innovation and creativity will be a must to reach success and it is here where young graduates can provide a fresh perspective. Certainly, the education system must also adapt to a new era that will result from this situation and although present curricula can become a constraint to achieve this goal in some cases, a drastic change in classroom methodology is a must. The objective of this paper is to describe that a learning process based on hand-on practice and autonomous learning can result in an upgrade of competences and skills. Therefore, a project carried out by Tourism undergraduates will be introduced in which students become the main characters of their own learning process. As a result, an increase in motivation has been revealed and also, in students' maturity towards the learning experience.

Keywords: *Innovation; methodology; applicability; employability.*

1. Introduction

2020 will be recalled as annus horribilis worldwide with over two million deaths and an estimated 420 million jobs loss during the second and third quarters (ILO, 2021), a situation which has been defined by the World Bank as the deepest global recession since the Second World War. Education became affected too with schools and universities closing and suddenly changing their classroom sessions for online training, in many cases without the required instruction for such a methodology. Therefore, adaptation turned the key word for education institutions. Back in time, 1999 also marked a historic milestone when a group of European ministers decided to change university education drastically. Later on, the Bologna process became implemented in the European Higher Education Area: there was a shift from traditional academic instruction, mainly based on the development of theoretical concepts, towards a model based on the development of competences and skills and designed around multidisciplinarity in order to foster employability among future graduates. Great efforts had to be made, since the implementation of the credit system took place during the last significant European recession and yet governments had to cater for the required investments to ensure the operating conditions of the credit system. However, it has not been as successful as expected at first, at least not in Spain where youth unemployment is more than double the European average.

Now we are experiencing an unprecedented crisis and once again, the education system must reinvent itself. Higher education cannot afford to carry on with previous standards in the new paradigm that will appear once the pandemic is over. And it is not simply a question of deepening in the online methodology and ensure that higher education institutions update their technology and technological systems to cater for the smooth development of the teaching process. Rather, it is a full shift towards the needs of our societies. Although it is well-known that changes in university systems usually take a long time to be implemented, it is also evident that some action should be taken and decisions made now so that universities become once again valuable tools for society.

One of the main issues to consider is curricula. Sometimes the contents they reflect do not fit in with what society needs and they can become a significant constraint for the teaching and learning process. Since these cannot be changed overnight, it is of paramount importance to introduce changes in the classroom methodology. What the world needs now is innovation and creativity as well as sustainability paradigms at all levels. Young people can bring a breath of fresh air but they need to be trained accordingly.

This paper will introduce one example of such a classroom methodology shift in which students from a Tourism Degree are involved. They establish their own learning pace, grounding it on research, discussion and teamwork, and have a real client to work for who will expect results in a few months. The learning of specific content is facilitated, as they

have to apply it to their teamwork and on the other hand, students' motivation is enhanced by performing tasks that have a clear target to achieve. Proactive and entrepreneurial skills are fundamental at present to revive the business fabric and therefore, they should be instilled among undergraduates to improve their future employability.

First, a brief account will be done on the Tourism Degree curriculum to set the background for change; next, a description will be given on the methodology introduced in the classroom.

2. Tourism curriculum

As an affiliated institution to a public university, our undergraduate curricula cannot be changed. Particularly, the contents for the Tourism studies revolve around management of the tourist business rather than becoming experts in all areas of the sector. However, to manage a business, first, the business must be created, on the one hand; and on the other, and most importantly, management can be performed by Business graduates. This lack can be compensated with the introduction of a range of electives as varied as possible, but in small higher education institutions this assortment cannot be broad because of the number of students. Therefore, in many cases electives are set according to the teaching staff and their fields of expertise. It is a question of costs that universities cannot overlook nowadays.

Examples of the contents are statistics, introduction to economics, introduction to law, business environment, recruitment, strategic management, financial accounting, or management accounting, among others; and they are distributed thoughout the Degree. This is demotivating for students because it is not what they were looking for when they enrolled in university. This results in students dropping out which, together with the low employment rates historically, make this study programme unattractive. And although private institutions achieve better results, according to a recent report on Spanish universities (Ivie-Fundación BBVA, 2020), still Tourism graduates have serious problems to find a job. Only 19% of 2014's graduates had a job in 2018 that required a university degree; the rest were either unemployed or performing below their level of training and lower paid. Most shockingly, this is the reality in a country where tourism accounted for 13% of the country's GDP in 2019. Undoubtedly, the tourist sector is certainly complex in terms of employability at present due to the Covid-19 pandemic, but another reality is that the course programmes of the Tourism Degrees do not tackle the sector's needs (Aznar & Pizarro, 2020).

3. Project description

In this section, a brief overview will be provided on the situation of the tourism sector that led to the development of this project, together with unemployment data. Then, a detailed description of the project will be given.

3.1. Source of the project: relevant data

If those study programmes did not match the sector's needs before the pandemic, now they are nowhere near close. A brief glance will give us an idea. Worldwide, there has been a drop of 74% in international arrivals (UNWTO, 2021), a loss of US$ 1.3 trillion in export revenues, and experts predict that it will take between 2.5 and 4 years for international tourism to return to 2019 levels. Regarding Spain, the rate for international arrivals fell by 78% and besides, tourism and hospitality account for 58% of workers under temporary employment regulation records, which is really serious as a great deal will turn into collective dismissals once those records deadline is over. However, domestic tourism in search of open-air activities, nature-based products and rural tourism has arisen to compensate the loss of arrivals to a certain extent.

On the other hand, rural depopulation is a severe problem in Spain where 61.5% towns and villages have less than 1000 inhabitants (INE, 2021) and 5% of the population live in 53% of the territory. More specifically, the autonomous community of Valencia already presents 500 abandoned villages, 72000 people live in villages under 200 inhabitants/km², and 71 communities are in risk of extinction (mostly in the province of Castellón) with a population density of less than 8 inhabitants/km². In other words, there is a stark risk of depopulation and the trend is still ongoing. Nevertheless, the fact that travellers are now looking for a more sustainable, authentic and responsible experience is a valuable chance to reverse the depopulation trend in rural enviroments.

This serious scenario led us to design a project that would cover a number of issues in the Tourism degree programme:

- to serve the sector with innovation and creativity tools,
- to help diminish the trend of depopulation in rural territories while focusing on values such as sustainability at all levels and respect and tolerance towards traditions and lifestyle, thus avoiding mass tourism and also searching for heritage preservation,
- to acquire specialist knowledge through hands-on learning,
- to enhance soft skills acquisition during the learning process,
- to develop autonomous learning.

Therefore, an analysis was made first to decide on the nearby area that could serve as the target to revitalize a rural population, i.e. Alto Palancia, a region in the province of Castellón (north of Valencia) which has 27 municipalities where 72.1% live in only 5 of those villages (Portal Argos, 2021) or in other words, 27.9% inhabitants live in 22 small villages. Out of these, the village of Caudiel was chosen, since it has lost 86.3% people in 10 years (Europa Press, 2021), the average age is 50.3 and presents a negative natural increase (more deaths than births). Concerning unemployment, 2020 saw an increase of 2.2% in which 60.9% are

women; conversely, young people account for only 15.2%, although this is because they leave the village in search of employment in bigger towns where they will probably swell the ranks of the unemployed too. The fact that youth unemployment in Spain represents 40.7% cannot be ignored, if we compare it to the 17.8% figure in EU27 (EUROSTAT, 2021). Likewise, female unemployment in Spain almost doubles the figure for EU27. Therefore, Caudiel was an ideal target to implement a revitalisation project.

3.2. Description of the project

Firstly, contacts were made with the local authority and its corresponding dynamisation group to inform them in broad terms what the project would consist of and how it may help revitalize the municipality. Their reply was positive at once and the academic organization began.

It was decided that all students would get involved except for those in their last academic year, who must focus on their internship and final degree project. Every group would work on a specific task depending on their previous specialist knowledge and the schedule was established as follows:

Table 1. Project schedule.

September	*October*	*February*	*April*	*May*	*June*
Analysis on municipality	Visiting the village	Bootcamp: two-day field work	Two-day co-working space	Results presentation in the village	Results presentation at home institution (fair format with culinary experience)

For the initial stage, students must work in their own groups to carry out different types of analysis on the municipality depending on their content knowledge whereas for the rest of the project the three groups are working together sharing information and establishing ways of coordinating their work towards the common goal. Furthermore, several seminars are being held in order to provide students with the necessary tools and specific knowledge required to develop their tasks. Thus, they learn on design thinking methodology, business intelligence, or culinary heritage, among others. In these seminars students achieve specialist knowledge from professionals in the respective fields and therefore, they also get first-hand contact with the sector business network. This is a crucial experience, since students realize on what the sector requires and companies get acquainted with these potential employees and their practical way of learning and acquiring the indispensable soft skills for working in tourism. With regard to specialist content acquisition, all the subjects involved derive the

application of the theoretical contents towards the project in development. Meanwhile, students are coordinating both their classroom activities and regular contacts with Caudiel's municipality and neighbours.

Students must work in self-managed teams and teachers become facilitators and although this learning methodology may become complex, the process is going smoothly as they are used to working on the basis of project-based learning (PBL). It is widely acknowledged (Elizabeth & Zulida, 2012; Ab Rashid et al., 2016; Ansarian & Mohammadi, 2018; Aznar, 2019) that this methodology is greatly beneficial for students due to its focus on specific and realistic issues and authentic interactions. This results in students' becoming more motivated and communicative so that this skill is also enhanced; in addition, critical thinking is stimulated as well as autonomous learning. Consequently, students acquire a number of skills that will be transferred to their careers later on.

The cornerstone of the PBL methodology is teamwork and although it is well-known how complex this may become, it is a fact that on the one hand, students value positively the upgrade of their competences once the project is over, but on the other, they can become very critical with regard to the distribution of work among the members of the team (Aznar et al., 2012). Therefore, the role of the facilitator is crucial at the initial stages of the project for several reasons: to ensure that there will be a smooth progression of the various tasks; to make them become aware of the complexities of teamwork so that they will be trained to be successful in their careers; and to enrich discussion, critical thinking and problem-solving.

A valuable outcome of PBL is students' motivation. In this project this has been key from the very beginning when they were welcome by the mayor and local government representatives. It is from this moment when they realized they were responsible for developing a project for a real client. As a result, this initial visit to the village became a boost in their eagerness and willingness to be creative and develop initiatives. And although the pandemic has forced to adapt and turned the bootcamp task into a virtual one, students are still enthusiastic about the study they are accomplishing. One of the most important objectives of the project was to make students the protagonists of their own learning and hence, press releases have been published in which they can be seen doing field work, news on their work progression are constantly published on social media, and they were even invited to a radio programme to inform on their experience.

The project will finish in three months and the most awaited moment is the presentation of results to the local government. Work is already well advanced and there is no reason to believe it won't be successful both for students and for the village representatives. However, students are beginning to feel the pressure of time and their responsibility. So, once again the role of the facilitators is crucial to guide them through the final stages. Besides, students are

learning what it means to work under pressure, which is something they will get confronted with during their careers.

Concerning assessment, every subject belonging to the three courses shares 25% of their grades towards this project. Students are assessed on their analysis, their results, their teamwork, and their communication skills. In addition, peer assessment is also pondered, since this is a valuable tool to make students aware of the importance of evaluating their own teamwork. And although students know they are going to be assessed, at present their interest is focused on the work at hand and meeting deadlines, which in turn is another example of preparation for their professional careers.

4. Conclusion

Learning through practical experience has always been considered as relevant in training, however nowadays it is of utmost importance. And although curricula take a crucial role as developers of specialist content knowledge, innovation in classroom methodology through hands-on tasks and assignments can ensure the right acquisition of such knowledge.

This paper has aimed to prove how the application of specialist content can enrich the learning process with the acquisition of both hard and particularly, soft skills that cannot be achieved through theoretical concepts. Through a project work based on PBL methodology, students are being trained for the following issues:

- Field learning, as students acquire knowledge without being aware of it and also, are more inclined to learn in the classroom because they see meaning in it. Furthermore, by being introduced to research methods in the first year of their degree, they prepare for their final thesis.
- Employability through the development of teamwork, working under pressure, meeting deadlines, enhancing their communication skills, evolving crucial skills in their professional sector, managing uncertainty (and the present pandemic has been the best case study, unfortunately), and what it means to work for a real client.
- Society, because students are taught to assume a set of values such as, a respect towards culture, their contribution towards sustainability and to reverse the trend of rural depopulation. Moreover, their youth entails a fresh perspective for a sector in need of reinvention.

Therefore, this methodology has turned from PBL (Project-Based Learning) to RPL (Real-Project Learning). The results at the end of the academic year will reveal whether the client is satisfied with the outcome, but what is evident is that students' satisfaction with their own learning process has improved significantly.

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Support from Teaching Staff and Self-efficacy as Determinants of Students' Perceived Employability: a Longitudinal study

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Abstract

Perceived employability acquires, for university students, growing importance to deal with occupational uncertainty. This study examines how teaching in university influences perceived employability in a sample of Italian final-year university students. We draw on Conservation on Resources Theory and Career self-management model to hypothesise a positive impact of support from teaching staff on students' perceived employability. We also contend that students' self-efficacy mediates the relationship between support from teaching staff and perceived employability. One hundred fifty-one university students completed a survey three times over 10 months. The results confirm that support from teaching staff enhances students' perceived employability directly and indirectly by shaping students' self-efficacy. Our findings confirm the role of university teachers and their didactical practice to equip their students with career resources.

Keywords: *Perceived employability; support from teaching staff; self-efficacy; university students; graduate employability.*

1. Introduction

In times of increasing labour market volatility, higher education students and graduates see their occupational perspectives challenged. They pay the highest cost of structural employment problems and negative contingencies, like the COVID-19 related economic crisis. More than ever before, Higher Education institutions' role is crucial in helping students have a smooth transition to the labour market by providing them with precious resources.

Accordingly, in this study, we explore perceived employability (hereafter, PE), a prominent resource for managing career transitions, including transitioning to the labour market. We draw upon the Conservation of Resources Theory (COR theory, Hobfoll et al., 2018) and Career Self-Management model (CSM model, Lent & Brown, 2013) to investigate how supportive teaching in University influence students' perception of being employable. In line with the COR tenets, we posit that support from teaching staff exerts a positive effect on students' PE by adopting teaching behaviours that help students find ways to apply knowledge in practice and deal with the reality of work. We adopt the CSM model to investigate the mediating role of self-efficacy in the relationship between support from teaching staff and students' PE. We apply a longitudinal design to explore the hypothesised relationships with a sample of Italian final-year university students.

Our study expands the knowledge about PE of Higher Education students, which is still in its infancy (Romgens et al., 2020). The focus on support from teaching staff stresses Higher Education's role as a contextual facilitator of students' PE. The inclusion of self-efficacy is a possible explanation of the mechanism through which support from teaching staff exerts its effects. Moreover, our study's relies on longitudinal design, which lacks in the literature about PE and is functional to produce more robust conclusions.

At a practical level, our results stress the need to shift the role of university teacher from knowledge dispenser to learning manager, who nurture students' confidence with supportive and employability-oriented teaching styles.

What follows is an introduction of study variables, along with the making up of the hypothesised relationships. Then, we deal with the methodology employed and present the results obtained. Eventually, we draw from the results to discuss the theoretical and practical implications, limitations, and research recommendations.

2. Students' Perceived Employability

PE — namely, the self-perceived ability and opportunity to attain employment appropriate to one's qualification level (Rothwell et al., 2009; Vanhercke et al., 2014)—results from the psychological approach to employability, which assumes that people act depending on what they perceive rather than objective reality (Vanhercke et al., 2014). People may possess skills

or have objective environmental facilitations that make them employable. Still, they can adjust appropriately to the current employment environment as long as they appraise their skills as equipment to navigate the labour market (Monteiro et al., 2020). Herein, we understand PE as a personal resource within the COR theory framework, in line with the assumption made by Vanhercke et al. (2014). The central COR theory's tenet is that individuals strive to gain and retain psychological, social, and material resources to deal with stressful conditions, maintain motivation and optimal functioning (Hobfoll et al., 2018). Coherently, PE assists individuals in their career endeavours, promotes the perception of control and confidence (Fugate et al., 2004), facilitates job-seeking processes (Yizhong et al., 2017), and career success (Gonzalez et al., 2015).

Scholarly research has mainly focused on personal determinants of students' PE, such as human and psychological capital (i.e., Donald et al., 2019). The study of contextual PE determinants is still in progress, as it is limited to the labour market's perceptions (i.e., Jackson & Tomlinson, 2020). We focus on more proximal contextual factors, such as support-oriented university teaching methods embedded in the daily didactical routine.

3. Support from Teaching Staff and PE

According to COR theory, factors located at the organisational and environmental level can facilitate resource creation (Hobfoll et al., 2018). We contend that support from teaching staff—namely the 'student's perception of the supervisor's performance in imparting knowledge to students and generally helping them' (Álvarez-González et al., 2017, p. 286)—is one of these factors that, within a university learning environment, can foster students' PE. University teachers can exploit their teaching methods to support students in understanding and applying knowledge and positively appraise their learning in terms of impact in real workplaces (Römgens et al., 2020). Teachers may exercise this function through supportive behaviours like involving students in discussions and activities (i.e. work-based exercises and examples, group work) to reflect upon what they learn and how to self-regulate to deal with work-related issues (Liu et al., 2020). Moreover, knowledgeable teachers may provide students with information about available career opportunities (Donald et al., 2018). This research claims that these behaviours shape the students' perception of being employable as they sustain their approach to the world of work. Nevertheless, only a few shreds of evidence confirm a positive relationship between support from teaching staff and PE, with cross-sectional data (i.e., Alvarez-Gonzalez et al. 2017). We, therefore, posit that:

Hypothesis 1. *Support from teaching staff predicts PE of university students positively.*

3. The Mediating Role of Self-Efficacy

CSM model posits that self-efficacy—the experience-based self-cognition on the personal capability to perform a task—drives motivation, persistence, and performance in many career stages, including university-to-work transition (Lent & Brown, 2013). The CSM model also understands self-efficacy beliefs as a product of learning experiences that convey positive information about the individuals' capability. Support from teaching staff may foster students' self-efficacy by providing them with means (i.e. encouragement, work-based activities and examples) functional to raise confidence in their capabilities and knowledge (Liu et al., 2020). In this way, their self-efficacy grows. Self-efficacy is a primary predictor of PE (Dacre Pool & Sewell, 2007). People who have faith in their ability to use their learning to face real workplace issues can, in turn, appraise more positively their likelihood to secure employment (Onyishi et al., 2015). Apart from a recent exception focusing on the perception of employability skills (see Liu et al., 2020), no study has investigated the mediating effect of self-efficacy in the supportive teaching-PE relationship. We formulate the following:

Hypothesis 2. *Students' self-efficacy mediates the relationship between Support from teaching staff and PE of university students.*

4. Method

4.1. Sample

We collected longitudinal data with final-year students from different Italian Universities, who completed an online questionnaire three times between November 2019 and September 2020. We reached students through agreements with teachers of their degree course. They were given a link to the online questionnaire, granted confidentiality, and given the possibility to provide their informed consent. They could provide their e-mail address separately to be contacted anonymously after the first collection. At the end of the data collection, 151 students completed the questionnaire three times, with a mean age of 25 years, mostly females (85.6%).

4.2. Measures

We measured the study variables three times. We measured support from teaching staff with 19 items adapted from Elvira et al. (2017), PE with five items developed by Bertson et al. (2006), and self-efficacy with three items developed by Gonzalez-Romà et al. (2016). All scales had a 5-point Likert response scale. We evaluated the internal consistency of the scales.

4.3. Data Analysis

We used support from teaching staff measured at T1, self-efficacy at T2 and PE at T3 to test the hypotheses. We followed the analytical approach developed by Hayes (2018) and used the macro PROCESS on SPSS version 25 to test the hypotheses. The indirect effect was estimated with a 95 per cent confidence interval. Age and gender at Time 3 were introduced to the analysis as control variables.

5. Results

Table 1 reports mean values, standard deviations, internal consistency values, and correlations among the study variables. All scales provided good internal consistency values (using Cronbach's alpha). Concerning the hypotheses test (Table 2), the results supported the positive effect of Support from teaching staff on PE (β=.27; p<.001; Hypothesis 1), corroborating the crucial role of teaching methods in shaping graduates' upcoming approach to the world of work. The results supported the mediation effect hypothesis (β=.05; p<.05; Hypothesis 2) and confirmed the mechanism explaining the effect of support from teaching staff on students' PE.

Table 1. Descriptive statistics, internal consistency values and correlation matrix of variables.

Variable	M	SD	Crobach's α	1	2	3	4	5
1. Gender[a] (T3)	-	-	-	-				
2. Age (T3)	*25.90*	*5.81*	-	-.14	-			
3. STS (T1)	*3.14*	*.69*	.92	-.12	.09	-		
4. SE (T2)	*3.71*	*.58*	.80	-.21*	.16	.29**	-	
5. PE (T3)	*3.15*	*.69*	.76	-.17*	.15	.35**	.30**	-

*Note. N= 151; STS = support from teaching staff; SE = self-efficacy; PE = perceived employability; [a]1 = male, 2 = female; *p<.05 **p < .01*

Table 2. path coefficients for the hypothesised model.

Variable	SE		PE			
	Direct effect		Direct effect		Indirect effect	
	B	SE	B	SE	B	95% CI [LLCI; ULCI]
Age (T3)	.01	.01	.01	.01		
Gender (T3)	-.27*	.13	-.17	.16		
STS (T1)	.21***	.07	.28***	.08		
SE (T2)	-	-	.25**	.09		
STS (T1) → SE (T2) → PE (T3)					.05	[.01; .12]

*Note. N= 151; STS = support from teaching staff; SE=self-efficacy; PE = perceived employability; [a]1=male, 2=female; **p<.01; ***p < .001; CI (95%) = 95% confidence interval using the bootstrap bias corrected method using 5,000 samples. Coefficients are not standardized.*

6. Discussion

We extend the knowledge about university students' PE, which becomes critical to face the university-to-work transition in an increasingly volatile labour market. We draw on COR theory (Hobfoll et al., 2018) and the CSM model (Lent & Brown, 2013) to shed light on how Universities can provide students with valuable career resources like PE. Our results confirm that support from teaching staff predicts students' PE over time, highlighting that, besides what is taught at university, teaching behaviour and methods (namely, how it is taught) are pivotal to make it meaningful and useful. Therefore, students see themselves prepared for the world of work and, in turn, the perceived likelihood to obtain suitable employment raises. This finding aligns with PE conceptualisation that sees it as also shaped by contextual factors (Vanchercke et al., 2014) and with the COR tenets that understand personal resources as a product of supportive organisational factors (Hobfoll et al., 2018). The mediation of self-efficacy remarks on the mechanisms through which supportive teaching raises students' PE. Moreover, it corroborates the critical role of self-efficacy to foster a sense of mastering over career-related endeavours (Lent & Brown, 2013).

At a practical level, our results suggest shifting the pedagogical practice to a student-centred approach. Students can be supported in scaffolding the knowledge they acquire and preparing themselves to face the labour market's reality. University teachers should then be encouraged to update their teaching methods to devote their efforts to strengthen the usefulness and value of what they teach (Ödalen et al. 2020). The role of self-efficacy leads us to suggest that these teaching methods should include self-efficacy-enhancing behaviours. For instance, they can provide students with means to test their learning by work-based practice in the classroom, with examples from reliable models (i.e. alumni or professional experts) or formative feedback.

Further research is advocated to address some of this study's limitations. More attention to the fluctuations of the resources under investigation is needed. Moreover, additional work is required to refine the instrument used here to assess support from teaching staff. Lastly, future research should control for variables that affect how people estimate their PE. For instance, a replication of this study could account for the type of degree and home university of the participants to determine whether these variables affect the results obtained herein.

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Human capital depreciation and job tasks

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Abstract

This research aims to investigate the link between human capital depreciation and job tasks, with an emphasis on potential differences between education levels. We estimate an extended Mincer equation based on Neumann and Weiss's (1995) model using data from the German Socio-Economic Panel. The results show that human capital gained from higher education levels depreciates at a faster rate than other human capital. Moreover, the productivity-enhancing value of education diminishes faster in jobs with a high share of non-routine analytical, non-routine manual, and routine cognitive tasks. These jobs are characterized by more frequent changes in core-skill or technology-skill requirements.

The key implication of this research is that education should focus on equipping workers with more general skills in all education levels. With ongoing technological advances, work environments, and with it, skill demands will change, increasing the importance to provide educational and lifelong learning policies to counteract the depreciation of skills. The study contributes by incorporating a task perspective based on the classification used in works on job polarization. This allows a comparison with studies on job obsolescence due to labor-replacing technologies and enables combined education and labor market policies to address the challenges imposed by the Fourth Industrial Revolution.

Keywords: *Education; human capital; depreciation; skill obsolescence; tasks; technological change.*

1. Introduction

Education prepares workers to perform a certain set of tasks in the labor market, but the introduction of ICT and digital technology has changed how we work. Technologies substitute repetitive tasks and create new ones, leading to changes in skill requirements. Previously acquired skills through formal education and working experience lose their value in the labor market, causing the depreciation of economic skills, and thus, human capital.

As the speed of technological change increases amid the Fourth Industrial Revolution, the effect of economic skill obsolescence has become more severe. Skills obsolescence has previously been only a concern for individuals in technology-intensive sectors or occupations. However, with the ongoing digital transformation, most occupations have undergone changes in tasks due to the skill complementing or substituting effect of technologies. Consequently, the majority of jobs nowadays are subject to some form of skill obsolescence. This might be especially the case in jobs that are comprised of repetitive, routine intensive tasks. Due to new technologies, the skills of older workers become obsolete quickly, and the economic value of human capital decreases. To stay productive in the labor market, workers will need to upskill or even retrain to find new occupations.

Technological and organizational changes are expected to accelerate, and to affect all parts of the economy, increasing the risk of and the urgency to counteract skills obsolescence. Albeit these lingering effects, few studies consider factors of technological change when analyzing skill depreciation. To help close this gap, the study at hand attempts to examine the economic skill obsolescence by incorporating different task types into the analysis. Considering differences in the depreciation rate by job tasks contributes to the field in that it may provide fruitful insight into the depreciation patterns of human capital, enabling governments to design more effective education and lifelong learning policies. This is crucial in order to prepare workers for changing work environments.

The main body of this paper is structured into 4 sections. Section 2 presents the main literature and the theoretical framework. Section 3 proceeds with the data and methodology. Section 4 summarizes the findings, and finally, Section 5 concludes.

2. Background literature and theoretical framework

2.1. Types of skill obsolescence

Individuals acquire skills through education. Those skills depreciate over time and thus one's human capital depletes. There are two types of obsolescence (Arrazola & Hevia, 2004; De Grip & Van Loo, 2002; Neuman & Weiss, 1995), technical and economic obsolescence. Technical skills become obsolete due to the worker's physical aging or the un-use of skills. The obsolescence of economic skills is caused by the loss of market value of the worker's

qualifications due to changes in the economic environment. We will focus on the latter in our analysis of human capital obsolescence.

2.2. Measurements of skill obsolescence

Skill obsolescence has not received much attention albeit its importance for human capital. Some scholars utilize Neuman and Weiss's (1995) operationalization of the depreciation rate which focuses on vintage effects. Depreciation is indirectly measured by the interaction between education and potential experience and indicates its effect on an individual's earning capacity following the Mincer model. It is based on the rationale that human capital depletes with the time since finishing formal education and potentially entering the labor force. This indirect measurement has the advantage that it captures the decreasing productivity effects through wages, which are the main worry for most countries (De Grip, 2006).

Murillo (2011) uses a modified version for the Spanish labor market and finds a schooling depreciation rate of 0.7% for 1995 and 0.4% for 2002, which increases with education level, and an experience depreciation rate of 3.8% and 1.8% respectively. Backes-Gellner and Janssen (2009) build upon an extended Mincer earnings equation and find that the rate of obsolescence is higher for workers in knowledge-based tasks compared to experience-based tasks. Lentini and Gimenez (2019) analyze sectoral differences of human capital depreciation in OECD countries for the period 1980 to 2005 and show that the depreciation ranges between 1% and 6% and is mainly significant in skill-intensive sectors regardless of the sector's technological intensity.

Other scholars model human capital and its depreciation mathematically and estimate the depreciation rate directly. Groot (1998) introduces a model and finds a depreciation rate of 11-17% for Britain and the Netherlands. Arrazola and Hevia (2004) obtain depreciation rates between 1.2% and 1.5% for Spain, depending on the type of sector and periods of unemployment. Also following this approach, Weber (2014) uses data for Swiss and shows that specific skills are prone to faster depreciation (0.9-1.0%) compared to general skills (0.6-0.7%). The spread in the depreciation rates is likely attributable to differences in measurement, as well as the variation in observation periods and datasets.

The aforementioned studies lay a good foundation for the analysis of human capital obsolescence, but most works do not incorporate the effects of technological developments which have transformed most advanced economies. Occupations become more complex and skill requirements change more quickly, highly depending on technology-related factors such as the type of job tasks, or the technology intensity of a sector. Thus, previously accumulated skills may become obsolete at a faster rate. As indicated by the results in Backes-Gellner and Janssen (2009), there are differences between knowledge and experience-based tasks, providing some evidence for the importance of incorporating a task perspective into the analysis. However, their specification does not consider the depreciation of formal education,

making the results hardly comparable and unsuitable for evaluating the effectiveness of current educational systems. Other studies, for example, Weber (2014) or Lentini and Gimenez (2019) do only indirectly consider differences in the depreciation by occupational segment or sector. To close this gap, this study directly incorporates a task perspective based on the classification of job tasks adopted from the literature on job polarization while focusing on the depreciation of education. This enables a comparison with literature on skill obsolescence as well as works on job obsolescence.

2.3. Hypotheses

This subsection derives the hypotheses and elaborates on the role of tasks for the depreciation of human capital. Human capital is formed through education and experience. Thus, human capital depreciation comprises two separate effects, the depreciation of the educational stock, and the depreciation of the experience stock. Those two rates, combined with investments in human capital, determine its present value. Human capital obsolescence does not occur at the same speed for everyone. More advanced skills are expected to depreciate at a faster rate (Murillo, 2011; Neuman & Weiss, 1995) compared to basic skills which do not change much over time. Advanced skills acquired through university education contain state-of-the-art knowledge which might become less valuable as technologies evolve. Concurrently, general skills are thought to depreciate at a lower rate because they stay valid for longer periods and can be applied even in changing economic environments. Specific skills depend on the current state of technology when acquiring the education and will decrease in value when there have been external changes. Thus, we hypothesize:

H1a: *Workers with higher education levels have a higher depreciation rate than workers with lower education levels.*

H1b: *Workers with specific, vocational education (VET) have a higher depreciation rate than workers with general education*.

The next set of hypotheses addresses the link between the routineness of job tasks and skill obsolescence. Job tasks define which skills workers use throughout their careers. However, with ongoing technological progress, job tasks and skill demands might change more quickly, rendering old knowledge obsolete. This means that the present value of human capital depends not only on knowledge acquired through formal education, but also on the technological skills demanded by the job, and the skills to use those technologies and knowledge. Consequently, the depreciation rate of human capital may depend on how fast or often job-related knowledge or job-related technology change. Jobs that are exposed to changes in job-related technologies are characterized by a high share of non-routine analytical and routine cognitive tasks, i.e., programmers or bookkeepers, respectively. Those individuals are also susceptible to greater changes in job-related knowledge and skill requirements. In turn, workers in jobs that are not dependent on technology, i.e., those with

a high share of interactive or manual tasks, are expected to have lower depreciation rates, thus:

H2a: *The depreciation rate is higher in jobs that are exposed to changes in job-related technologies compared to other jobs.*

H2b: *The depreciation rate is higher in jobs where the impact on job-related knowledge due to changes in technology is high compared to other jobs.*

3. Data and Methodology

To examine the depreciation rate and potential influencing factors, we utilize the German Socio-Economic Panel for the years 1984-2017 for the relationship between educational attainment and wages as well as other control variables for personal or job-related characteristics.

As presented in Section 2, the prevailing measurement of skill obsolescence is the indirect estimation of the depreciation rate. We model the depreciation rate of human capital depending on the decreasing effect of schooling on wages with time in the labor force using an extended earning function based on Neuman and Weiss (1995) and Mincer and Ofek (1982). The model accounts for the productivity-enhancing effect of education, the marginally decreasing effect of experience, and the depreciation of human capital related to the obsolescence of the worker's skills from formal education due to changes in the market environment. The education-specific depreciation is indirectly estimated in equation (1) as the interaction between the highest education level and potential years of experience *(Edu_i X $pexper_{it}$)*. The coefficient of β_2 indicates how skill obsolescence affects the worker's earnings.

$$\ln w_{it} = \beta_0 + \beta_1 Edu_i + \beta_2 (Edu_i \times pexper_{it}) + \beta_3 pexper_{it} + \beta_4 pexper_{it}{}^2 + X_{it} + \varepsilon_{it} \quad (1)$$

We use a panel fixed effects estimation with cluster robust standard errors to account for autocorrelation and heteroskedasticity of the error terms. Controls are included stepwise.

Next, we investigate whether the skill obsolescence depends on the main type of task a worker performs. To incorporate different occupational tasks, we construct a categorical variable from the German classification of occupations (KldB 1992) following the method suggested by Dengler, Matthes, and Paulus (2014). Based on the classification, each occupation is assigned one predominant task. These task groups are adopted from Spitz-Oener (2006) and Autor, Levy, and Murnane (2003) and differentiate between non-routine tasks (interactive, analytical, manual) and routine tasks (cognitive, manual).

We introduce the categorical variable *tasks* to differentiate between the different types of occupational tasks. This variable is first simply added to equation (1) to control for possible

task-related wage effects. Finally, we estimate equation (1) groupwise for each of the 5 task groups to see how the depreciation rate varies for different types of job tasks.

Table 1. Results of fixed effects regression with deflated log hourly wages as dependent variable.

Log hourly wages	(1)	(2)	(3)	(4)	(5)
VET	0.718***	0.497***	0.509***	0.488***	0.495***
	(27.04)	(18.20)	(18.35)	(14.54)	(14.59)
Higher VET	0.696***	0.597***	0.581***	0.555***	0.567***
	(19.98)	(15.95)	(15.69)	(12.67)	(12.89)
University	0.649***	0.613***	0.635***	0.602***	0.609***
	(16.47)	(12.95)	(13.97)	(11.34)	(11.38)
VET*exper	-0.015***	-0.010***	-0.012***	-0.011***	-0.011***
	(-17.40)	(-11.51)	(-14.35)	(-11.18)	(-11.13)
Higher VET*exper	-0.016***	-0.013***	-0.014***	-0.014***	-0.014***
	(-13.81)	(-10.25)	(-11.52)	(-9.70)	(-9.71)
University*exper	-0.010***	-0.010***	-0.012***	-0.012***	-0.012***
	(-9.43)	(-6.25)	(-8.78)	(-6.87)	(-6.82)
exper	0.040***	0.070***	0.070***	0.063***	0.064***
	(7.71)	(9.57)	(10.38)	(8.05)	(8.10)
exper-squared	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(-41.64)	(-12.55)	(-13.70)	(-10.90)	(-10.68)
_cons	0.881***	-3.248***	-2.347***	-2.382***	-2.347***
	(14.36)	(-24.00)	(-16.19)	(-14.07)	(-13.69)
Controls	none	+ personal	+ job	+ industry	+ tasks
Observations	262.7780	261.101	204.689	158.561	154.792
R-squared	0.407	0.425	0.388	0.386	0.385

4. Results

This section presents the results of the different specifications of our panel fixed effects regression, summarized in Table 1. In our preferred specification, column (4), the annual depreciation rate of education is the lowest (1.1%) for workers with VET degrees, followed by workers with a university degree (1.2%) and highest for workers with higher VET (1.4%). These values are in line with previous studies (Lentini & Gimenez, 2019; Neuman & Weiss, 1995; Weber, 2014) and add additional evidence to the higher depreciation rates for higher education levels. Moreover, these estimates indicate that skills from specific education deplete relatively faster. The depreciation rate for one additional year of potential experience is relatively low (0.01%) compared to other studies (Murillo, 2011).

Next, we present the results of our regression by predominating task-type which are graphically summarized in Figure 1. We show that the depreciation rate varies by education level and job tasks. Especially in non-routine analytical tasks, non-routine manual tasks, and routine cognitive tasks, skills are at higher risk of depreciating. Those job tasks are exposed to more frequent changes in job-related technology and likely to be affected more by it.

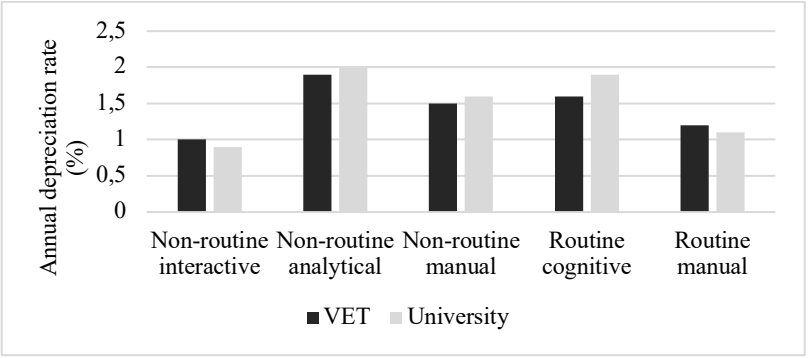

Figure 1. Results for the depreciation rate by predominant type of job tasks.

Table 2. The link between job tasks and skill obsolescence.

Task type	Example	Change in job-related technology	Impact on job-related knowledge	Skill obsolescence
Non-routine interactive	Lobbying, entertaining	low	low	low
Non-routine analytical	Programming, designing	high	high	high
Non-routine manual	Repairing, renovating	medium	medium	medium
Routine cognitive	Bookkeeping, calculating	high	low	medium
Routine manual	Operating machines	medium	low	low

5. Conclusion

New technologies change working environments and skill demands, rendering skills acquired through formal education obsolete. The present study analyzed the economic obsolescence of skills due to changes in the economic environment and incorporated factors related to technological change, i.e., technology intensity and occupational tasks. The results bring forth that skills in non-routine analytical, non-routine manual and routine cognitive tasks depreciate faster than skills in other tasks. This may be attributable to frequent updates in job-related technology and its impact on job-related knowledge, as summarized in Table 2. Additionally, routine cognitive tasks are in the process of being substituted by technologies, increasing skill obsolescence. The results show that tertiary education does not protect workers against skill obsolescence. This finding is important because it suggests that increasing the education level of the workforce is not enough.

With the ongoing digital transformation, more dramatic changes in work environments are likely, possibly increasing the rate of skill obsolescence further. While the results of the

current study indicate that human capital depreciation will be smaller in routine tasks, this should not be interpreted as good news; routine-intensive occupations are likely to gradually disappear in their current form. In turn, the depreciation rate for non-routine tasks is relatively high, while the demand for those job tasks increases. Thus, changes in educational content and investments are inevitable to avert serious problems.

These developments put pressure on governments to provide effective education policies targeting the obsolescence of human capital. While many countries have realized the importance, more education measures are needed to prepare the workforce for the ongoing changes. This study may help policymakers to design effective training programs that allow professions to update their qualifications periodically to incorporate the most recently demanded skills. Most importantly, educational policies need to incorporate technological knowledge demanded by the workplace and enable workers to adapt their abilities to changing market conditions quickly amid more rapid and disruptive technological advances.

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A Qualitative Study of the Inclusion of Social Enterprise in the Entrepreneurial Education Curriculum

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Abstract

Despite rising interest amongst students and the general public in social enterprise, it is often taught as an add-on along with sustainability in more general entrepreneurship courses. This has led to under-equipping students with the skills and knowledge they need to start a business in this area. We spoke to both academics and students, using semi-structured interviews, about their views of current social enterprise inclusion and what could be improved. The research found that entrepreneurship academics included social issues in their courses as part of entrepreneurial education, however, this was at introductory level and students were frustrated there was little opportunity to follow up on this interest, especially those in their final year, with no clear path for those interested. Focus varied between institutions and it was suggested that the institutional focus on employability statistics could be harmful for social entrepreneurship education. We suggest that more institutions have social enterprise modules which are able to be accessed university wide to allow multidisciplinarity, and separated out from general entrepreneurship at a higher level to fully focus on these issues to fully prepare those who are interested in starting or joining a social enterprise.

Keywords: *Social Enterprise; enterprise and entrepreneurship education; employability.*

1. Introduction

Entrepreneurship education (EE) has increased markedly in recent years, for example, a study of the evolution of EE in the US shows that in 1975 there were just 100 higher education qualifications that included entrepreneurship, increasing to 500 by 2006 (Morelix, 2015). In the majority of cases, there is a positive correlation between EE and rates of entrepreneurship (Lima *et al*., 2015; Fayolle and Liñan, 2014), although the extent of the impact is argued. Studies have also found that EE also increases attitudes towards entrepreneurship (Fayolle and Gailly, 2015; Heuer and Kolvereid, 2014). Bischoff *et al*. (2018) studied the impact of stakeholders on EE programs and found that the most common external stakeholders involved in these courses were entrepreneurs, companies and alumni. They argue that involving these stakeholders with experience in the field provided an opportunity for knowledge transfer and often led to success. Success factors range from how the course incorporates relevant cultural factors (Shi, Yao and Wu, 2019) to how courses are able to create enterprising role models for students, either through discussing past examples or bringing in speakers (Fellnhofer, 2017) and feedback from alumni suggests learning by doing and courses of a practical nature work best (Phillips, 2019; Phillips, 2018).

Abu-Saifan (2012) stated that Social Entrepreneurship is the 'field in which entrepreneurs tailor their activities to be directly tied with the ultimate goal of creating social value'. There is increasing interest in creating social and cultural value, which has been recognised in the UK by the QAA, 2018. However, many universities have tried to fit SEE (Social Enterprise Education) into their existing EE curriculum without making suitable changes for the differing circumstances (Weber and Westley, 2012). Often when they are adapted, ethical frameworks and tools are rarely addressed explicitly in a course's curriculum, instead focusing more on business aspects (Steiner *et al*, 2018). The study found that institutions would understandably set a focus on their own field of expertise, but then neglect other content, with business schools leaning heavily on market skills but then not including political or philanthropic skills. These imbalances mean that the majority of students would finish without learning all the skills necessary to become a Social Entrepreneur. Lounsbury and Strang (2009) state that Social Entrepreneurship arises at the intersection of shifts in culture and organization structure, and therefore the best way to propel the field is to focus on a cross-disciplinary curriculum and indeed there are examples of using multi-disciplinary courses to aid this (Sanchez-Romaguera and Phillips, 2018). It is, however, noted even social enterprises need to apply business principles, with that knowledge 'residing in business schools' (Weber and Westley, 2012). Non-business schools students may have access to SEE training via extracurricular activities (e.g. Phillips, 2017 and Phillips, 2010). Recent events in the UK, including the Coronavirus pandemic and Brexit, show that uncertainty is at this point ingrained in the modern world, however, as shown earlier, academics in the field do not believe that EE is adapting to the modern world (Carolis and Litzky, 2019; Kariv *et al*.,

2019) and that this is having a knock-on effect onto the quality of SEE (Pache and Chowdhury, 2012; Certo and Miller, 2008). More widely, many believe that the current state of EE is not satisfactory however, suggesting students are not being sufficiently prepared for EE (Fayolle and Gailly, 2015) with Carolis and Litzky (2019) suggesting EE is too narrowly focused on the 'traditional image' of an entrepreneur, which has since evolved, and recent innovations are rarely reflected (Kariv *et al*., 2019). Environmental impact is an area investigated, with Greene et. al. (2018) stating that educators need to learn from wider society to provide suitably up-to-date information. It is therefore important that SEE is able to effectively prepare students for modern social and environmental issues enabling graduates to apply this knowledge to create social value. Therefore, we decided to investigate academics and students views of social enterprise with the aim of understanding where improvements could be made.

2. Methodology

This research was approached with a constructivist philosophy, which is widely used when discussing entrepreneurship education. We looked at the viewpoints of both students and lecturers from two different institutions - Participants were needed for two groups; academics in the field of entrepreneurship education and university-level students with an interest in social entrepreneurship, who are undertaking entrepreneurship education or have done in previous semesters and self-selected to be interviewed. The research was completed through semi-structured interviews with both students and lecturers, discussing their experience of social enterprise teaching, how it was taught, level of satisfaction and options available. The results were split into themes.

Table 1. A summary of the subjects interviewed for this study.

Code	Student or Academic	Details
A1	Lecturer, University of Manchester	Lecturer in Enterprise
A2	Lecturer, University of Manchester	Lecturer in Enterprise
A3	University of Southern California	Entrepreneur and Adjunct Professor of Entrepreneurship
A4	University of Southern California	Entrepreneur and Adjunct Professor of Entrepreneurship
A5	University of Birmingham	Lecturer in Entrepreneurship
S1	Student, University of Manchester	BSc in Management completed 2 entrepreneurship modules
S2	Student, University of Manchester	BSc in International Management, completed 2 entrepreneurship modules
S3	Student, University of Manchester and University of Southern California	BSc International Management with American Business, completed 4 entrepreneurship modules
S4	Student, University of Southern California and Universidad Carlos III de Madrid	BSc International Studies and Business Administration, completed 4 entrepreneurship modules
S5	Student, Loughborough University, Aston University	MSc International Business, completed 4 entrepreneurship modules

3. Results

a) Firstly, there was a clear interest in social enterprise by students, which was also observed by academics;

S1 - *'It is not possible to deny the impact that companies and their activities have in different aspects of society, not only the environment – which they mostly do – but also people's lives.'* A1 - *'this interest is definitely increasing, as students are becoming fascinated by non-traditional business forms in the social space, such as social enterprises, green and sustainable enterprises, movements toward "conscious capitalism," and many others'* and A3 - *'I have definitely noticed more students this year asking questions regarding issues such as climate change, especially when these topics are heavily in the public eye'*

Both Academics and students agreed that in their courses, social enterprise issues are addressed, although academics accepted it was introductory level;

A2 - '*My units all do'... 'I try to introduce issues in my course around how what businesses do and what we do as individuals have an impact on what happens in society'* and A4 - *'I*

think most courses try to include them somewhere, I certainly do. They're too important to the current business world to ignore wholly' with S4 - *'As I double major in International studies and business administration, some of my courses consider social movement. Nevertheless, the business side of my studies does not cover as much of said social movements'*

b) However, many students found that even when they had some exposure to social issues in entrepreneurship education, there wasn't a way to expand upon this education in their current course;

S5 - *'Once I'd finished my course that included a social enterprise element, my only other choice was applying for a masters to continue (learning about social entrepreneurship), and this wasn't really a possibility for me'* and S3 - *'Not at home (Manchester), no. I was able to develop some of these skills on exchange (to USC) where there were more niche options'*

c) One student suggested that there were ways to develop these skills further, but required use of limited free time;

S2 - '*I have taken part in some entrepreneurial events, like the Manchester Entrepreneurs Society and start-up weekends, but I found that by third year I didn't really have time to keep going with these'.*

d) Some students noted regional differences;

S3 - '*While in America (University of Southern California), courses seemed to be much more practical, real use cases and real world problems. Courses at Manchester feel much more theoretical. I definitely feel more comfortable applying my knowledge in a practical sense after my year abroad.'* And S4 - *'It is true that during my year abroad, I took a business sustainability course, which was focused exclusively in the environment. I would say I lack more courses regarding social issues.'* S5 also noticed a difference, but this change in institution was due to graduating with a bachelor's degree and beginning a master's degree, so a change in depth of understanding is to be expected - '*On my current course, these issues (social issues) are definitely explored much more. When it was only briefly mentioned before, I feel like now I'm learning how to apply theory to these situations'.*

e) Interestingly, academics felt that goals and restrictions placed on them by their institution has limited entrepreneurship education;

A2 - *'Employability is pushed as a focus of university study, which can lead courses to be too focused on employability skills rather than developing thoughts and skills'* and A5 - *'discussing personal interests or passions of the student group can't always be explored, time has to be generally focused on the curriculum'*. Two academics raised the belief that entrepreneurship education is about more than education, but could be useful in cultural shifts

A2 - *'I would like it to be rejected that entrepreneurship is about maximising profits, it's not, the evidence is there to show that entrepreneurs are interested in change, trying to make things better, on a deeper level, I would hope that entrepreneurs will think about what is really important'* and A5 - *'I don't believe future education has to be so focused on the current climate, but preparing students for the future of entrepreneurship. This way, students can be ready to adapt to issues that arise in the world and hopefully work towards solving them'.*

4. Discussion

Both students and academics had positive opinions of including social issues in EE courses. On specific SE topics being included in courses, there was more of a disagreement. Most students and academics felt that SE should be included within traditional EE; however, some thought that all issues aren't always relevant to every course and forcing them into every course can be disruptive. These academics suggested that either a specific SE course was added by the business school, or that the most relevant existing courses were chosen to include these issues. However, including SE in with traditional EE has given it some legitimacy. All academics interviewed stated that they had included social issues in their courses and all students had discussed social issues in at least one entrepreneurship course. There were, however, clear differences in the expectations of the breadth of this inclusion.

Where academics felt that they had successfully integrated the core ideas, most students felt that these topics were rarely explored thoroughly enough for any real proficiency in the topic, suggesting there is a difference in expectations of how social issues should be included.

Academics who believed they had elements of SE in their course admitted these were just introductory, with others using these issues as case studies to explore traditional entrepreneurship techniques. The research showed that students were hoping for a more complete look at how social issues impact upon both traditional entrepreneurship and the opportunity for SE. This difference can be possibly explained by an issue raised by the student group in the research. Students seemed to gain an interest in social topics from one module which would introduce these issues, and then have no way to follow up on these topics. This was a particular problem in final year courses, with no options to explore further in undergraduate courses and little free-time to gain experience in extra-curricular projects due to heavy final year course loads. How social issues became a part of an entrepreneurship curriculum differs between institutions, and even between faculties within an institution.

The research did find that social issues were being updated, with those discussed reflecting the global trends of the modern world. The two social issues that appeared to gain the most attention were environmentalism and sustainable living.

A point raised by academics was how the exploration of topics such as social entrepreneurship directly clashed with the aims of their institutions. Specifically, how the university's focus on employability takes away from the other benefits of a university education, developing skills that will not just support a graduate to enter a career path. This is an issue for EE in general, as only 0.6% of students start their own business within 6 months of graduating (HESA, 2017), so for universities looking to increase employability statistics to attract future students, entrepreneurship is not necessarily an attractive focus. Since many entrepreneurs start their business later in life, it is clear that all EE cannot be judged by the same short-term metrics that universities are held to in general, but rather understood to be part of a set of skills learned either for entrepreneurship or intrapreneurship. This study was limited to a small number of participants, future work could involve exploring and comparing programmes in more detail with more participants to understand how SEE could be better integrated into a university education.

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Required skills for employability in Portugal from graduates and students of the Polytechnic Institute of Bragança (IPB)

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Abstract

The Polytechnic Institute of Bragança (IPB) developed an online survey, called the Observatory of Students and Graduates, aimed at entities in Portugal as a means of gathering information about the stakeholders view of IPB graduates and students, regarding skills for employability. Of the total (424) entities contacted, 118 responded, representing 28% of the total. It was noted that 79 of the responses have included IPB students and graduates in their staff, being 27% entities of the Agroforestry-food sector, 16% from the Consulting, Real Estate and Finance sector, and 14% from the Transport and Commerce sector. IPB graduates and students's skills were discussed from the perspective of employers. 12 skills were listed, with an average of 95% of responses between "Very Important" and "Important".´The skills that stood out the most were: "Learning" and "Motivation/Involvement". The lowest priority skills were: "Physical: Robustness and manual dexterity", followed by "General Culture". These data point to the clear fact that the soft skills have greater relevance than hard skills. One of the justifications is that the advent of artificial intelligence, and other technologies that have been performing functions that overlap with technical - human knowledge.

Keywords: *skills; employability; hard skills; soft skills.*

1. Introduction

Human or professional competencies are understood as synergistic combinations of knowledge, skills and attitudes, expressed by professional performance in a given context or in a certain organizational strategy (Carbone et al., 2005; Freitas, Brandão, 2005).

Competencies can be divided into two categories: hard skills and soft skills. As for the first, Rainsbury et al. (2002) define hard skills by: "*They are skills related to technical aspects to do some tasks at work and often take into account the acquisition of knowledge*" (Pager et al., 1993). In general terms, soft skills are defined as "interpersonal skills, human, personal or behavioral skills needed to apply technical skills and knowledge in the workplace" (Weber et al., 2011). Moss and Tilly (1996) define soft skills as: "Skills, abilities and traits that relate to personality, attitude and behavior rather than formal or technical knowledge".

The careful combination of hard and soft skills is essential to achieve professional success, however this study shows that the world is changing and self-knowledge is increasingly required to the detriment of knowledge.

2. Survey: Graduate and Student Observatory

The Polytechnic Institute of Bragança (IPB) developed and ran an online survey, aimed at the entities that were included in IPB's database, to gather information about the entities' employability in relation to IPB graduates and students.

2.1. Survey Universe

In the survey, 424 entities were contacted, located throughout the territory of mainland Portugal, and the period for collecting responses was from April to August 2020. The entities responding to the survey were divided into 11 sectors, according to the respective codes of conduct, economic activity (CAEs) or similarities between the main activities developed, being defined as:

G1. Agroforestry-food;
G2. Information Technology;
G3. Manufacturing / Extractive Industries; G4. Engineering;
G5. Transport and Commerce;
G6. Consulting, Real Estate and Finance; G7. Health and Social Support;
G8. Art and Culture;
G9. Research and Education;
G10. Hospitality, Catering and Services;
G11. Public Services.

2.2. Employability relationship of entities with IPB graduates and students

The first question to be raised was whether the responding entities had an employability relationship with graduates and students in training by IPB, and the answer to this question was acquired through the following question: "Does your entity have staff, graduates or students of IPB? ". The entities that answered "No" are those that do not have IPB graduates or students in their staff. Of a total of 118 entities that answered this question, 79 said "Yes", that is, they have graduated employees or students from the IPB, corresponding to 67% of the entities. Regarding the division of entities in each sector, the percentage can be seen in

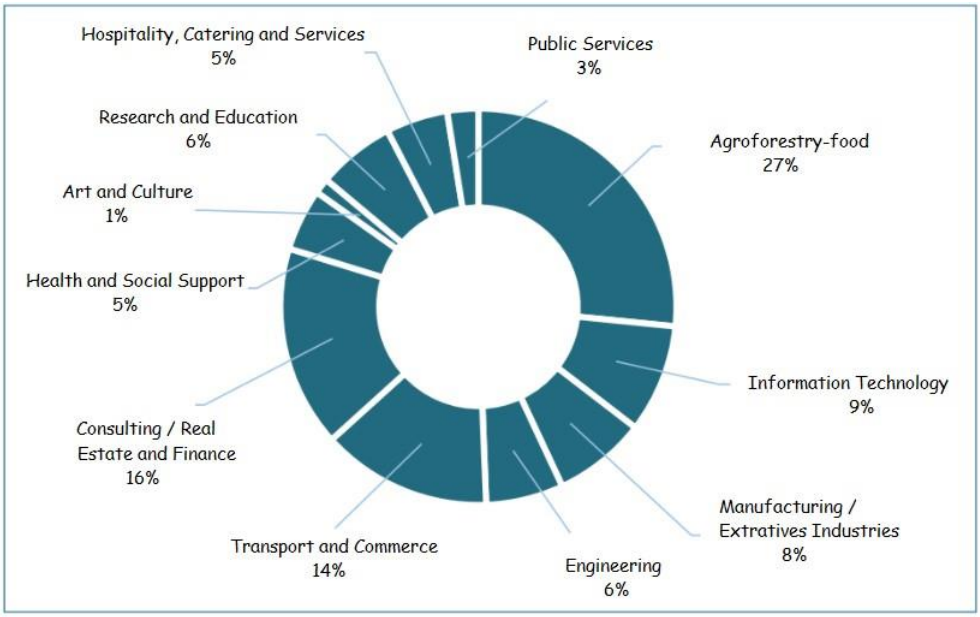

Figure 1. Graph of sectorization of the corresponding entities related to similar activities. Source:Own source.

Among the contacted entities, the sectors that stood out for integrating more graduates and students of the IPB were G1.Agro-forestry-food with 27%, G6.Consulting, Real Estate and Finance with 16% and closely followed by G5.Transports and Commerce with 14%.

According to data from the National Statistics Institute (INE) located on the PorData website, gross value added (GVA) points out that the tertiary sector is the most relevant in the Terras de Trás-os-Montes area, accounting for 63% of participation. However, the weight that the primary sector (Agriculture, Animal Production, Hunting, Forestry and Fisheries) has in the region is also notorious, representing 9.7% of GVA, a percentage higher than that verified at national level, which justifies the that was visualized in the graphic above.

2.3 Competencies of IPB graduates and students

In the criteria regarding the competences that the entities attribute as relevant in the recruitment of a new employee, a list was organized with the main competencies cited in articles and placed in the survey to be evaluated. These competencies should be analyzed and classified according to their relevance to employers. The proposed classifications were: Very Important - Important - Little Important - Not Important. The 12 skills listed were defined according to the following description:

1. Learning: Availability and ability to learn continuously, namely in the workplace;
2. Social / Cooperation: Ease of interpersonal relationships and teamwork, namely interdisciplinary;
3. Flexibility / Transfer: Use of prior knowledge to adapt to different situations, processes and requirements;
4. Motivation / Involvement: Willingness to do, availability for work and identification with the entity;
5. New Technologies: Appetite to deal with technological equipment, databases and specific software;
6. Communication: Transmit and interpret different forms of oral and written expression;
7. Autonomy: No dependence on systematic orders from the head, assuming risks and responsibilities;
8. General Culture: Detention of broader knowledge and not directly related to the job function;
9. Responsibility: Assumption of work tasks and company values in conscience;
10. Physical Robustness / manual dexterity;
11. Innovation / creativity: Introduction of new ways of doing, ability to respond to unexpected situations;
12. Technical Knowledge - Specific: Ability to perform technical tasks in the area of training and / or professional performance.

Figure 2 shows a graph of the distribution of competences and the classification given to them.

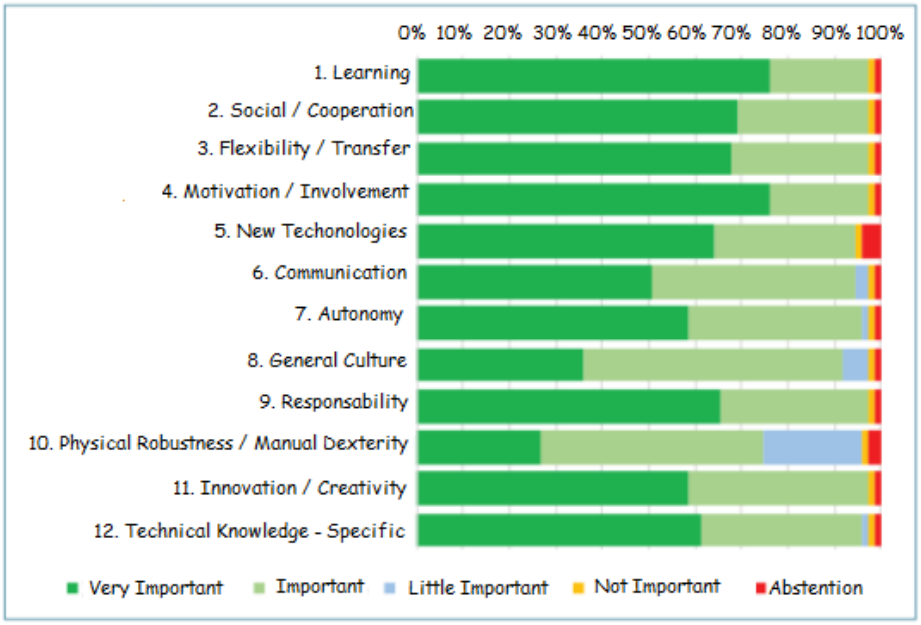

Figure 2. Distribution of competences and the classification given to them.

The vast majority of voted skills remained at an average of 95% recognition between "Very Important" and "Important", being considered skills of great value on the part of employers. The skills that stood out the most were: 1.Learning and 4.Motivation/ Involvement, both with 57 votes (76%) as "Very Important" and 16 votes (21%) as "Important", with the highest priority skills employers. The lowest priority skills were 10. Physical Robustness/ Manual dexterity, with only 20 votes (27%) as "Very Important" and 16 votes (21%) as "Little Important", followed by 8.General Culture, which received only 27 votes (36%) as "Very Important" and 4 votes (5%) as "Not Important". The 5. New Technologies competency was the one that had the most abstaining votes, this reflects that the employer does not know how to point out whether the use of new technologies is important or not at the time of recruitment, this competence ends up being more specific in terms of some areas of the knowledge than an essential competence in general.

3. Conclusion

The collected data point out to the fact that current employers are interested in professionals who have availability and the ability to learn continuously, and have a strong motivation and commitment to exercise the requested demands, and it is clear that the skills that fit the soft skills have added value compared to hard skills, and as a comment in one of the responses,

the following suggestion was made: “In addition to the above, develop autonomy and accountability skills”.

Moreover, our results should be communicated to higher education institutions, to improve course plans and the interface with the employers and companies, but also to improve opportunities to students improve their weekness, according to the needs and skills valued by employers. Other authors have previously emphasised the importance of internships and work placements for skills development, but also the risk these initiatives have in increasing social and educational inequalities (Bonnard, 2020). In some courses and institution internships and work placements are optional, giving the student the responsibility to anticipate and appropriate, themselves, its potential benefits. Boonard, 2020 suggested that instructors should present to students how the work placement can be valued and how they can appropriate their potential benefits in their skills development, employability competecncies and curriculum. Similar results were reached by Velasquez, 2020, that promoted an interesting study including 14 people (managers, teachers, students, nursing graduates and technical nursing professionals) workin in higher education and health services, and concluded it is propitious that managers and teachers plan and organize teamwork to monitor graduates, but unfortunately the reality in educational institution is that teachers gave more theoretical training than practice, with action not corresponding to vocational training, and a profile that did not meet current needs; such as comprehensive training with values, knowledge of languages or dialects and the use of ICTs, in addition to soft skills, and code of ethics (Poquis Velasquez et al., 2020).

The results of the present study are of high importance to higher education boards and course directors. We highly recommend proximity, since the first year of graduation, between students, teachers and employers. Taking the students to the companies, public and social institutions, but also bringing the employers inside the classroom, can help a closer relation between teaching, learning and market needs. Future studies should be performed including 360 degrees evaluation, also collecting feedback from teachers, students and alumni, together with employers.

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Pandemic Pedagogy: Assessing the Online Implementation of a Decolonial Curriculum

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Abstract

The student protests in South Africa (2015–2017) triggered shifts in pedagogical practices, such that by 2020 many South African higher education institutions had begun to make some concrete moves towards more socially just pedagogies within teaching and learning (Quinn, 2019; Jansen, 2019). In March 2020, however, South Africa went into lockdown as a result of Covid-19, and all higher education teaching became remote and non-synchronous. This paper reports on the effects of the move to remote teaching on the implementation of a new decolonial 'emplaced' pedagogy at one South African university. The idea of emplacement draws on the careful incorporation of social space as a teaching tool within the social sciences, such that students can situate themselves as reflexive, embodied persons within concrete spaces and communities which carry particular social, economic and political histories. This paper draws on data from course evaluations and student assignments, as well as a description of course design, to argue that many of the benefits of careful emplacement in historical and contemporary context can happen even where students are never in the same physical spaces as one another or their lecturers. This relies, however, on students' having access to both the necessary technology and to an environment conducive to learning.

Keywords: *Online pedagogy; decoloniality in higher education; emplacement; social science; emergency remote teaching.*

1. Introduction

1.1. Background: the University Context

Since a 1997 White Paper, the higher education sector across South Africa has been under pressure from the state to transform, in order to move away from the inherited inequities that resulted from apartheid policy and planning. As Lange (2017) has noted, however, post-Apartheid higher education policies have also largely had a neo-liberal framing, which has led to a focus on improving access and throughput. The focus on these imperatives resulted in an absence of attention to the concomitant need for change in curricula and institutional culture (Luckett et al, 2019.) This gap was highlighted during the nationwide student protests that took place across higher education institutions between 2015 and 2017 under the banner of #RhodesMust Fall and #FeesMustFall. These student movements called for radical challenges to institutional practice, including the call to decolonise the curriculum and pedagogy.

Recent scholarship on teaching and learning in South Africa has shown that this call to decolonise pedagogy and curricula has had an effect on educational practices in South African universities, and many South African higher education institutions have begun steps towards more socially just or decolonised pedagogies within teaching and learning (see, for example, two recent edited collections by Quinn, 2019 and Jansen, 2019, as well as South African examples within Morreira et al, 2021). Most of these initiatives are new and were still in early stages when the country went into a nationwide lockdown in March 2020, as a result of the Covid-19 pandemic. Universities were immediately closed and students sent home, and teaching was put on pause while university management debated how to re-establish teaching and learning under a lockdown.

The landscape of higher education in South Africa (like much of the national landscape more generally) is a deeply unequal one, such that some universities have much greater stability and access to resources than others. Wangenge-Ouma and Kupe (2020:1) thus note that universities were very differently able to respond to the challenges of the Covid-19 pandemic, with well-resourced universities able to quite quickly institute online remote teaching and provide training for teaching staff in new technologies and online pedagogies, and provide students with laptops and data. Less well-resourced universities were not, however, and the 2020 academic year was finished at different times and with quite uneven results across the sector. It is worth noting at the outset of this paper, then, that any attempt at instituting socially just or decolonized pedagogy within the South African context needs to be undertaken in such a way that students' have adequate access to all learning materials, and to a conducive learning environment.

The university on which this paper focuses is a well-resourced one, that was able to quite quickly take teaching work online, under what was referred to as Emergency Remote

Teaching (ERT). Nonetheless, in addition to the challenges of re-designing curricula for online delivery, and training staff in new technologies, the university also faced an enormous challenge in supplying all students with laptops and data such that they could access the work. In some cases this was impossible, and physical materials were delivered to students via courier in a distance learning model. Furthermore, the university was of course also unable to influence students' home learning conditions, which in the context of South Africa often involved a lockdown in crowded conditions, with no room to study or think away from other family members, and often inadequate access to food and sanitation while so doing.

1.2. Implementing decolonial principles in pedagogy

The course discussed here had recently been re-designed in keeping with a set of principles and questions developed at the University of Cape Town in 2017, in a working group called "Decolonising Pedagogy in the Humanities" (Morreira and Luckett, 2018). In the re-design, the convener had also been cogniscent of the idea of emplacement (Morreira et al, 2020). This perspective stems from a recognition of the fact that much social science teaching in higher education is theory-heavy, abstract, and removed from concrete engagements with the material world. This results in students and knowledge being removed from place and collaborative relationality, and existing instead within a framework of deplaced, individualized competition (ibid). The complex histories of colonialism's effects on the social world as it exists in the Global South are also elided when place and the material world are left out of the classroom. One way to resist coloniality is to thus bring place and materiality more strongly into curriculum design. The idea of emplacement thus draws on the careful incorporation of social space as a teaching tool within the social sciences, such that students can situate themselves as reflexive, embodied persons, with agency, within concrete spaces and communities which carry particular social, economic and political histories. Consciously teaching in and with place also provides a push back against disciplinary boundary policing, as multiple intersecting perspectives are necessary to understand any one place because "a place has a human history and a geologic past: it is part of an ecosystem with a variety of microsystems, it is a social, economic and political order." (Orr 1992, 186). Emplacement thus also carries the potential to allow students to begin a critical, engaged re-thinking of place and socio-political history.

Concepts in Social Science was re-designed in early 2020 in line with these principles. The course is a first year offering, delivered exclusively to students on an extended degree programme, and aims to provide first year students with the tools to critically read, analyse and engage with key social science texts and concepts, including situating the students as nascent knowledge-makers/researchers in the social sciences. In what follows, I discuss the ways in which it was possible to institute decolonial principles of emplacement in the course as run online under ERT. While other decolonial elements were included in the course, such as multilingualism for example, the analysis here focuses on those parts concerned with

emplacement. Data presented in this paper was drawn from the course outline and online course site; students' assignments and results; and responses to a course evaluation taken by 67 out of the 179 students in the class. In all cases students have been kept anonymous.

2. Findings and Analysis

2.1. Course Design

Prior to 2020's nationwide lockdown, the course was intended to be delivered face to face, and included students' engaging with the world on and beyond the university campus, through fieldtrips and assessment tasks that required engagement with place. The course was arranged around a core theme of the social geographies of Cape Town, which was defined as the study of how and why we occupy physical space and place in the way that we do, through the study of social relations, social identities and social inequalities as they play out within they city. While it was no longer possible to teach with and in Cape Town in situ, as many students were not even in Cape Town for the course but had been sent home to various parts of South Africa, the key theme of Cape Town was kept, and it was approached through online remote teaching instead. Using the university's e-learning system, the course was laid out in an easy to follow weekly system, and students asynchronously[1] accessed set readings, short lecture videos, and active learning tasks each week. The course was split into two halves: in the first half, weekly modules were taught under the overarching theme of 'Social Geographies: Situating Ourselves', which included modules on 'Origins: The Many Names of Kaapstad'; 'Identity, Space and Place'; and 'Monuments and Memorials', which all set out to explore the complex social history of Cape Town - as KhoiSan territory; colonial outpost; apartheid city; and post-apartheid city - and allowed students to situate themselves within this social history. This first term also introduced the idea of social science as a means of making knowledge within a postcolonial/settler society, asking what it means to conduct research, what some of the histories of this kind of work are, and how and why we might conduct our own research in the present in such a context. In the second term, under the overarching theme of 'Concepts in Social Science: Ways of Knowing the City and Ourselves Within It' the modules used key concepts in social science – such race, gender, inequality, and xenophobia – to explore beneath Cape Town's surface. The course asked that students

[1] A key principle of ERT was that it needed to be as low technology as possible, to allow students with limited access to data to access materials. The university struck a deal with cell phone companies such that the university's learning system would be 'zero-rated', ie would carry no monetary costs to students to access, but even so many students lived in areas with inadequate cell phone reception coverage where the possibilities for internet/data connections were poor. As such, all teaching was asynchronous; students were offered different sizes of video for download, or could access just a transcript and set of slides; or they had the option to have hard copies of materials and flash drives with electronic materials delivered to their homes.

and lecturers work together towards imagining a city that sustains all its' peoples, thinking through what social science can teach us about how the city currently is, and what we can imagine differently. Modules in this term thus covered themes such as Race and Racialisation: What Understanding Structure Can Tell us about Agency; Land and Legacy: Inequality in the City; and Nationality and Xenophobia, for example.

While students were not physically present within a classroom space in Cape Town, then, the course was designed in such a way that the principles of emplacement, through which students can begin a critical, engaged re-thinking of place and socio-political history, still underpinned design. Whilst no fieldtrips were possible, the students were still able to remotely explore the campus and city within which their University is located. Grading was done on the basis of continual assessment, with marks split between smaller, low-stakes weekly active learning tasks (eg. 'What elements of your culture really matter to you? Where do you think you learned them?') and higher weighted submissions, including a multilingual glossary of terms, and a research project. This final assessment of the course required that students conduct a small piece of research, in which they either interviewed someone who they were in lockdown with, or did an auto-ethnographic reflection on their own lives, using core concepts the course had explored for their analysis.[2] Given that many students were at home in lockdown under less than ideal learning conditions, this allowed students to link concepts such as structure, race, governmentality and inequality to the materiality of their own lives under lockdown, as well as enabling students to harness the idea of agency to think through those parts of their daily lives over which they could exert control. Students were thus able to take the concepts from the course into their own daily lives, and into the real world, such that the materiality of space and place could still be present in their learning. The following excerpt from a final student assignment in which they reflected on the course in general give a sense of the ways in which this enabled students to reflexively engage with the concepts in ways that situated them within post-apartheid Cape Town:

"Throughout the duration of the course I was reintroduced to many concepts that I used on a daily basis. This reintroduction allowed me to think about concepts and their ideas differently and to see them through new, socially constructed eyes. Through this I have

[2] This task required that students 'conduct either an oral history with a household member, or an auto-ethnographic reflection on your own life, around the theme of 'social geographies' (defined as 'reflecting on people and their environment, with a particular emphasis on social factors.')' Auto-ethnography is an anthropological method; students using this method were tasked with 'thinking carefully and critically about your own life experiences, so as to use them as data that can be analysed and presented to us in narrative form.' The project was broken down into three smaller tasks: students first wrote a concept note, outlining their idea for research and their preferred methodology; after they had been given feedback on this they then submitted a transcript or recording of the interview they had conducted, or auto-ethnographic fieldnotes; followed by a final research report, which followed a set structure they were guided through in class.

realized that safe, welcoming and open green spaces tend to nurture me, spaces like environmentally friendly parks, perhaps even public waterfalls. These type of spaces not only sustain me, but they aim too at ensuring that people of different backgrounds can come together in the city of Cape Town and grow together towards a more liberal and equal city. I envision Cape Town to become a city that through equality disregards the separation enforced on generations of people. I would like to see the country too move in ways that will shape individuals into becoming free and socially educated in terms of the possibilities we as society can reach."

2.2. Results from the Course Evaluation

The course evaluation was completed by 67 of 171 students (39%), and showed students to have responded well to the theme of social geographies of Cape Town. 73% of respondents agreed with the statement 'I enjoyed using Cape Town as a focal point for exploring concepts in the social sciences.' Qualitative statements from students in keeping with this theme included, "I loved it, it's so much easier to study complicated concepts through every day things,"; "I valued when we learnt about identity and space and how it affects who we are", and "The course inspired critical thinking about who and where we are." Students also valued that the research project situated them as knowledge-makers within the academy, even as first year students, and allowed them to draw on their everyday lives in working with complex concepts. 79% of students thus agreed with the statement, "I found the research project useful for putting concepts into practice and developing my skills as a social scientist in the Global South." Qualitative statements in keeping with this theme included " I value the skills and the effort that is taken into conducting research. I learned that it was not only about asking questions but also linking up certain parts of our history together to form one, coherent storyline"; and, "I really valued being able to interview my own grandfather about his life experiences, and recognise how that fits into the history of our country, and can be analysed using the concepts we have been working with this semester."

2.3. Students' Course Results

The table below compares student result in 2019 (face to face implementation) with student results in 2020 (remote implementation). Note that the content, assessment methods and mode of delivery were all changed considerably in 2020: but the National Qualification Framework (NQF) level, which measures applied competence, remained the same.

Table 1. Comparison of Student Results 2019 and 2020, as a percentage of the class as a whole.

	2019	**2020**
Passes	90, 9	88,3
First Class Pass	13,8	22,5
Fails	2,1	1
Incompletes	6	10,7

The category 'Pass' shows cases where students received over 50% for the course. The category 'First Class Pass' shows a pass grade of over 75%. The category 'Fail' shows cases where students submitted all tasks but received a final coursework mark of less than 50%. The category 'Incomplete' shows cases where students did not pass the course because they did not submit enough work to reach the 50% grade requirement.

The table thus shows that there was a small drop in student passes in 2020; but that the percentage of passes in the First Class category (a grade of 75% and above) was higher in 2020 than in 2019. It also shows a drop in the percentage of those who failed even after submitting all tasks. The data sets and changes year on year are of course small: nonetheless, they indicate that where students were able to access content and focus on learning, the course was able to fulfil its aims, despite ERT. However, the table also shows an increase in the percentage of students who did not submit enough work to pass the course. This increase in Incompletes likely indicates that the effects of social conditions of lockdown in South Africa (such as crowded learning conditions, increased mental health strain) impacted on some students' ability to complete work, despite work being delivered to students in hard copy and on flash drives where internet capacities were insufficient. The rise in Incompletes highlights the difficulty of implementing a decolonial, socially just curriculum where the conditions under which students are able to learn are unequal, even where they have equal access to teaching materials.

3. Conclusion

This paper has considered the effectiveness of implementing a curriculum of emplacement under Emergency Remote Teaching during the South African lockdown. It has thus focused on those parts of the course that could be said to be employing a pedagogy of emplacement. The paper shows that it is possible to enact a pedagogy of emplacement even from a distance, through content and assessment methods that enable students to position themselves as reflective, agentic persons situated in places with complex histories. However, it also argues that there are broader difficulties in implementing a decolonial or socially just curriculum where students' social conditions are not all equally conducive to learning. It is likely that

the pandemic will result in continued remote teaching in South African higher education for all of 2021, and possibly even some of 2022, depending on the availability of vaccines. The paper thus recommends that university-run student residences be re-opened (under appropriate social distancing measures), and that students who are vulnerable to poor home conditions for learning be prioritized for placement in those residences.

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Organizing Events as a Tool to Develop Marketing Skills – the atUAliza.te Event Case Study

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Abstract

Marketing education literature is prolific in research dedicated to the best methodologies to provide higher education students with the knowledge as well as the soft and hard skills needed for their future careers as marketing experts. This article presents an experiment developed in a marketing degree, that took place outside the classroom over the last twelve years. The experiment consists of organizing an annual marketing conference coordinated by a team of students who are supervised by a marketing teacher. It is a two-day event that brings together the best speakers from the market and academia targeting both marketing students and professionals. The participation of students as part of the organizing team is voluntary and no assessment is performed by any course of the degree. These students refer to the development of skills such as improving negotiation skills, networking, public speaking skills, organization, planning, team management, conflict management, leadership, time management, among others, as an added value for their careers.

Keywords: *Events Organization; events Management; marketing education; skills.*

1. Introduction

The objective of this paper is to present the event "atUAliza.te – The Marketing Conference" whose creation, evolution and organization is an initiative from marketing students of the University of Aveiro – Portugal. The paper also intends to explore how being part of the organizing team of such initiatives allows students to develop competencies and contribute to their education in the marketing field, as a whole. The paper starts by presenting some literature review about the most important skills to cope with the requirements of the market and how experience-based methodologies such as the organization and management of this type of events can contribute to complement the students' training. The third section is dedicated to describing the main phases of the organization of the event, how the team is organized and works both internally among the team members and externally with all the stakeholders involved in this endeavour, followed by testimonies from students, the role of the teacher, some important facts and numbers and conclusions related to this activity's importance to the students are also presented, in the final part of the paper.

2. Literature Review

There is a vast amount of literature on what concerns new methodologies to improve students' skills, namely in the area of marketing. Besides, the incorporation of new and/or different competencies and subjects in the curricula of undergraduate degrees is often suggested. Several authors indicate that this is not enough and, in an increasingly competitive and challenging world, more than just regular teaching is necessary to change teaching/learning paradigms through new methodologies. Such methodologies can help students to increase their personal and professional skills and enhance performance, linking more easily knowledge to its practical applicability and bridge the gap between the academy and the market (Estima & Duarte, 2016; Pinheiro *et al*., 2019). The preference for more active methodologies and a more experience-based pedagogy has been growing in recent decades. A growing body of literature has studied and presented examples of this approach (e. g., Granitz & Koernig, 2011) and defined it as the process by which learning is promoted based on experience (Maher & Hughner, 2005), developing market and marketing skills and promoting greater student satisfaction (Caza *et al*., 2015). Forman, (2006) argues that this methodology, when combined with more traditional methodologies, can have an even greater impact on students, developing individual problem-solving skills and innovative challenges.

Besides program degrees covering areas such as event organization, protocol, institutional relations and related subjects, to the best of our knowledge, no one addressed the topic of event organization as a teaching methodology to improve skills in marketing students. The literature shows that the organization and management of events "requires particular skills, knowledge, and competencies" (Perry *et al*., 2011, p. 85), including vision, adaptability,

leadership skills, high organization skills, marketing, communication, commitment, strategic planning, accountability and people management (Bowdin *et al*., 2006; Padron & Stone, 2019; Perry *et al*., 2011). The important skills that result from this kind of experience-based activity could be an excellent approach to develop the main skills required by 21st-century marketers (Coelho, 2019; Schlee & Harich, 2010).

This paper presents an overview of the "atUAliza.te – The Marketing Conferences" event creation, evolution and organization and intends also to explore how participating in the organization and management of this type of activities allow students to develop competences and contribute to their marketing education.

3. Case Study

This section presents atUAliza.te case study, starting by sharing the history and describing all the activities involved in each of the phases of the event, including the competences that the marketing students develop and acquire. In the end, some important facts and numbers are highlighted to demonstrate the importance and magnitude of this activity.

2.1. History and Scope

Created in 2009 under the insignia atUAliza.te (the word in Portuguese means something like "update yourself" and the capital letters UA are the initials of the University of Aveiro), this marketing conference reflects the initiative of the students who, over the years, have worked together to position the event at a national level. The event is held annually and brings together leading Marketing professionals and keynote speakers that represent brands who stand out for their innovation, creativity, quality and who are inspiring and stimulating examples for the audience. Over the years it has become a must-attend event for students, entrepreneurs, and professionals eager to explore new trends in the area, from the most varied sectors. One of the main purposes of the organization team is to create a moment for training, knowledge update, networking and to promote the proximity between the University and the Market. Each year the main subject is chosen and the invited speakers from different market sectors ranging from retail, services, industry, fashion, automotive, etc, are contacted. The topic of the conference changes annually to match the most recent topics and market trends. Past topics have been related to branding, personal branding, content marketing, creative thinking, luxury marketing, digital marketing, among many others. In 2014, for the first time, the event welcomed an international speaker and, since then, many other international brands have been represented. This year, the event will have its twelfth edition, which was not held in 2020 due to the pandemic situation.

2.2. The event

In this section, all the organizational process is presented, based on the three phases of the event planning process – Pre-event; (hosting) Event and Post-event. All the routines and decisions are detailed, and, for each phase, a list of the potential competencies acquired and a small testimony representing the student's team is presented to illustrate the experience in first-person.

2.2.1. Pre-Event

This is the first step of the process, and the main objective is the constitution of the team. It starts with the selection of the students who will be responsible for the team and assume the Management of the conference program. Usually, some students from the previous year are already identified to take on this role and responsibility in the following year given their performance and work. Other teams related to Communication and Design; Sponsorship and Finance and Staff are then formed. Each team has its specific functions according to the description below.

- Management of the Program – This is also the team responsible for the whole event, and the main responsibilities are: (i) selecting the other team leaders; (ii) coordinating the other teams in weekly meetings; (iii) proposing the theme for the current edition and submitting it to the group of leaders; and (iv) selecting, contacting and inviting the speakers according to the theme of the event. This team has also the responsibility to report to the general coordinator (i.e., the teacher indicated to supervise the whole group of students). The main skills developed are Leadership, Resilience, Planning, Coordination, Negotiation, Argumentation.
- Communication and Design: This team is responsible for the development of the event's entire internal and external communication policy, as well as the development of all graphic/digital communication support (examples of this materials can be seen on the page of the event AtUAliza.Te, 2021). Students in this team are also responsible for the creation, development and managing of the event's social networks and website. On the day of the event, they are responsible for the live news of all the communications including live social media management. The main skills developed are design, creativity, flexibility and, communication.
- Sponsorship and Financial: this team is in charge of searching and selecting the event sponsors, presenting the sponsorship dossier (developed by the communications team) that describes the different types of sponsorship and respective benefits offered. The same applies to the event partners whose participation, involvement and continuity over time have been growing (i.e., the main sponsors). They are also responsible for the management of the online tickets

store and the revenue of the event, processing all the income and expenses and managing all the processual documents. The main skills developed are leadership, resilience, argumentation, flexibility, communication and, negotiation.

- Staff: this team complements and supports the other teams, assuming a character of greater importance on the day of the event, forming all the human resources support to the event, involving the reception, routing and information to the participants. Each team member has a specific role on the day of the event, such as check-in, coffee break management or room assistant. The main skills developed are leadership, resilience, flexibility and, communication.

2.2.2. Event Hosting

The event takes place over two consecutive days, in the Auditorium of the University of Aveiro. The speakers, partners, sponsors and participants are welcomed and all the tasks necessary for the smooth running of the event are carried out. This is normally the most stressful period since it is the result of all the work developed for over ten months. It is also the moment to verify the quality of all the work done. The main skills developed are Management of contingencies, conflict management, time management, leadership, stress management, people management.

2.2.3. Post-Event - Evaluation and follow-up

This is the moment to perform the evaluation and follow-up of the event. The event is evaluated by the organizing team, the speakers, and the partners and sponsors. The participants' evaluation is also collected at the end of the event through a questionnaire. These data are then communicated to those directly involved in the event (i.e., speakers, sponsors and partners), and to the institutional stakeholders using a specific dossier.

Besides this self-assessment exercise, at the closing stage, the potential leaders for next year's edition are identified and invited to start thinking and planning the event. This identification is based on the performance of the elements of the team during all the phases of the event, taking into account their proven experience and demonstrated leadership in different areas. The main skills developed are the ability to self-evaluate, manage expectations, capacity for analysis and reflection and communication.

2.2.4. Student's Testimonies

Over the years, as teachers, we followed students and their growing process. Many students show a clear evolution and acquire a very different vision of their education process after participating in the event. As a way of documenting this reality, we selected three testimonies from students who started their participation in their first academic year as regular Staff members and were then selected to participate as team leaders in the following editions.

"For many of us, atUAliza.te was our first challenge - our first practical case, lived as a team, in the first person, on a more professional rather than academic setting. It was our first and closest contact with the labour market - it was our first challenge to develop skills in communication, planning, negotiation, strategy, ... and MARKETING!" Alumni 1

"For me, atUAliza.te is, and always will be, the reason for my professional success. It was the event that gave me my first job in marketing and has been directing me on the right path for building my future. The developed networking, the daily challenges to overcome and the team's leadership make each participant emerge richer from this project." Alumni 2

"From atUAliza.te, I took a huge amount of learning and certainties that all those involved in the events will have a bright future waiting for them based on the leadership, planning and negotiation skills developed." Alumni 3

2.2.5. Role of the Teacher

The teacher in charge has the fundamental role of coordinating the whole team and to provide the event with a unique identity. He also officially represents the University in the relationship with speakers, guests, sponsors and partners. He assumes the responsibility of choosing the program managers, delegating to them the task of recruiting the remaining staff (normally the team as around thirty students). These recruited elements come from different courses and academic years. Moreover, as already mentioned, the team is mainly constituted by marketing students. These teams always report to the teacher in charge and need his agreement when making key decisions.

2.2.6. Facts and Numbers

Among many other things, there are some facts and numbers that demonstrate the relevance of the event, which we would like to highlight:

- Sponsors – From the first year the number increased from 4 to 30, demonstrating the interest of the event for the companies;
- Speakers - Throughout the 12 editions we had more than 230 speakers, about 20 per edition;
- Conference participants – We went from about 50 participants in the first to around 750 participants per edition;
- Students - Throughout all the editions we have had a total of over 400 students participating as part of the organizing team (around 30 per year)
- Partners - Over the years we have had partnerships with the University of Aveiro and ISCA-UA as internal partners, RFM (a national radio) as the communication partner, and specialized national and local press;

- Budget – The event's average budget is currently around €35.000;
- Recognition – The event has been recognised as the best national marketing conference and one of the best in management, according to specialized magazines; several other universities organise study trips for their students to attend the conference every year; employers in the region and nationally recognise the skills of those involved in these conferences and today we can state that several students have obtained their first professional experience as a result of these conferences;
- The event is operated as an extra-curricular activity with voluntary participation and is not linked to the assessment of any curricular unit.

4. Conclusions

As can be noticed on the page of the event (AtUAliza.Te, 2021), this initiative has been growing in quality, popularity and importance over the past twelve years. It is now positioned in Portugal as one of the best national marketing conferences and is particularly a reference for marketing students but also students from other related areas such as design, advertising, management, international relations, among others. This perceived quality relates to aspects already mentioned in section 2.2.6. However, we would like to highlight that as the event became more notorious, it started to become easier to attract more sponsors and, consequently allowed us to invite other relevant keynote speakers (e.g., from international brands). Although not explored in this article, the participants' evaluation is also collected at the end of the event through a questionnaire, enabling us to measure the evolution of the event over time.

In this case study, rather than presenting a narrative of what we have developed with the students in recent years, we wanted to demonstrate how it is possible to develop technical and soft skills and create an institutional culture and a huge sense of belonging on students, with the organisation and management of an event. As teachers, there are some aspects that we would like to share beyond what was explicit in the case study. Students who participate in the event team develop a new sense of responsibility, identify themselves with the event, create a sense of achievement, increase their interpersonal skills and significantly increase their network.

As a school with other degrees in accounting and finance, the team recently decided to allow these students to also participate in the organization of the event, particularly in the budget team. This bond has also been very interesting to observe, as it was rare to see it in other more formal activities.

Despite being a very demanding activity, it is also easy to transpose to other contexts and colleagues from other areas besides marketing can use this model to benefit universities and

students and their relationship with the industry. Moreover, the authors strongly believe that organizing such events during the graduation period, provides students with something that goes far beyond what they could learn inside the classroom.

In the future, it would be interesting to discuss the implementation of this conference concerning other (marketing) students' conferences - either in Portugal or even in a broader international context (e g. European, global). This would allow us to deepen the conclusions of this study and compare the results, particularly regarding the skills acquired with this type of activity.

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PhD courses and the intersectoral experience: a comprehensive survey

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Abstract

It has been found that most PhD graduates (>85%) do not achieve a long-term academic career and thus there is a growing need to re-imagine PhD education that incentivizes doctoral students to engage with research consumers, not only within their discipline, but also, across other disciplines and sectors to have real social impact for an improved society. The aim of this work is to identify intersectoral/interdisciplinary courses that are considered to broaden student career outside and inside academia. For this purpose, a survey was designed to identify modules which lead to the improvement of students' skills while an analysis of their attributes was also performed. Two target groups have been considered: (a) young researchers and (b) program directors each of which can provide different information regarding the courses of interest. 52 students and 11 directors from 5 European Universities, participated in the study. An absence of such courses in the standard PhD program was observed, while any intersectoral/interdisciplinary activities were conducted outside the PhD program, and organized by collaboration of academia and other organizations. The survey findings reveal the need to restructure the PhD programs.

Keywords: *PhD courses; career enhancement; intersectorality; interdisciplinarity.*

1. Introduction

PhD studies are widely considered as the highest level of education, deepening knowledge and skills in a specific field of research. Interdisciplinary PhD programs have, however, been suggested that follow a T-shape approach. This approach considers the traditional PhD expertise and skill coupled with additional learning as part of a multi-disciplinary and intersectoral community (Mountford et al., 2017). With intersectoral training we mean training that is organized together with actors from different sectors, including academy, industry, public sector and/or 3rd sector. Several challenges have been identified and solutions have been proposed in (Chouvarda et al., 2019) regarding interprofessional and interdisciplinary education and teamwork in Connected Health (CH) research in particular. These focus on overcoming disciplinary boundaries, recognizing that CH research involves an intersectoral ecosystem. The entire ecosystem can only benefit from CH post-doctoral researchers who move from academia to industry and apply their knowledge and skills in CH research, development, and entrepreneurship. Graduate students may not, however, have some of the broader skills required by industry, especially in engineering and medicine (Cui & Harshman, 2020; Lieu Tran et al., 2019). PhD students can, however, take steps to bridge the gaps between traditional academic PhD training, or even interdisciplinary PhD training in CH, and employer expectations of post-doctoral researchers as professionals in the CH industry.

To that end, a survey was undertaken to identify intersectorally designed/delivered modules and their attributes, which are available to PhD/Postdoctoral students and help them broaden their career prospects beyond academia. With the results of this survey, we aim to identify: (a) what are the modules that people involved in PhD studies find more useful in terms of career enhancement, (b) What are the attributes that made these courses successful and satisfying, (c)identify needs and gaps in PhD programs, and (d) use this information to develop innovative educational interventions.

This survey is part of the work conducted in the CHAMELEONS[1] project. This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 873105. The overall aim of this project is to develop a range of interdisciplinary, inter-sectoral and international modules. These will be designed to broaden the skills of PhD graduates and improve their employability in academic and non-academic environments, considering the domain of connected health (Caulfield & Donnelly, 2013). The purpose of this research is to improve the skills and attributes of Ph.D./Postdoctoral students so that they will have increased employment opportunities and impact on completion of their studies.

[1] https://www.chameleonsproject.eu/

2. Methods

2.1. Target Group

We have identified two different groups of people involved in PhD programs. In particular: (a) Young researchers: In this category PhD & Postdoc students were included. The inclusion criteria were: (i) the participants should be currently PhD candidates or (ii) they have finished their PhD in the past 5 years, (b) Research associates/ program directors: This category included all academic faculty who had been involved in the design or delivery of an intersectoral module or course.

For the study purposes two different questionnaires were developed, one per target group, in order to identify the different perspectives of the two groups in relation to the intersectorally designed courses. While the goal is to extract information about these courses, different points of view are revealed by each group.

2.2. Design of the questionnaire

The survey was iteratively designed with the participation of partners from Aristotle University of Thessaloniki, University of Oulu, University College Dublin and Maynooth University. For the design of the survey, an initial workshop was organized in order to define the directions that needed to be followed. In this workshop, a set of questions was proposed and discussed. In a second stage the initial questions were reviewed/refined by the partners, to decrease redundancy and increase clarity. Finally, the questionnaire was implemented and internally reviewed before final deployment.

2.3. Deployment

The questionnaires were developed using the online survey tool LimeSurvey[2]. A central installation of the tool is provided by AUTH. All processes were GDPR compliant, and the questionnaires were developed after the consultation with AUTH's Data Protection Officer and after receiving ethical approval form AUTH's ethical committee. The survey was completely anonymous, no personal information was asked from the participants and no communication information was stored or kept.

To achieve the goals of the project the questionnaires were divided into two categories: (i) General Questions and (ii) Course-specific Questions. In the first category, the questions focused on demographic characteristics of the participants and on attaining general information regarding the courses that they may have taken/developed during their studies. The interest here lies in the nature of the courses and specifically what percentage of these

[2] https://www.limesurvey.org/

courses are internal (included in PhD program) or external (not included in PhD program), intersectoral or not, interdisciplinary or not. In the second category, the participants were asked if they had taken/directed a specific course that was useful in terms of broadening students' career prospects outside academia. For this specific course, the participants were asked to answer to questions which are divided into three subcategories: (i) Nature of the course: to obtain general information about the specific course (title, content etc.) and the nature of the course (internal/external, intersectoral/not, interdisciplinary/not), (ii) Satisfaction: to obtain information about the satisfaction of the participant regarding the specific course, (iii) Structure: to obtain information about the structure of the course (duration, interaction level, grading, etc.).

3. Study Results

3.1. Young researchers

52 young researchers participated in the survey. Regarding the universal characteristics, Figure 1 depicts the flow of information with regards to the sex, age, basic education, career plans and the courses that students consider as useful for their career enhancement. Regarding modules taken during their PhD studies, 84% (44) have taken part in both internal and external courses. In 37.5% (12) of the internal PhD courses there was involvement from non-academic tutors/speakers mostly, 91.67% (11) as guest speakers. Guest speaker disciplines varied across modules. External activities attended by students mostly comprised seminars/webinars and conferences, 68% (26) of which were interdisciplinary.

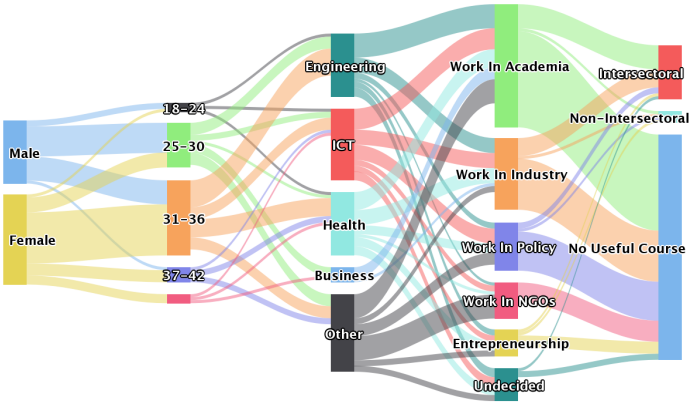

Figure 1. Universal characteristics of students; Column 1: Sex, Column 2: Age, Column 3: Background, Column4: Career Plans, Column 5: Attended courses useful for broadening non-academic career.

Of the 52 participants, only 14 (23%) attended a course that was useful in terms of broadening their career prospects outside Academia, with only 10 of these being intersectoral in nature.

93% (13) of these courses were external to the student's PhD program, 57% (8) of which were organized by academia in collaboration with industry or professional organizations. 43% (6) were interdisciplinary in the following combinations: 1. Health and wellness, ICT, medicine, computer science, 2. Designer, Engineers, Education, Sport Science, Psychology, Business, 3. Business, science, law, communication, 4. Sports Science, Education, Psychology and Nutrition, 5. Health, Informatics.

When asked how they located the specific course, the two major routes were advertisement and supervisor referral, while in terms of important characteristics for deciding to take the course, it seems that the most important reasons were structural, since the duration and time of the course were most important with a mean value of 4.29, followed by the structure with 3.71 and teaching/learning strategy with 3.69. The most important factors in selecting a particular course were the improvement of soft/academic skills with mean values of 3.92/3.5 respectively.

Students identified some aspects of the course in which they participated that they would like to change including the involvement of more guest speakers, better engagement between the speaker and the audience, and more activities to understand the transition that takes place between PhD and workplace. Also, they would like more specific and practical courses and longer learning periods. Students also identified courses that they would have liked to attend but did not have the chance including: 1. Time management, 2. Business, 3. Scientific writing and presentation.

When it came to module structure, 50% (7) were modules that were performed on demand and not included in a specific timeline, while for 36% (5) the duration was '1 week or less but more than one day'. 78% (11) of the modules were free of charge and for 93% (13) the structure of the module included lectures. 72% (10) demanded physical presence in class and 35% (5) of the modules were publicly available. 35% of modules required an application and selection process. Finally, 50% (7) of the modules had no evaluation and 65% (9) offered no ECTS.

3.2. Program directors

Regarding the second group of participants, 11 program directors, most of them, 90% (10) has participated in the coordination of PhD courses, both internal and external. In 50% of the internal courses, there was involvement of non-academic speakers, mostly as guest speakers (75%). 50% (4) of the external courses were interdisciplinary in nature and 87.5% (7) of the directors participating in the survey encourage their students to attend such activities.

Despite this, only 30% (3) had participated in courses that broadened students' career prospects outside Academia. All these courses, 3 in total, were external, intersectoral and interdisciplinary courses, with involvement mostly from academia. The disciplines included

were: 1. Medicine, Engineering, 2. Social sciences, ICT, engineering, medicine, 3. Medicine, Nursing, Physiotherapy, Education Technologist, Education Developer.

These courses focused on developing specific skills, like collaborative writing and problem solving. Directors felt that these courses were attractive to students, due to their interdisciplinarity and the networking opportunities offered. 66.67% (2) of these courses were included in the standard PhD program, lasted less than 3 months, and there was no fee to attend. Directors suggest that these courses are more valuable when attended in the late years of students' studies. All required physical presence in class and were available to members of a certain faculty and not open. 66.67% (2) had evaluation in the form of projects and continuous assessment.

3.3. Comparative results

Figure 3 depicts in detail the type and structure of the courses proposed by students as compared to directors. Figure 4 depicts the importance of specific attributes of the courses as derived from the two distinct groups of participants. For both groups, the duration of a course seems to be the most important criterion for a successful course. Although students find more important the assessment strategy while directors the interdisciplinarity and networking.

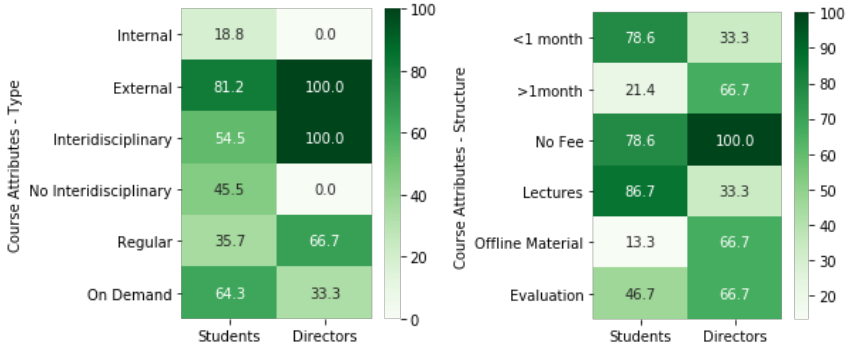

Figure 2. Comparative results for Type and Structure of the Courses.

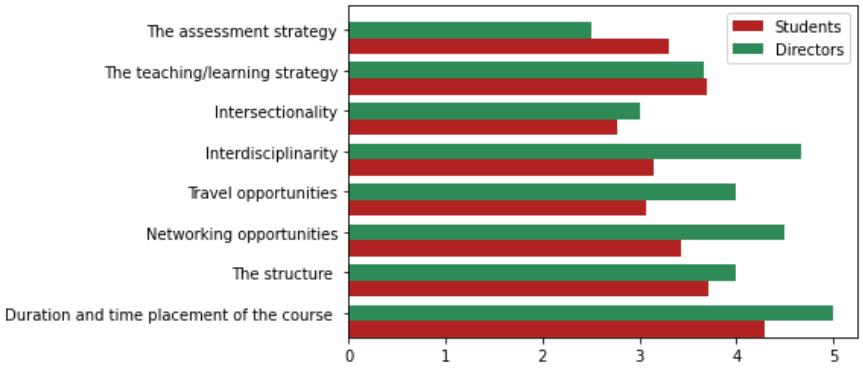

Figure 3. Comparative results for the Courses' Attributes Importance.

3.4. Identified Modules

The modules that were identified by the survey can be divided into 4 categories, based on the knowledge/skills they are providing. Each one of these categories can be considered as a section that can be followed by students, depending on their needs. Each module contains a variety of choices, including courses, informative videos, or guidelines. The four categories and the respective modules are depicted in detail in Figure 2.

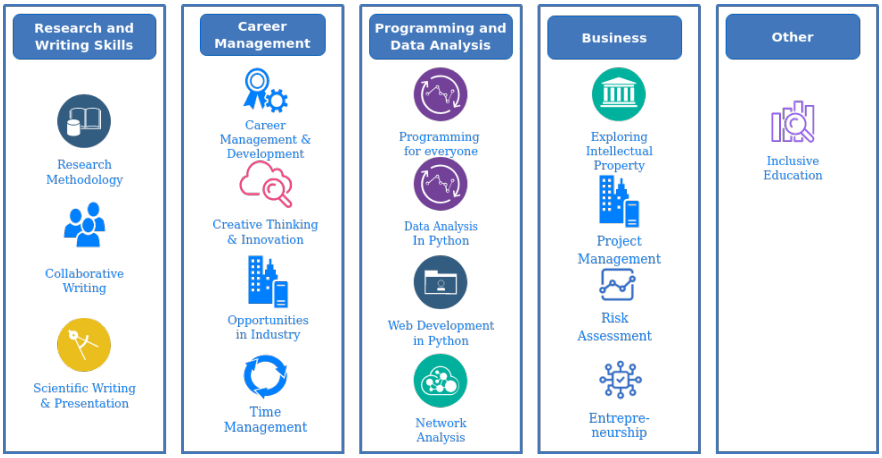

Figure 4. Modules identified through the survey.

4. Discussion and Conclusion

The survey results confirm the bibliographic findings that currently the PhD programs do not include courses or modules that aim to broaden students career opportunities outside academia (Bosch, 2018). However, interdisciplinary activities and science diversity provide

great experience to the students (Patricio & Santos, 2020). Students are interested in these activities as it was found that most of the courses that students attended are external activities like webinars/seminars or summer schools and directors tend to suggest to their students that they attend external activities even if these are not integrated into the program. Moreover, these courses are often organized by academic organizations in collaboration with industry and tend to be interdisciplinary. Such programs give students the opportunity to broaden their knowledge of basic education by merging different fields of science. These findings suggest that there is a need to restructure PhD programs.

Regarding the attributes of the courses that both groups found useful for the students' career development, this survey revealed that these groups have different perspectives. These attributes will be considered by the consortium as a baseline for the development of three intersectoral modules.

Additionally, the main reasons for selecting a specific course, seem to be structural. The students prefer brief and comprehensive courses to enrich their skills in specific fields. On the contrary, directors believe that a longer period and the involvement of more disciplines would improve the courses. Students want more practical modules that allow the direct application of the obtained knowledge. Finally, both groups believe that external, intersectoral and interdisciplinary courses are a positive addition in the PhD studies.

Concluding, CHAMELEONS project will take into consideration all these aspects that the participants found satisfactory in the courses they attended, to design the three modules that aim to assist students to broaden their skills and improve their employability in academic and non-academic environments. Moreover, the modules identified through this survey will be embedded in the state-of-the-art toolkit created by CHAMELEONS project. The toolkit will provide courses aiming to help PhD students to broaden their career opportunities outside academia and give them the opportunity to follow a structured learning strategy, with modules and material, towards improving their skills.

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Service-learning - Diagnostic technologies presented by Ph.D. students to help socially neglected people during the SARS-CoV-2 pandemic

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Abstract

Innovation is becoming a fundamental part of many sectors and environments, including universities, not only regarding their research but also how education is approached. In this line, one of the ways to achieve these objectives is based on a collaboration between society, which presents a need to be solved, and the University. This society-university integration is achievable via the Service-Learning methodology (SLM), which has always been based on establishing strong links between the educational world and society.

This paper presents a SLM-based project linked to technological development for the health sector during the SARS-CoV-2 pandemic. Specifically, undergraduate chemistry students, and Ph.D. students led by professors have presented part of their technological developments to people in society who are at risk of exclusion to help them understand aspects of infection as well as diagnosis of diseases. In short, the objective is to transfer in an enjoyable fashion, a set of technological developments and knowledge that can help society understand aspects related to the COVID-19 pandemic.

Keywords: *Service-learning; teaching; social integration; pandemic.*

1. Introduction

Year 2020 has been a period of learning and development for many sectors of society. The SARS-CoV-2 pandemic has forced both society and the university itself to go through a challenging time in almost all aspects. These social circumstances are serving to frame the training procedures of our future professionals (Martinez et al., 2003). Undoubtedly, everything that is being experienced in society should help mold the training channel for students, in order to properly manage and employ current resources, especially in the most underprivileged social strata.

An adequate understanding between university teaching and society makes it possible to address social shortcomings and educational considerations. This bond must be integrated within an educational proposal that combines learning and community service in a single plan. This plan is called the service-learning methodology (SLM), which is founded on an experience-based methodology, in which students (guided by professors) are engaged in helping the community and, at the same time, achieving their sought professional competencies (Annete, 2000; Gallego, 2014).

Some authors describe SLM as a solidary activity of students, oriented to effectively meet the needs of society and in line with the curricular contents of their educational programs (Tapia, 2008). SLM is an innovative approach that brings together the learning of contents, competencies, and values with the development of tasks of service to society (Tinkler, 2019). In this way, learning extends outside the classroom and the student learns the importance of their presence and skills for communities in the field of service. This methodology presents effective aspects in different areas of the student's training within the university: (i) the fact that the SLM focuses on a more practical and applied training results in an improvement of the academic curriculum; (ii) training in values which are useful for the future of the students while reflecting on society and its communities; (iii) link with the community since the activities linked to the SLM respond to a professional intervention on a real social problem (Gallego, 2014). Activities linked to SLM group training aspects based on the combination of theory with practice, the classroom with real problems, or student’s training with social commitment (Butin, 2006; Manzano, 2010). That is why a quality university education cannot separate professional dvelopment from social training (Martinez, 2007; Gallego, 2014). So much so, that in recent years many universities are actively implementing methodologies based on SLM in a large part of the degrees they offer. This has led to the implementation of different institutional programs. For example, "Lernen durch Engagement", in Germany, where voluntary internships are being replaced by SLM activities. Likewise, networks are being developed to facilitate the joint development of this type of activities (Gallego, 2014). In view of this application, the implementation of the SLM-based methodology is a great improvement in the pedagogical field for the university setting

(Dillabaugh, 2019; Sewry, 2018). In relation to this setting, it is not only focused on undergraduate students, but also on Master's and Ph.D. students.

In previous work, this methodology is also being transferred to the field of training future Ph.D.s (Torrecilla et al., 2020). In particular, it is valuable that the research and technological development carried out in the laboratories of the universities, as well as the new generated knowledge, becomes known by society (Sewry, 2018; Saitta et al., 2011). Communication promotes the generation of more knowledge as society itself reveals its main needs (Ching, 2018). The application of this methodology in university doctoral studies fosters solidarity and the integration of different communities, stimulating the much needed mutual appreciation.

The objective of this work is to employ the SLM methodology during the training of graduate students. For this purpose, aspects related to the development of technological applications based on artificial intelligence in the field of disease diagnosis will be addressed. These technologies will be disseminated as a priority in neglected communities. The activities are developed for people at risk of social exclusion who meet in centers belonging to the Madrid City Council. More specifically, in different centers belonging to the Department of Social Inclusion for Community Integration and Social Emergency of the Madrid City Council (Spain). For this purpose, the results of research projects linked to the diagnosis of diseases being developed by doctoral students supervised by the faculty will be used. The main objective pursued is the integration of society-university and, to this end, it is worth highlighting: (i) to make society aware of the main results obtained in the aforementioned field; (ii) to make it easier for society to participate in each of the steps and feel sufficiently integrated to contribute ideas, needs, and possible lines of improvement; (iii) to transmit the innovation criteria to society and for society itself to provide feedback; (iv) for students to receive the values transmitted directly by the communities themselves at risk of exclusion; and (v) for the service to become a workshop of values and knowledge.

2. Applied Service-Learning Methodology

This manuscript presents a SLM-based approach developed within the Ph.D. studies in the Chemical Engineering program of the Chemistry Division of the Complutense University of Madrid (UCM) (Spain). This project takes place during the academic years 2019-20 and 2020-21. This development focuses on the design of a plan to integrate SLM activities in the training of Ph.D. students. The team consists of two university professors and four graduate students. In addition to the values that the students will receive, this project will significantly improve their ability to present ideas. Within the development stages of the SLM project presented, six phases are contemplated, which will be carried out sequentially (Gallego, 2014).

a) **Analysis of resources and situation**: in this first phase, the available human resources, the situation, and the specific problems of the community to which the project is addressed will be evaluated.

b) **Initial preparation**: in this stage, a list of activities to be developed by SLM teachers and students is designed. This scheduling was supervised by the Madrid City Council linked to this project.

c) **Coordination of tasks**: different coordination meetings are held in which each of the graduate students and faculty organized their schedules and times to fulfil the tasks to be developed in the project.

d) **Carrying out activities**: two activities are carried out for different communities and different videos made for their diffusion in each of the communities. The activities started with workshops entitled "Breath, a New Approach to Prevention" (May 14, 2019) and “Robotics, a New Way to Help Society” (February 26, 2020), Figure 1. Later, videos were developed to disseminate the results for the same communities mentioned above. The tasks being developed are contemplated in two teaching innovation projects; "Service-Learning in the Transfer of Technological Results", and "Service-Learning, a Way to Transfer to Society the Technological Results of the University", funded by UCM. Likewise, after each event, meetings will be held with all the parties involved in the project to learn about relevant aspects and improve its quality.

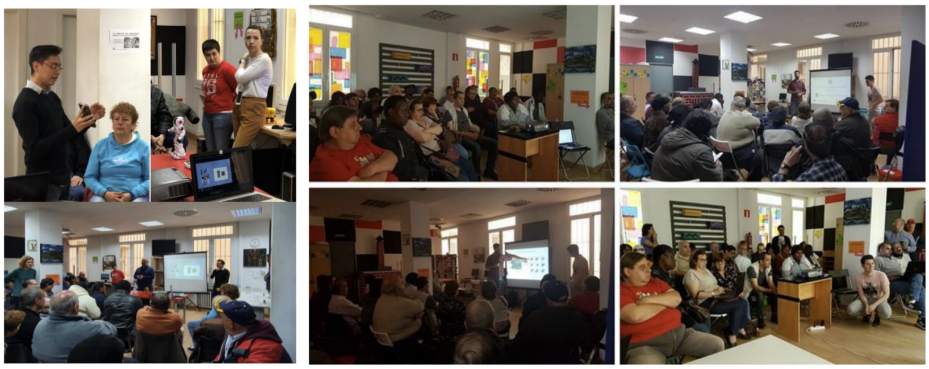

Figure 1. Images taken at the workshops entitled “Robotics, a New Way to Help Society” (left) and "Breath, a New Approach to Prevention" (right).

e) **Reflection**: the information gathered in each activity will be used to improve and facilitate the search and design of future events for SLM students.

3. Results

Currently, given the problems that still exist derived from COVID-19, there are still some online events to be held to finalize the results shown in this project. Even so, the results are representative nonetheless. The processing system of the surveys has been organized from the transcription of the recorded texts, identifying complete sets. The content analysis was carried out with Statgraphics 18. The analysis was informative, so the task of categorizing and coding the information collected was carried out. For the validation of the category system, the two professors linked to the project being developed and also a group of two more professors not initially linked to the project were involved. The kappa index was calculated to reflect inter-observer agreement. This coefficient, in all cases, has exceeded the value of 0.70 (Gallego et al., 2014). The results have been elaborated through surveys to both students and teachers at two levels, taking into account students and teachers.

At the student level, the study was conducted in the three areas of student training during the development of the SLM methodology, specifically: (i) academic demands, where the mastery of contents, positive attitudes towards work, knowing presentation options, and recognizing realistic ideas in the world of work among others will be considered; (ii) the characteristics implicit in the development of values, including aspects such as self-esteem, empathy, teamwork, self-improvement, motivation, creativity, communication, responsibility, and more; (iii) relevant aspects in the area of community relations will be considered, such as social development, community intervention, diversity and values, coexistence and interaction, among others.

Among the results of the interviews, the importance of problem solving by doctoral students directly from the students stands out. Solving real problems through the union of different areas of knowledge not only linked to the research presented was adopted by the students. Another feature that most surprised the members of the project is the possibility of defending their developments in other non-technical forums as well as the received questions. In practice, the return to work in the laboratory made them see their tasks and objectives from other points of view, considering the advantages of the application of what they are doing. In general, one of the most common results is the pleasure of helping people who are suffering situations that are very different and complicated from those of the doctoral students. Also, in general, it was very interesting to see how science and technology can entertain other people, even when their background is not technical.

At the level of teachers, the categories that were addressed are distributed in the same areas considered in the previous level, specifically (i) in the area of academic curriculum, the articulation of contents, quality of learning, didactic strategies, active participation, among others, will be considered; (ii) analysis of the implicit characteristics of training in values, including aspects such as teamwork, motivation, leadership, responsibility, empathy, among

other aspects; (iii) linking with the communities to aid in social development where diversity and values, pro-socialization, community intervention, among others, will be taken into account. In general, the professors who have participated in this project consider this methodology very promising to present to researchers a new scenario in which to promote and share their technological developments. In addition, it complements one of the aspects that gives great importance to the development of research projects related to the influence on society of the results obtained.

4. Conclusions

This manuscript presents the preliminary results of several projects based on the service learning methodology (SLM). Through these projects, centers with a population at risk of exclusion are integrated with doctoral students using the SLM methodology. Although the project will continue in the coming months, the results are promising, both on the part of the doctoral students and professors as well as the people belonging to communities at risk of exclusion.

The doctoral students have acquired competencies and social skills in terms of collaboration with the community, and at the same time they have strengthened ties with people with serious social problems. This synergy has greatly favored not only knowledge but also training in values and community service. So much so that the compelling results that have been obtained are opening up the possibility of establishing new activities of the technological projects that are launched in the Algoreach research group.

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Board game for the engineering students to promote interest in city infrastructure courses

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Abstract

Learning is a complex process that includes self-motivation, self-control and self-discipline. The efficiency of learning depends on the motivation of students and overall atmosphere in the classroom. At the same time, promotion of interest to communicate out of the classroom is of the same importance. Furthermore, if students find an interest in a specific professional field during the out-of-classroom activities, the study process in engineering sciences becomes easier and more enjoyable.

To promote the interest in engineering studies at Riga Technical University study programme Heat, Gas and Water Technology, workshops at the infrastructure units of the related industry representatives, summer workshops in the sports, seminar and recreation centre, as well as basketball and table tennis competition between teachers and students are organized on a regular basis. Through the thematic games, teachers find the motivation to upgrade the quality of the study process and students gain more information on the topic and ability to achieve higher results. The proposed board game for the out-of-classroom activities is a successful method to facilitate the communication between lecturers and students in practice. At the same time, the game contains control questions that allow to stimulate and promote the knowledge level of the students.

Keywords: *Gamification; course organization; time management; communication; out-of-classroom; board game.*

1. Introduction

"Active learning" process where both a teacher and a student are interactively involved in the study process, has received considerable attention over the years. Teachers are constantly looking for new methods to increase the knowledge of students and to grow new professionals. Sometimes they do serious preparatory work to adapt new study materials or use different approaches for teaching. Through this type of learning, self-motivation, self-control, and self-discipline is facilitated for the students: Aksit *et al.* (2016). Nevertheless, the communication between the teacher and the student is the key factor in effective learning.

Usually, the teacher is responsible for the motivation of students to learn new things, adapt new study course concepts and different learning styles, and manage the classroom in general: Sword (2020). Good communication skills are characterized by the ability to communicate with students, parents, and colleagues: Silver (2018), Sword (2020). However, sometimes pure communication in the classroom between the teacher and students is not sufficient. Out-of-classroom gamification methods allow to create an interest not only from the students who gain more practical understanding about the requirements of the field but also from the representatives of the industry that are interested in communication with the new specialists and want to develop strong contacts with the university: Tihomirova (2019).

The Importance of Promoting Interest has equally significant position: Harackiewicz *et al.* (2016). When someone has an interest in a professional topic, the learning process becomes easier and more enjoyable, the motivation to learn new things increases; Cumberland (2014), Cuhna *et al.* (2020). The promotion of interest can be produced through various communication techniques or models such as learning: (i) particular situations that trigger interest; (ii) features of the environment (e.g., surprise) that catch the person's attention; (iii) repeated experiences of triggered and maintained situational interest; (iv) self-sustaining, well-developed, individual interest (e.g., the student visits art museums): Harackiewicz *et al.* (2016). Thus, the key in student academic success lays in positive, confident, engaging emotions and interest in the specific study field: Harackiewicz *et al.* (2016), Sword (2020).

Institute of Heat, Gas and Water technologies of Riga Technical University provides all level higher education (Bachelor professional, Master academic and Doctoral studies) and performs research in the field of heating, ventilation, air-conditioning, water and wastewater treatment and distribution systems. The academic staff of the Institute applies different teaching methods in routine work, organises workshops both in the university and in the out-of-classroom environment. These workshops usually take place at the territories of the cooperation partners or university outdoor areas. Furthermore, regular basketball or table tennis competition is organized between teachers and students to promote the interest and communication willingness from students. Within this paper we aim to demonstrate the primary rules of a board game that has been developed for out-of-classroom activities of

students from study programmes related to heat, gas and water technologies to promote communication and interest in the specific engineering field.

2. Basic Rules

Quiz games like Linkee, Colorbrain or Shot in the Dark are among the most popular board games: Graham (2020). Adaptation of these or similar board games for training purposes has been already reported. Their modifications by using specific questions of some professional field allow to stimulate knowledge level of the students in the particular field. Also, there are several examples by using modified Monopoly game to increase the level of motivation, understanding, critical thinking and decision-making skills in students: Shanklin & Ehlen (2007), Oliveira *et al.* (2015), Dirgantara *et al.* (2018). At the same time, modifications suitable for heat, gas and water engineers have not been reported.

A table game described in this manuscript is a combination of "Monopoly" and typical quiz games. It was developed to promote the interest in engineering students through the out-of-classroom activities with or without the lecturers. The game contains quiz questions from the field of infrastructure development and urban planning that allow to repeat study topics, increase the speed of thinking and, as result, the knowledge of the field. Playing the game is also a successful method to facilitate the communication between the lecturers and students.

2.1. Description of the rules

Basic rules of the game are similar to "Monopoly" (www.hasbro.com). However, there are multiple modifications when compared with the original game version (Table 1).

Table 1. New terms and replacements introduced in the table game for heat, gas and water engineers.

	Original title	Number of players	Replacement
1	Bank	1	Head of Urban Planning Department
2	Jail	1	Engineer Certification Centre
3	Player	2+	Engineer
4	Free parking		Vacation
5	Chance		Energy audit
6	Street		Elements of city infrastructure

To play, a special board (Figure 1), quiz cards, play money, player tokens, colour chips and two six-sided dice are needed. The game can be played by 2+ students. According to the

classic rules, the player that roles the highest total on both dice goes first. Game play proceeds clockwise from that player. Starting capital of each player is 1500 money units (MU).

Head of urban planning department (n=1) is responsible for splitting the funding between the players and control of money, all property and infrastructure until it is introduced in the game.

Head of certification commission (n=1) is responsible for the certification of an engineers (engineer project quality).

Each time the engineers (n=2+) pass 'Lets' Go', they collect a Salary of 200 MU from the Urban Planning Department.

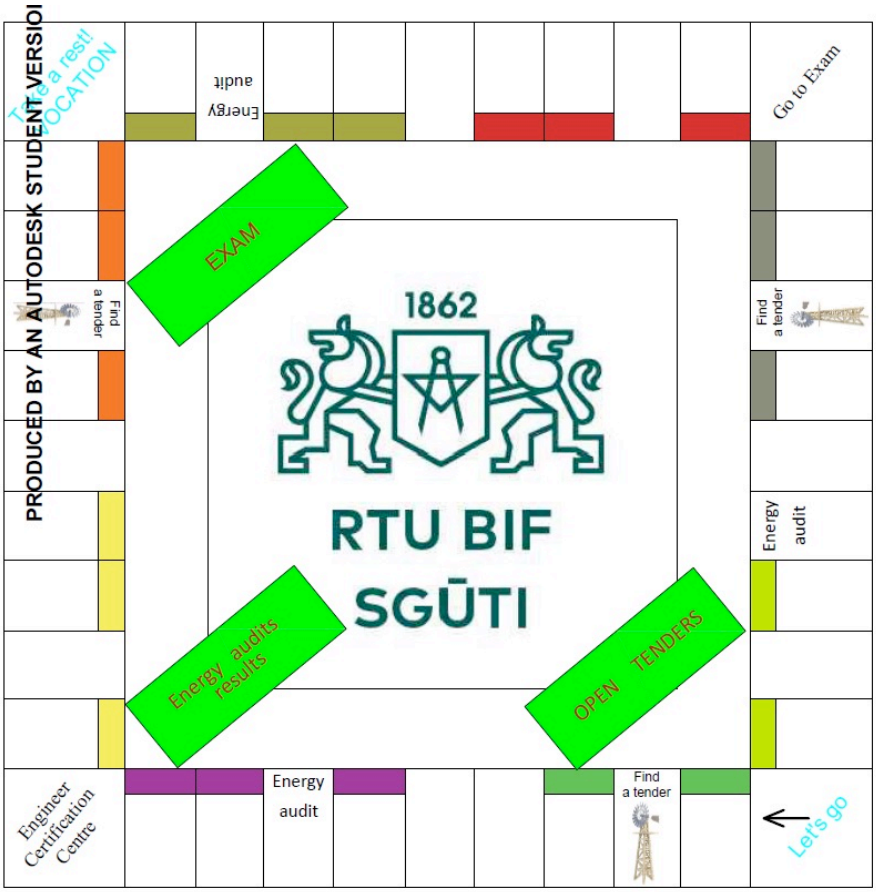

Figure 1. Schematic representation of the table board for the game.

Each colour on the board represents different types of city infrastructures (Table 2) that are further divided into three or two parts. If it is not already occupied by other engineers, each player can submit an infrastructure development project to the Urban Planning Department for

any property that he/she lands on. The project (50 MU) can be submitted and realized only for one type of infrastructure system per round (1st, 2nd and 3rd upgrades). The type of the realised project is indicated by special coloured coded chip from Urban Planning Department (Figure 1). With each implemented project, the utility bills to other players increase by 10%. If engineers do not submit the project for a property, the Urban Planning Department can announce a public auction starting from the lowest price.

Infrastructure projects can be realized by different engineers. Players can sell and buy projects for any property that they land on or outsource (50 MU or 10% of your total object price). In this case the incomes from the object are divided between the project engineers.

Players can get extra funding from Urban Planning Department by implementing energy audits. When a player lands on "Energy audit", they take a card from "Energy audit" quiz. If the Energy audit is passed, the engineer gets money from Urban Planning Department (50MU), if it is failed the engineer should return money (50MU) to Urban Planning Department. Also, if a player can pass three Energy audits in a row for one of its properties, he/she can double the income from Urban Planning Department.

Transfer to "Engineer Certification Centre" is possible through landing on a field marked 'Go to Exam', draw a card marked 'Go to Exam' or roll doubles three times in a row.

There are only 2 ways to pass the "Engineer Certification Centre":

1) Take a card form the Certification committee in heat, gas or water field (choose only one field). The card contains one question and 3 answers (one is correct). Answer the question. If the answer is correct, the player continues the game and receives a certificate which increases the rent price by 10% of all players property until the player finishes the round.

2) After the third failed answer, the engineer must pay the 50 MU fine and leave the "Engineer Certification Centre" without a certificate. Then the used cards are returned to the bottom of the pile the action is completed.

The engineer can choose to sell a part or full set of their property to Urban Planning Department or to end the game when all fields are equipped with all level of infrastructure upgrades.

Field "Find a tender" provides income or loss of money due to participation in construction works. The player chooses a card and according to it, the player gets money from the owner of next closest field with upgraded infrastructure. Loss of money is indicated in a card which indicates the amount to be returned to Urban Planning Department.

The winner of the game is the one who remains the last in the game or holds most of the finances (estimated both in cash and owned property).

Table 2. Sample of principial scheme of game sequence.

Infrastructure	Type of subsystems	Upgrades		
		1st level	2nd	3rd
District heating	Combined heat and power	new filter, better boilers	Change from fossil fuels to renewable energy	Installation of solar renewable energy and thermal storage
	Heat distribution metwork	Installation of new or replacement of old pipes	Operation temperature reduction transition from 3rd generation to 4th generation	transition from 4th generation to 5th generation
	Heat substations	Better regulation based on outdoor sensors	Advanced control with temperature regulation schedule	Bidirectional heat substation
Gas	Distribution network	Replacement of pipelines	Network extension	SNG vehicle network
	Compressor stations	Upgrade to new equipment	ICT for remote monitoring and maintenance	Integration of biogas
	Emergency services	New transport and equipment	Integrated solution with state fire and rescue service of Latvia	New app for communication
Wastewater	Wastewater treatment plant	Project and building	System monitoring	Optimization of process
	Sewage system	Installation of new pipes	Building of pump station	Installation of online monitoring system
	Individual wastewater treatment system	Project and construction	Quality monitoring	Additional stages for process optimization

A number of examples for use of gamification in different levels of education can be found. Gamification in teaching process is an excellent approach to make the atmosphere in the classroom more positive and open. It is often used to increase students' motivation and engagement in educational environments and stimulate their learning interest at all levels of studies: Dichev & Dicheva (2017), Wang & Wang (2018). The gamification allows to receive additional attention of learners and motivate them for self-study also out-of-classroom. Board games allow to put the focus on student interactions, encourage healthy competition between classmates, stimulate work together to solve the game, reduces stress, encourage creative and strategic thinking and provide a break from traditional lesson structure. At the same time, it

should be noted, that the board games used for studies are not developed to replace a whole study course. They are only an interactive part of studies or teaching process to promote the interest in the specific study field.

3. Conclusions

To increase the knowledge level and communication skills of students in heat, gas and water engineering field, a table game has been designed for out-of-classroom activities. The game combines traditional board game style with technical terms and details from the specific engineering field. Various infrastructure units have been selected and their modifications introduced in the game. The principles of the game are simple, and it can be also used by non-professionals. Furthermore, parts of the game, especially quiz and "Energy audit" cards can be replaced or modified according to the knowledge level of the players.

Use of gamification during the study process and out-of-classroom activities allows us to increase the interest in students, facilitate their self-learning, and stimulate their effort to achieve the result. Modified and specialized board games can become equally important in the study as role plays and practical discussions.

Our board game has been developed as additional tool for out-of-classroom activities of students without formal assessment and examinations. It aims to promote communication and interest in the specific engineering field. Alternatively, it can be also used in competitions not only with course members, but also with teachers participating in the game.

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The impact of study abroad experiences on international students' employability: a preliminary study on Chinese engineering students in US

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Abstract

This study aims to examine how study abroad experiences influence Chinese engineering students' employability. Employability in this study is defined as capabilities, processes and performances before job search, during job search and after job search. This study aims to explore how study abroad experiences contribute to engineering students' global competencies; how study abroad experiences influence engineering graduates' job search process; what the long-term impact of study abroad experience on engineering graduates' early careers are. This study adopts interpretative phenomenological approach via semi-structured interview. The preliminary findings include: firstly, study abroad experience is a premise for Chinese engineering students for being screened during job search both in China and abroad; secondly, study abroad allows students to discover their real interests which decided their career directions; thirdly, students kept learning and self-reflecting which contribute to their capabilities building; fourthly, study abroad trained engineering students with soft skills. Moreover, recommendation from professors and alumni facilitate the job search. Lastly, personal value and family reason influence graduates' career decisions in working in China or abroad. Conclusion was drawn that study abroad experiences have positive impact on engineering students' employability building, job search process and their early careers.

Keywords: *Study abroad; global engineering competency; employability.*

1. Introduction

Aims of higher education have been changing for last centuries. The aim of the universities in medieval time was to nurture elite in the area of theology, law and medicine (Boden & Nedeva, 2010). Since the 1960s, to stimulate economy and decrease the inequality in education, the higher education has been massified to train young university student to be qualified workers in the job market (Teichler, 2009). Higher education institutions are expected to better prepare graduates being equipped with attributes required by job market (Barrie, 2006). Higher education institutions adopt many measures to enhance graduates' employability, for instance, through industry-led curriculum (Green et al., 2009), internship experience, study abroad, career counselling (Teichler, 2009). Social and economic conditions have also been changed. With globalization, higher education institutions design various global programs to enhance students global competency, for instance, English language immersion programs, internship abroad, study abroad (Yang, 2002).

Recent studies prove that study abroad experiences have a positive impact on graduates' employability. According to QS Global Employer Survey, 60% employers believe the positive impact of study abroad (Coelen & Gribble, 2020). In job search, study abroad experiences offer graduate a competitive advantage (Franklin, 2010). Study abroad experiences shown on the Curriculum Viate leaves the recruiters with the impression of adaptability, independence and cross-cultural awareness (Franklin, 2010). During interview session, study abroad experience provides students with evidence to say about their experiences and capabilities, especially their independence and resilience (Green et al., 2020). Study abroad experience influences graduates' career direction. Study experiences contribute greatly to their first career choice (Farrugia & Sanger, 2017). Over 70% alumni of study abroad programs do jobs with international dimensions, such as dealing with international clients, practicing international law (Franklin, 2010).

Furthermore, due to the changing job market condition caused by 4th industrial revolution and new disruptive technologies for future engineers, the impact of study abroad experience on engineering students' employability are worth being examined. This study aims to explore following research questions: How do study abroad experiences contribute to engineering students' global competencies? How do study abroad experiences influence engineering graduates' job search process? What are the long-term impact of study abroad experience on engineering graduates' early careers.

2. Literature review

2.1. Global Engineering Competencies

Future engineers should be named 'holistic engineers' because besides technical skills or hard skills, future engineers should have international awareness, equip with entrepreneurial spirit, the ability to innovate, the ability to work in a team cross disciplines, the ability to lead and manage projects in today's fast-changing world (Grasso & Burkins, 2010). For well-rounded engineers in the 21st century, they should be equipped with: 1) subject-related skills in math, science, etc; 2) engineering skills, system and integration; 3) soft skills in profession including the skills to communicate, to have team collaboration, to build contacts; and 4) business skills in cost accounting, scheduling and planning (Doyle, 2020). Global competency for engineers is defined as "knowledge, ability and predisposition to work effectively with people who define problems differently than they do" (Downey et al., 2006, p.110). Jeseik et al. (2014) measured global engineering comptency in three dimensions: technical coordination; engineering cultures; Ethics, standards and regulations. Chang et al. (2009) categorized three dimensions for competences of engineers: global competence; technical competences. Ball et al. (2012) used five types of global competencies: cross-cultural communication, cross-cultural disposition, world knowledge, cross-cultural teams and engineering-specific cross-cultural competences. Mohtar and Dare (2012) measured global competency for engineering students in three dimensions: global technical, global professional and global sociocultural. Chan et al. (2017) stressed the importance of soft skills for engineering students, sometimes called generic skills or transferrable skills, refer to competencies and skills that beyond the discipline and can be transferred across different contexts.

2.2. Graduate Employability

In recent decade, academia keeps discussing the definition of graduate employability. Tomlinson (2017a) proposes that the graduate employability is conceptualized by human skills, social, cultural, identity and psychological capitals. There are five types of capital contributing to graduate's employability: 1) human skills capital: hard skills, soft skills and career building skills; 2) social capital: social network and contacts; 3) cultural capital: cultural knowledge & behaviour, as well as symbolic value; 4) identity capital: graduate identity to be employed; 5) psychological capital: resilience, self-efficacy and adaptability. Cashian (2017) proposes social structure of employability model. In this model, employability is affected by three phases: pre-university, university and post-university. Student's background and family bonds are the factors at the pre-university levels. Before entering into university, students gained their connections, basic skills and attributes from family, schools, peers and communities. In university, students further gain knowledge and skills from degree subject learning, integration activities and community activities. In post-

university stage, students get on-job-training and other workplace training. Therefore, the employability model is through lifespan with interaction in social world. Tomlinson (2017b) categorize graduate employability at three levels: micro level, meso level and macro level The micro level refers to student's individual skills and attributes and also the cultural and social capitals of their own; the meso level means that students' skills can be trained through institutional level, for instance, activities in university or training at work place; macro level means that employability is influenced by environment, for instance, the social and cultural surrounding in a bigger context. Holmes (2013) discusses the three types of employability: 1) possessional dimension: the skills & attributes students own; 2) positional dimension: student-centred way to position themselves to actively train their skills and being prepared to work transition; 3) processual dimension: work transition is a process and many factors involved. Higher education is only a stage and students' social capitals and biographical factors have impact (Holmes, 2013).

3. Research Methodology

This study adopts a qualitative method in an interpretive paradigm which allows the researcher to collect data from listening to participants' voices and perspectives (Mackenzie & Knipe, 2006). Phenomenological perspective is used to collect data via semi-structured interview. Phenomenology examines the lived individual experience of every participant. The experience is direct and subjective from participants. The researcher should "describe, understand, interpret and explain these experience" (Cohen et al., 2018, p.300). 10 participants were interviewed by researcher in this preliminary study as shown in Table 1. The participants were selected through purposive sampling. They were enrolled by top engineering research universities in China and joined study abroad programs, for instance, dual bachelor degrees program, combined bachelor and master degrees program. All of them studied engineering program abroad over one year. They are now in their early career either working in China or abroad.

Table 1. Interviewees' Information.

Name	Current Position	Education Background	Work Location
Steve	Algorithm Engineer	Bachelor in China, Master + PhD in US	China
Lee	Software Engineer	Bachelor in China, Two Master in US	US
Tom	Fintech Engineer	Bachelor in China, Master in US	China
Shaun	AR/VR Engineer	Bachelor in China, Master in US	US
Alice	Supplier Engineer	Dual Bachelor in US, Master in USA	US
John	Process Engineer	Bachelor in China, Master in USA	China
Alex	Research Engineer	Bachelor in China, Master + PhD in US	US
Martin	Research Engineer	Bachelor in China, Master + PhD in US	US
Ruth	Software Engineer	Dual Bachelor in US, Master in US	US
Bill	Design Engineer	Bachelor in China, Master in US	China

Each interview was around 60 minutes by appointment. The interview was conducted via video communication on Zoom. The ethics issue and the video recording were read to the interviewees before the research interview questions being asked. The interview language is in Chinese which is the mother tongue of the researcher and all the interviewees. The audio of the interview was recorded and transcribed. The researcher examined the accuracy of the transcripts. The revised transcript was sent to each participant for re-examining its accuracy and the reliability.

4. Preliminary findings

Upon conducting in-depth interview with 10 participants in a semi-structured approach, here are preliminary findings: Firstly, based on the interview, the hard subjected-related skills are the core for engineering graduates' employability.

> *Bill: For engineering students, hard skills are the premise and the core. During the job interview, all the rounds of tests, including written, phone and on-site, are all about applying the subject-related knowledge to solve problems. In the onsite interviews, the managers or technical persons provided the engineer graduate with a real-world problem to solve.*

Secondly, study abroad experiences not only provide engineering graduates with degree learning and the advanced research in lab, but also provide engineering students with the

training for soft skills. The soft skills gained in their study are very helpful in their early career. Like what Ruth said, the soft skills become her strengths in her current position.

> *Shaun: During lab research, we need to collaborate with members from other labs, other universities and industry people. We learnt the proper way to connect with people from different cultural backgrounds.*

> *Ruth: The most impressive course I took is Entrepreneurship I and II. The teacher owned a company before. So, he was very experienced. He showed us how to present and how to do proper gestures during presentation. He even invited industry people to serve as judges during our group presentation. I keep using the presentation skills he taught in my career. It is my strengths among colleagues in China.*

Thirdly, during study abroad, students kept learning and self-reflecting so that they built capabilities, especially the intercultural communication skills, adaptability, upon graduation gradually.

> *Tom: In the 1st semester, I spent every day learning and living with Chinese students. At the beginning of the 2nd semester, I suddenly realized that I should meet and have local friends. So I thought an idea to go to church, not for the religion but for knowing local people and new friends. I happened to know a very friendly couple at their 70s. They invited international students to their home weekly. I had the opportunity to communicate among diverse groups.*

Fourthly, study abroad allows students to discover their real interests and further decided their career directions. The wider range of course selection and curriculum with more flexibility in host universities provided them with more opportunities in selecting courses they like or they are curious about, which helped them further decide their career direction.

> *Steve: Study abroad experiences have a huge impact on my career direction. Because I studied mechanical engineering as my major in the first three years in China as my bachelor and then I was exchanged to USA for one year at my senior year. I was allowed to select more courses and then discover my real interest which lies in robotics. So I started to study robotics as my master degree and then further applied for PhD. The major studied abroad is the one I like and I decided to do it as my career.*

Moreover, during study abroad, the host universities have many associations or services for career guidance for all students. For instance, the Career Fair each semester, the CV revising services, counselling services, career seminars by amateurs, etc. Professors and senior students in the same lab recommended them so that their CVs can be selected out more easily

during screening, especially the top hi-tech companies. It is social capital the student accumulated.

> *Alice: The most difficult part is that your CV should be selected out among the huge amounts of CVs by HRs of top tech companies. The senior students who worked in the same lab recommended me so that my CV was selected out and got the chance to be phone-interviewed for two rounds and onsite-interviewed for five rounds.*

In addition, the bigger economic and political context do influence international students' career, especially during this pandemic time, as well as the changing visa policy based on the changing bilateral diplomatic relations.

> *Martin: I plan to change to other companies. However, I find it quite difficult to find jobs in pandemic times. Also, fewer companies are willing to offer H1B visa to international students due to current visa policy. Therefore, I feel lucky to have my current job in this pandemic time. I really hope that the new President will change the situation, and Sino-US relations as well.*

Last but not least, some graduates returned to China to work because they noticed the promising opportunities for them that they can contribute what they learned in frontier tech to their motherland. Some graduates are staying abroad. They like the company culture, for instance the work and life balance, the mentor system for helping them personal growth. Some graduates are hesitated about returning or not. Because their parents prefer them returning to China, especially during the pandemic time. Therefore, personal values and external factors influence graduates' career decisions.

5. Concluding Remarks

In connecting engineering students' study abroad experiences and employability, participants express their great improvement in their soft skills including English proficiency in oral communication and academic writing, intercultural communication skills, presentation skills, adaptability in new environment and in diverse group. Participants agree that the most fundamental and vital factor for engineering students in job search is the subject-related hard skills and problem-solving skills. The soft skills trained during their study abroad contribute to their success in gaining the employment and more importantly, in maintaining and developing their early career in managing projects, collaborating in a team and further leading a diverse group. The study will be continued to interview more participants and more findings will be consolidated. The study will also shed lights on the reform of engineering education on how to embed soft skills training into current engineering curriculum at home, after all, not everyone can afford and has the ability to study abroad.

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Research development in doctoral education: role of languages and cultures

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Abstract

Portuguese universities have been receiving an increasing number of students from Portuguese-Speaking Countries at the level of PhD studies, namely from Brazil, Angola, Cape Verde and Mozambique. As acknowledged by research, undertaking a PhD overseas entails several challenges and one of the deepest concerns the implications of languages and cultures in several doctoral activities, since they act as significant research reconfiguration agents. Against this background, this paper reports on a study that aimed at understanding the role of languages and cultures in doctoral research development. For this matter, and within a qualitative approach, semi-structured interviews were conducted with doctoral students from Portuguese-Speaking Countries attending a Portuguese university. Results from thematic analysis reveal that students' linguistic and cultural backgrounds influence several stages of the research process: theme and research objetives definition, theorisation of the research problem and concept mobilisation, construction of data collection instruments and data collection and thesis writing. Implications of findings for institutional policy and practice concerning doctoral education and research are put forward.

Keywords: *Portuguese higher education; doctoral research development; international doctoral students; languages and cultures.*

1. Introduction

Globalisation and internationalisation have been posing several challenges to Higher Education Institutions (HEI) worldwide. One of the biggest challenges concerns the increase flow of international students (UNESCO, 2018), namely within doctoral programmes, which brings forth questions concerning the encounter of different languages and cultures in educational and research activities. In Portugal, recent national policies have led to an increase of international students in HEI (DGEEC, 2018). Within those policies, an emphasis has been put on the need to attract international students particularly from the Community of Portuguese-Speaking Countries (CPLP). Students from the CPLP represent the most numerous group among foreign students attending HEI in Portugal, due to strong historical-cultural ties and the existence of special access regimes within cooperation agreements. In 2017/2018 about two-thirds of international students came from the CPLP mainly Brazil, Angola, Cape Verde and Mozambique (DGEEC, 2018). This increase is noticeable not only at under graduation and master levels but also at PhD programmes: since 2005/06 there has been a growth in the number of PhD students from the CPLP at a cumulative annual rate of almost 30%. In 2011/2012, 12.3% of total students attending doctoral programmes were from the CPLP, mainly from Brazil and Angola, and in 2017 23% of the graduated doctoral students enrolled were international and came mostly from Brazil, Angola, Mozambique and Cape Verde (PORDATA, 2019).

This has not been accompanied by a shared reflection and discussion among the Portuguese academic community concerning the challenges faced by these students, namely regarding the role of languages and cultures in doctoral research activities. Some studies have been acknowledging that pursuing a PhD in a foreign context brings forth critical challenges related to languages and cultures which play a very important role as reconfiguration agents influencing all stages of research: reading literature and theorising the research problem (Robinson-Pant, 2017); construction of data collection instruments and interpreting data (Araújo e Sá *et al*., 2020); writing the thesis and thesis viva (Doyle *et al*., 2017); disseminating findings (Pinto & Araújo e Sá, 2020a). In Portugal, studies focusing on the challenges of researching across languages and cultures in doctoral education are almost inexistent. With the aim of exploring the experience of doing a doctorate at a Portuguese HEI, and focusing on four doctoral programmes in the area of the humanities and social sciences, Araújo e Sá *et al*. (2020) interviewed international doctoral students from African Portuguese-Speaking countries. Findings show that languages and cultures influence the acquisition of the language of the discipline, research dissemination, and thesis-writing. Likewise, Pinto & Araújo e Sá (2020b), in a study that aimed to shed light on what it means to research across languages within doctoral education, concluded that CPLP international students' linguistic and cultural heterogeneity are not acknowledged by supervisors as

mediation and reconfiguration agents of the research process, instead being perceived as problematic.

2. Methods

2.1. Research question and institutional context

This paper aims answering the following research question: what is the role of languages and cultures in doctoral research development in the voices of students from the CPLP attending a Portuguese university? A qualitative case study was undertaken in the Department of Education and Psychology (DEP) of the University of Aveiro (UA, Portugal) in 2018. In 2017/2018 the UA was attended by 1132 international students (total number of about 13.000 students): 236 in graduation degrees, 373 in master's and 536 in PhD programmes. 57% of the foreign students enrolled in PhD programmes were from the CPLP, mainly from Brazil as perceived in Table 1:

Table 1. Nationality of CPLP students enrolled in PhD Programmes at the UA (2017/2018).

Nationality	N. of students
Brazil	202
Angola	43
Cape Verde	27
Mozambique	24
East Timor	8
Sao Tome and Principe	2
Guinea Bissau	1

In 2017/2018, the DEP had 220 students attending its four doctoral programmes and 39% were foreign students. 86% of the foreign students were from the CPLP (n = 74), as shown in the following table:

Table 2. Students attending the DEP's PhD Programmes (2017/2018).

PhD Programmes	Total n. of students	Foreign students	CPLP students
PhD Programme in Education	128	62	54
PhD Programme in Multimedia in Education	59	21	17
PhD Programme in Psychology	17	2	2
PhD Programme in Gerontology and Geriatrics	16	1	1
	220	**86**	**74**

The PhD Programme in Education, the focus of this study, had the largest percentage of foreign students: 48% (n = 62). Of these, 87% came from Portuguese-Speaking Countries (n = 54): Brazil (n = 26), Angola (n = 21), Mozambique (n = 5), East Timor (n = 1) and Sao Tome and Principe (n = 1).

2.2. Participants, data collection and analysis

Twelve PhD students were interviewed (semi-structured interviews of 45 to 70 minutes). Interviews were conducted in Portuguese, audio recorded and transcribed. Following the General Data Protection Regulation of the European Union (Regulation 2016/679), all participants were informed of the research objectives and how data might be used and were guaranteed that all data would be treated confidentially and anonymously. Students were selected according to some criteria: active enrollment for at least three years in the PhD Programme in Education, and thesis completion in 2017/2018 or near completion. Three students had finished their PhD and nine were finishing. Six were male and six were female and were aged between 33 and 60 years. Six came from Angola, three from Brazil, two from East Timor and one from Mozambique. Their mother tongues were very diverse: Portuguese (five students), Kimbundu (two), Nhungué (one), Umbundu (one), Kikongo (one), tetum (one) and Indonesian (one). Six of them were conducting the empirical study in Angolan context, three in Portuguese context, two in East Timor and one in Mozambique.

The interviews were submitted to thematic analysis (Clarke & Braun, 2013), informed by an iterative process that combined a systematic and rigorous analysis of transcripts with literature review. The themes that emerged were the following (Table 3):

Table 3. Themes – data analysis.

Role of languages and cultures in doctoral research	Theme and research objetives definition
	Theorisation of the research problem and concept mobilisation
	Construction of data collection instruments and data collection
	Thesis writing

3. Findings

Findings are structured according to the themes of analysis and data are presented and discussed by providing an account of participants'voices. Statements are illustrated by quotes which give representative perspectives of the larger group of participants.

3.1. Theme and research objetives definition

The ways linguistic and cultural backgrounds intervene in the definition of themes and research objetives are underlined by nine students from Angola, Mozambique and East Timor. All these students were conducting their empirical studies in their countries and the themes were defined according to contextual needs that they identified from their professional experiences as teachers, heads of higher education departments, employees of Ministries of Education. In this sense, research objetives were aimed at analysing and improving contextual features, as perceided in the following quote:

I study practices of learning assessment of Angolan teachers. I'm a teacher and I want to contribute to assist teachers in my country in assessing students' learning. (ST2)

This is a trend very much observed in doctoral students coming from African countries who perceive the opportunity of taking their PhD abroad as an opportunity to contribute to their countries' development (Doyle *et al*., 2017).

3.2. Theorisation of the research problem and concept mobilisation

Five students highlighted the role of languages and cultures in the theorisation of the research problem and in concept mobilisation. Regarding the first aspect, students emphasised that the construction of conceptual frameworks requires mastering English:

Most scientific articles about East Timor are in English. There are only a few in Portuguese. So, I have to make a big effort to read in English. (ST4)

One student, whose mother tonge is not Portuguese, emphasised that reading literature in Portuguese was quite important for her research but extremely difficult:

I used to proceed this way: I read the articles in Portuguese, then I translated them into my mother tongue, and then I wrote a synthesis which I translated back into Portuguese. (ST8)

Concerning concept mobilisation, students' voices emphasised a need for negotiation between culturally inflected ways of knowledge (Manathunga, 2017). This is noticeable, for instance, when a student wanted to focus his thesis on a concept which supervisors had never heard about:

My supervisors asked: "What is tarabandu?". I explained it is a traditional law to ensure environment and agricultural protection. It is a Timorese concept. At first, they did not understand. So, I looked for papers in English to give them and they understood and accepted the focus on this concept. I was glad I taught them a new concept. (ST4)

This example reveals that the encounter of different research cultures in doctoral research may enhance mutual transformative learning by acknowledging students' different academic knowledge traditions and contexts.

3.3. Construction of data collection instruments and data collection

Eight students underlined the implications of languages and cultures in the construction of data collection instruments to be applied in their origin contexts. Issues of terminology and local validation arose in their voices:

When we discussed the survey, I said: "Maybe in Portuguese that is correct, but in East Timor it is not like that. My students will not understand those words!" After explaining, my supervisor understood. (ST8)

Brazilian students, who are doing their research in the Portuguese context, posed questions regarding Portuguese language varieties:

I wrote the interview guide in European Portuguese because there are differences in relation to Brazilian Portuguese. If I ask "For how long did you take 'mamadeira' [bottle of milk], a Portuguese person will not understand, I have to use the word 'biberão'. (ST3)

Cultural and social issues were also emphasised in the construction of data collection instruments, with students explaining negotiation processes with their supervisors, as perceived in the following example:

In the construction of the questionnaire, we discussed whether housewife is a profession. In Angola it is considered a profession. But my supervisors did not understand. I explained this and then they understood. (ST9)

In what data collection is concerned, two Brazilian students highlighted an ideological perspective on language and culture related to Portuguese language varieties and their prestige, which hinders data collection process:

I have faced problems with my data collection in schools. I realised that my supervisor had no problem with data collection. I thought this happened because she was a higher education professor. But today I know that it happens because I am Brazilian. (ST3)

3.4. Thesis writing

As literature suggests, academic writing is difficult for all doctoral students, but it becomes much more demanding when students and supervisors have to deal with writing across different cultural and linguistic backgrounds (Doyle *et al.*, 2017). Ten students underlined the impact of language proficiency in thesis writing. For those whose mother tongue is not Portuguese, the emphasis was on the difficulties concerning grammar, syntax and ortography which cause anguish and distress:

Speaking Portuguese and writing in Portuguese is quite different. My thoughts are done in my mother tongue and only then in Portuguese. My linguistic spontaneity only exists when I'm using my mother tongue. Writing, grammar, spelling… this is a new learning step and every day I'm learning to write European Portuguese. (ST1)

Students whose mother tongue is Portuguese emphasised the clash between Portuguese language varieties, namely European and Brazilian, as stressed in the following quote:

Although we all speak Portuguese, we do not speak the same Portuguese. If we don't speak the same Portuguese, we don't write the same way, naturally. This is very frustrating. (ST11)

In spite of this, students feel that they must write their thesis in European Portuguese, recurring to paid revisions or to the help of colleagues and supervisors, emphasising the fear they have that the jury in the thesis viva might see this as a problem:

I will write in European Portuguese and then ask for a linguistic revision because of the jury. When I presented my project, an examiner said: "Before I saw your CV, I already knew that you were Brazilian". So, I am afraid that there may be some comments on my writing. (ST12)

4. Discussion and research implications

Findings show that languages and cultures influence several activities of doctoral research development, acting as research reconfiguration agents (Robinson-Pant, 2017). Mainly, this influence is perceived by students in thesis writing, in the definition of the theme and research objetives and in the construction of data collection instruments. While the influence on the two latter research activities seems to be almost innocuous, the impact on thesis writing is

problematic causing students' anxiety and linguistic insecurity. This issue has a double facet: on one hand, the difficulties felt by non-native speakers of Portuguese who need institutional support in order to develop academic writing skills; on the other hand, the frustration and distress felt by speakers of other varieties of Portuguese who realise that their varieties may not be accepted. Nevertheless, data reveal that these students were agentic and reflexive about their doctoral research activities and were able to engage their supervisors in critical discussions leading to the recognition of their linguistic and cultural backgrounds. Students' voices underline the need for supervisors and host institutions to recognise contextually inflected modes of research development as a way of opposing to "an epistemological hegemony of the academic space wherein the so-called knowledge elites position themselves as the only legitimate producers of knowledge" (Pinto & Araújo e Sá, 2020b, p. 15).

In the light of these results, it is important that HEI and, specifically, supervisors deepen knowledge concerning students' contexts and knowledge traditions since knowledge is culturally, historically and geographically situated (Manathunga, 2017). This requires supervisors' training for intercultural doctoral supervision which may contribute to research promoting plural perspectives, by encouraging students to draw upon their own linguistic and cultural knowledge in doctoral studies.

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Designing active Maths for undergraduate STEAM students

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Abstract

This work presents a set of student-centred activities that may help undergraduate students understand mathematics in their first year of a STEAM degree. In particular, the authors refer to the difficulties students meet in making connections between syntactic and semantic dimensions in learning mathematics, especially in Linear Algebra topics. The specific goal of this paper is to present and discuss how it can work in the case of linear transformations. This topic stands in the middle of every Linear Algebra standard course and is pivotal in many recent applications, such as computer graphics. The study describes the teaching-learning experience and reports the results of the first pilot study, which involves about 100 undergraduate Architecture students of Politecnico di Milano. One of the peculiarities of this work is its context since the class is composed of heterogeneous group of students, in terms of knowledge background and attitudes towards mathematics. The main findings of this paper are underlining how a student-centred strategy, based on asynchronous activities and synchronous class discussion, allows misconceptions to emerge and be appropriately addressed.

Keywords: *Student-centred activities; open educational resources; linear algebra syllabus; linear transformations; architecture students.*

1. Introduction

Many scholars show that in Science, Technology, Engineering, Architecture and Maths (STEAM) programs first-year students face difficulties in Maths (Gueudet, 2008; Andrà, *et al*., 2019), in particular with Linear Algebra (Moura Santos & Costa, 2020). Gueudet (2008) argued that such difficulties are due to the difference between procedural mathematics at high school and conceptual at university. In Linear Algebra (LA) for instance the concepts are as important as the computations, a concept such as Linear Transformation (LT) can be more easily apprehended when "seen" from a geometrical point of view (Lay *et al.,* 2016), but the high school syllabus is almost everywhere reduced to Calculus (Santiago *et al*., 2012).

Open Educational Resources (OERs) have proved to be a good learning support in several areas of Higher Education, in particular in STEAM areas. Technological tools freely accessed on the Internet, such as videos, applets and interactive quizzes, can be used inside and outside the classroom, in order to place the student in the central role of the learning process (Prince, 2004). The strategies can vary from pausing a lecture to propose a quick exercise or quiz to completely changing the class dynamics. One of the advantages of applying student-centred (SC) strategies is, for instance, better academic performance (Freeman *et al*., 2014).

In this article, authors seek to describe the use of several OERs, in an Elementary Mathematics course aimed for a group of Architecture undergraduates in Politecnico di Milano (https://www.polimi.it), with an average attendance of 100 students per semester. The syllabus of the course is divided in two parts, being one dedicated to the fundamentals of Linear Algebra and the other part dedicated to Calculus with one variable. This paper focuses on using OERs for approaching the concept of a LT, as one of the main concepts in Linear Algebra that allows us to interpret many relevant computer applications (Lay *et al*., 2016).

The presentation unfolds as follows. Firstly, the relevant aspects of the LTs are recalled. Followed by a description of how the instructor designed and carried out a student-centred activity (SCA) in a first-year mathematics course. Finally, a brief discussion on the main findings and the limitations of our proposal closes the work.

2. Mathematical content: Linear transformations

Gilbert Strang in the popular essay[1] "Too Much Calculus" highlights "the central role of linear algebra, [whose] applications touch many more students than calculus. [Because] we are in a digital world now." In the middle (or better, in any place) of a LA syllabus stands the concept of a Linear Transformation (LT). It can be treated as one more "key abstraction" of the syllabus or provide a dynamic and graphical representation of a matrix-vector

[1] http://www-math.mit.edu/~gs/papers/essay.pdf

multiplication (Lay *et al*., 2016). Here, for the aforementioned audience, the last approach was adopted. Within LA course, first-year students can encounter simultaneously the most abstract topics in mathematics and the most relevant applications of today's world: the general concepts of vector space, LTs, factorization coexist along with their applicability in computer simulations for fluid-dynamics, and for computer graphics. Teaching/learning this subject can be challenging in many programs due to the abstract character and the formalism of mathematics that students have not been exposed to in school before (Lalaude-Labayle *et al*., 2018) so often students feel that Maths is "out-of-reach" (Stewart, 2017).

In our context, a heterogeneous Architectural first-year students group, the LA official syllabus only considers elementary ideas for analysing and solving linear systems and their geometrical interpretations. Introducing LT as a result of a matrix operation on vectors in the Euclidean plane (R^2) and in Euclidean space (R^3) allows students to have a geometric flavour of the abstract concept and, at the same time, the basics of computer graphics. This paper focuses on treating LT as a means to figure out the connections between linear systems, matrix-vector multiplication, the graphical view of actions on vectors, and other properties.

The standard definition of a LT is a function T between two vector spaces, for instance acting from R^n to R^m, such that $T(a\underline{u}+b\underline{v})=aT(\underline{u})+bT(\underline{v})$, where $\underline{u}$ and $\underline{v}$ are any vectors in R^n and a and b are any real numbers[2]. Moreover, any matrix multiplication is a LT and vice-versa in R^n, namely each LT T in R^n can be represented by a nxn matrix A resorting to the row-column product, that is $T(\underline{v})=A\underline{v}$. Geometrically and dynamically speaking, multiplications by 2x2 matrices are LTs in R^2 that represent reflections, shears, contractions and expansions, rotations and projections. The beauty of the strong connection between LTs, matrix multiplication and geometrical actions is that it will be easier to make sense of compositions of LTs and inverses (Lay *et al*., 2016).

3. Methodology

For this paper, the data have been collected during the mathematics classes and the students' activities in LA and in particular on LTs. Table 1 shows the course schedule and the moments when the data were collected: as a rule, the students attended on Fridays 3hrs of lectures delivered online, and 3hrs of tutoring/exercises delivered in a mixed format (half of the students were in presence and half were online); apart for the first two weeks and the last one. During weeks 1 and 2, the students filled in anonymous questionnaires (Q0 and Q1), delivered through Socrative[3]. The answers to Q0 and Q1 allowed us to learn about the gender

[2]One can simply think in the special case of a=b=1 as the vector sum of two vectors, and try to visualize what the definition of LT says in this case: the LT of the vertex $u+v$ of the parallelogram whose other vertices are u , 0 and v is equal to the vertex $T(u)+T(v)$ of the parallelogram whose other vertices are $T(u)$, 0 and $T(v)$.

[3]Socrative is an educational platform which enables instant feedback polls for a large classroom https://www.socrative.com

and high school provenience of the students, and also to figure out which are their attitudes towards Maths and their study habits. The information provided by these questionnaires, which is shown in the next section, facilitated the instructors' choices of the learning activities to be performed. The LT activities were delivered in week 4 and 5, and are described in detail below, in Section 4. Moreover, as complementary, yet relevant data, the authors report on the students' feedback in a questionnaire (Q3) about the lessons of weeks 4 and 5, and the students' performance at the midterm exam delivered online in week 7.

Table 1. Course calendar and data collection.
The underlined sessions point out the LT exposition and activities.

October-November 2020						
Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**	**Week 7**
Lecture	2 Lectures	Tutoring + Lecture	Tutoring + Homework + Lecture	Tutoring + Lecture	Tutoring + Lecture	Tutoring + Midterm exam
Q0	Q1		Linear Transformations		Q3	Midterm

Source: by authors.

3.1. Description of the sample

The total number of students enrolled in the Elementary Mathematics course were 174, among them 100 are first-year students, while 74 are repeaters, i.e., students enrolled in the second or third year of the corresponding Degree, but who still did not pass the Maths exams. From the total number of enrolees, 65% are female, 47.3% have a weak mathematical background according to their high school of provenience (ART and Other), while the remaining 52.7% of the students have a strong background (LS+TE)[4].

In questionnaire Q1, one question is related to the students' attitudes towards mathematics - *To what extent do you feel confident in your performance for this mathematics course?* Only 76 students answered the question: almost half of them are sufficiently confident, whilst 39.5% of them have a small degree of confidence in their mathematics performance. What is quite relevant from our point of view is that only 9 students feel very confident. The Table 2 shows how many students who have (or don't) a good mathematical background feel confident or not. The majority of students who have a strong background (LS+TE) feel confident at the start of the Maths course, while the majority of "weak" students do not feel confident. As a consequence, it can be argued that the sample of students is quite heterogeneous. That is, the enrolled students are polarized into two clusters that have different degrees of knowledge, acquired skills and attitudes/beliefs towards Maths. The

[4]LS=science and mathematics majors, TE=applied mathematics, ART=artistic majors.

following comments provided by two students in Q1 confirm that: one writes that "the pace of the lesson is too fast, even too much", while another student states that "despite the lesson being interactive, the professor is too slow and spent too much time on the easy argument, however some of my colleagues (from weak school) is less confident than me and has difficulties to get into the details".

Table 2. Relation between students' confidence and mathematical background. Strong= Strong mathematical background, Weak= weak mathematical background.

	Strong	**Weak**
Confident	65.8%	41.4%
Not Confident	34.2%	58.6%

Source: by authors.

3.2. Research questions

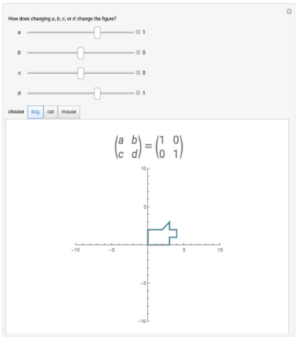
To recall, this work deals with the design of student-centred activities (SCAs) in LA, more precisely on LTs, a topic that is all but easy to teach and learn due to the intertwining of the syntactic and semantic dimensions.

Hence, our research questions are: **RQ1**) *How can teachers support the learning of LTs?* **RQ2**) *To what extent the designed activities may foster a discussion to reveal the emerged difficulties related to LTs?*

4. The student-centred lesson on linear transformations

In order to answer **RQ1**, the following lesson about LT was designed and carried out in three sessions, the first two have SCAs whilst the third session does not. In the **first session (S1)** students have been asked to do some work autonomously during the last hour of tutoring in week 4. They were informed by email, the previous Friday, that the task is composed of three items: i) "study" the video on "Matrices and LTs" (10 mins) on YouTube[5] focusing on the geometrical meanings; ii) explore the applet[6] "DogCatMouse" according to a set of instructions (see Figure 1), iii) answer a set of questions filling in a table (Figure 2).

[5]Video from the YouTube channel 3blue1brown https://www.youtube.com/watch?v=kYB8IZa5AuE
[6]https://demonstrations.wolfram.com/ChangeTheDogMatrixTransformations/



- open the applet using Chrome
- watch the starting demo carefully
- in the initial configuration, after the demo, the matrix is the identity
- select a figure (Dog/Cat/Mouse).
- change the matrix entries (a, b, c, d), what happens to the pet?
- look at the pet's tail, it does not move from the origin (0,0), why?

(a) (b)

Figure 1. DogCatMouse applet. (a) The preview of the applet designed to explore the geometrical meaning of linear transformations (b) List of instructions designed to guide the exploration of the applet. Source: by authors.

[a b c d]	Descriptions	Entries of the matrix
[0 0 0 1]		
[a 0 0 0]	the pet shears along the y-axis	a=?

Figure 2. Sample of the "Fill in table activity": students are asked to fill in the blank in table as part of their work in session 1. Here 2 over 10 rows of the table are reported. Source: by authors.

The **second session (S2)**, a synchronous lesson (90min long), was delivered through a streaming platform[7] with the support of two digital tools: MS OneNote as virtual board, and Socrative. This session (**S2**) was composed of three moments: i) ice-break activity, delivered by Socrative, where students should answer five multiple-choice questions concerning the activity in S1 and some properties of the LT; ii) discussion with comments on students' answers to highlight the main properties; iii) cooperative revision of the task assigned in **S1**, namely commenting students' suggestions on how to fill in the table (Figure 3). This last activity was designed with the purpose of fostering students' awareness of the deep relation between the algebraic and geometrical dimensions of LTs. During the filling in, students formalize the mathematical object guided by the teacher and increase their level of confidence in this topic. The last **session (S3)** is a tutoring lesson (about 90min long) where the teaching assistant proposes and solves in front of the students a set of standard exercises only indirectly connected to **S1** and **S2**.

[7]The streaming platform adopted is Cisco Webex Meetings

5. Data analysis and results

This section aims at addressing **RQ2** reporting and discussing the data relative to students' answers to the "ice-break" activity during **S2**, their answer to the feedback questionnaire (Q3) and their performance on LTs at the midterm exam.

The lesson in **S2** was attended by 86 students, but only 69 participated in the ice-break activity. Their answers confirmed that the majority of them successfully completed the task in **S1**: indeed 90% of the students answered correctly to question 1, in which they were asked about the pet's tail behaviour (see Figure 1b). Moreover, 80% of them answered correctly to question 5 - "*a linear transformation maps straight lines as shown in the figure*" - strongly related to a statement and a frame in the recommended video on "Matrices and LTs". The remaining questions were related to the exploration of the applet and the filling-in-table: the answers to question 2 - *"if a=c=1, and b=d=0, the pet does not move. [True/False]"* - show that some students (20%) have difficulties with the idea and role of the identity matrix, so during the synchronous discussion the focus was on addressing this issue. The question 3 - "*if a=c=k>0, and b=d=0, then…* " did not point out any particular difficulties (95% of the students answered correctly), but allowed the instructor to prompt the discussion about the condition *"k>0"* introducing the topic of reflection transformations. The question 4 - "*if a column of the matrix is null, then the pet vanishes. [True/False]*" - highlighted an issue about orthogonal projections (60% correct answers). During the discussion the instructor was able to figure out that the mistake had a double origin: on one hand some students did not notice that the pet was "flatten" on the x-axis of the applet, on the other hand some students noticed that, but they thought the pet "had vanished". Such a discussion prompted a discussion also about LT in 3D dimensions, where projections are pivotal for architectural students.

The feedback questionnaire (Q3) to the LT session received only 38 answers. The majority (32 over 38) of the students perceived the three sessions as effective. Almost all the comments confirm that LTs are perceived as a hard topic to learn, even though the SCAs were appreciated. For instance, one student writes: "The topic is new to me, but I like this teaching method, the lessons are not too fast, and the instructors were available to address the issues.", while another student reported that "LT are funnier than calculus" suggesting that the proposed activities do contribute to the goal of making LTs less "out-of-reach".

Finally, in the midterm exam, there were two questions related to LTs: Question 1 was about the properties [2 points], while question 2 asked for the construction of the matrix associated to a given transformation [2 points]. The number of students who attended the midterm exam was 99, the total average mark for both questions was 1.92 over 4 (std=0.99). However, students performed better in question 1 (avg=1.62, std=0.62) than in question 2 (avg=0.31, std=0.71). Note that question 1 is more in line with activities performed during in sessions

S1 and **S2**, since it requires resorting to properties analysed during these sessions, whilst question 2 is more procedural and in line with session **S3**, that didn't include SCAs.

6. Discussion and conclusions

The focus of our present research lies on how to support the teaching/learning of LTs (**RQ1**) and to what extent the designed SCAs may foster a discussion to reveal conceptual emerging difficulties related to LTs (**RQ2**). In particular, to check if the use of OERs, such as videos and applets, does foster a deep understanding of the dual nature of LTs. The results of our investigation reveal that, during the three sessions, the proposed SCAs have prompted students to participate actively, mainly in S2, providing comments and making questions, unfolding conceptual difficulties and misconceptions on the dual nature of LTs. More precisely, the asynchronous session (S1) was effective both in fostering students' thinking and in sharing an instrument that both the teacher and the students can use during synchronous sessions (Andrà *et al*., 2019). The use of OERs paired with SCAs sustained therefore the students' deeper understanding of a challenging topic, reducing the "out-of-reach" feeling towards Maths and LA (Stewart, 2017) and fostering the connection between syntactic and semantic dimensions (Lalaude-Labayle *et al*., 2018). Nevertheless, this preliminary study has its limitations, the major ones concern the data collections: the anonymous nature that does not allow always to link answers in different datasets; the cardinality of the sample that changes along the weeks and does not allow to have the whole picture but just a glance. Despite those limitations, which are going to be addressed in a future study, the current findings allow us to claim that a similar approach can be used to approach other mathematical concepts, with appropriate adjustments, to implement active learning strategies among STEAM students.

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Monsters, fear and fun. Bringing creative methodologies into the higher education classroom to study children and childhood

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Abstract

This paper addresses the methodology of Design Thinking and its applicability as a creative methodology when teaching and learning Sociology of Childhood in a higher education context. Students were asked to develop an exercise in order to expand and deepen the theoretical and conceptual knowledge discussed in theoretical classes. Active and creative methodologies were specifically and purposefully designed to develop the ability to think critically about the problems presented, stimulating debate and sociological imagination. Inspired by the Mindshake Design Thinking Model Evolution 6², practical classes were organized and oriented towards specific techniques, namely the "Inspiration Board", "Intent Statement" and "Insight Clustering", following, respectively, the phases of exploration, data collection and analysis and interpretation of results. Illustration is given through the development of a research itinerary committed to think, discuss and creatively research the meanings of the "dark" and "darkness" of the night for children. Incorporating Design Thinking in the teaching and learning process in the field of social sciences, namely when researching children and childhood from a sociological perspective, proved to be a both fruitful and engaging tool both for teachers and students.

Keywords: *Childhood; creative methods; darkness; design thinking; qualitative design; sociology.*

1. Introduction

There is a widespread consensus around the need and urgency to rethink curricula and teaching-learning methodologies in the context of higher education (UNESCO, 2016). Despite the greater use of information and communication technologies and a shift towards the digital (Twenge, 2017), characteristics distinguishing generations persist, leading individuals to think and learn differently (Törőcsik, Szűcs, & Kehl, 2014). Accordingly, after education is completed, when facing the labour market, young people are being increasingly questioned by employers regarding their transversal skills, namely the ability to think creatively and critically, to take initiative and to work collaboratively (Zemke, Raines & Filipczak, 2013).

Having these assumptions as a backdrop, this paper presents and details the experience of using Design Thinking principles in the teaching and learning process in a higher-education context. The experience was developed within the framework of the "Sociology of Childhhood" course, during the academic year 2019/20. The reasons for developing such experience were twofold. On the one hand, because previous practice showed that one of the main challenges when teaching sociology of childhood to undergraduates is to break with common sense and overcome the epistemological barrier that impacts the ways how individuals who observe, namely students/young adults, perceive and conceptualize the individuals who are being observed, this is, children. On the other hand, because elective courses usually are more flexible, leaving the teacher with greater freedom to imagine creative teaching and learning solutions adjusted to specific challenges.

The main objective of "Sociology of Childhood" is to provide students with the theoretical, conceptual and methodological tools for a critical and sociologically anchored understanding of the diversity, relativity and complexity surrounding children and childhood in contemporary society. The course is structured in theoretical and practical classes, tutorial monitoring and remote solutions. Active and creative methodologies were specifically and purposefully designed to develop the ability to think critically about the problems presented, stimulating debate and sociological imagination. Inspired by Mindshake's Evolution & Design Thinking 6² model (Tschimmel, 2018), practical classes were organized and oriented towards specific phases and techniques, namely the "Inspiration Board", "Intent Statement" and "Insight Clustering". This paper presents and details the implementation of this particular pedagogical project, giving voice and turning the experience of the main actors involved – teacher and students – more visible. Specifically, it contextualizes the proposed methodology and illustrates the pedagogical and research path adopted by a group of students committed to investigate meanings and representations around the dark of the night from the perspective of children (Roque and Carreira, 2020). The empirical exercise serves as a motto to discuss the place of Design Thinking and creative methodologies in motivating and engaging more

effectively both students and teachers in the pedagogical relationship in a higher-education context and, ultimately, to think about its limits and challenges.

2. Background

Design Thinking refers to "a method and a process for investigating open and ill-defined problems, acquiring and analysing information, identifying opportunities for innovation, deepening empathy, experimenting with new perspectives and visualising new concepts" (Tschimmel *et al*., 2015, p. 6). In the Portuguese context, Katja Tschimmel has contributed strongly to give more visibility to such a methodology, insisting, in particular, on its transferability to several domains, namely education and training.

The theoretical and methodological foundations of Design Thinking are broad and diverse (Lawson, 1986; Rowe, 1987; Cross, Dorst, & Roozenburg, 1992; Eastman, Mccracken, & Newstetter, 2001). Design Thinking applies to the creative development of processes, strategies and programs, and is transversal to the collection of data, knowledge analysis, deepening of empathy, experimentation with new perspectives and ideas, visualization and prototyping of new concepts, always with a focus on results. Katja Tschimmel (2015, 2016, 2018) argues that Design Thinking is an attitude (mindset), a model for structuring and focusing on a design process that can be used in education in the same way that it has been applied in product design processes and service systems.

The main argument for transferability into the field of education lies on the fact that Design Thinking is centered on the human being. Moreover, it is multidisciplinary and collaborative, optimistic and experimental (Tschimmel *et al*., 2015, p. 6). The transferability defended by Katja Tschimmel for the field of education is operationalized through the adaptation and application of the Mindshake Design Thinking Model Evolution 6^2 model (Tschimmel, 2018), developed between 2012 and 2015, the year in which the last version was registered in Creative Commons sa-by (MINDSHAKE, 2020). This model can be used to guide a Design Thinking process applied in various areas; it includes quantitative and qualitative research methods, is based on primary and secondary data, and is connected with visual thinking and different tools for creating meaning. The model is called Evolution 6^2, which the author explains in three moments. First, "Evolution", because the creative process is a process in permanent evolution, iterative and interactive, both at the level of people and situations. "E6", because the model is divided into six main phases, all of them starting with the letter E: "Emergence", "Empathy" "Experimentation", "Elaboration", "Exposition" and "Extension". Finally, "$E6^2$" because in each phase of the process there are moments of "Exploration" (divergence) and "Evaluation" (convergence), thus, metaphorically raising the power of the model to the square.

The last few years have witnessed the spread of an important set of methodologies considered innovative or creative in social research, including sociology (Denzin & Lincoln, 2011; Kara, 2015; Mason & Dale, 2011). These methodologies cover a diverse range of techniques and approaches resulting from the research experience in multi and interdisciplinary teams, and the need to answer the increasing complexity of social science research questions (Kara, 2015). Creative methodologies mean a wide range of methodologies, not necessarily new to the history of social research. The adjective stresses the procedural nature of the methodologies, emphasizing the creation of something from elements that already exist, arranging or articulating them in different combinations in order to solve specific questions or problems (Kara, 2015). Many of these methodologies are close to the principles and assumptions of Design Thinking, although not always in direct relation to this approach (Mäkelä *et al*., 2014). The following section explores in detail a teaching and learning exercise consisting in the application of some of the techniques of Design Thinking when studying children and childhood-related topics in the broader context of a Sociology undergraduate course. By the end, the authors expect to reflect critically on its scope, potential and limits in the higher-education context.

3. Using Design Thinking to research children and childhood

3.1. Methodological approach

This paper draws on the pedagogical work developed by the authors within the course "Sociology of Childhood" [SOC2425L], at the University of Evora. In the academic year 2019/20, students were asked to develop an empirical exercise consisting in a critical and grounded sociological reading of a specific theme or debate concerning children and childhood in contemporary society. A total of 17 small groups, of 2-3 students each, took part in that initiative. Each group of students had a different topic assigned, freely chosen among several broad topics suggested by the teacher. Inspired by the Mindshake Design Thinking Model Evolution 6[2], the operationalization of the exercise encouraged the exploration of three specific phases: the "Inspiration Board", the "Intent Statement" and "Insight Clustering", following, respectively, the phases of exploration, data collection and analysis and interpretation of results. The next section illustrates the application of such techniques for the development of a research itinerary committed to think, discuss and creatively research the meanings of the "dark" and the "darkness" of the night for children (Roque and Carreira, 2020).

3.2. Results

Just as the Design Thinking techniques are developed with an open end, so this exercise started without knowing the point of arrival. The kick-off was given through the composition

of an "Inspiration Board". An Inspiration Board is "a fun, risk-free and stressfree way to collect interesting images related to your project without analysing them. It is also an effective way to let go of critical and logical thoughts and to (re)discover parts of a larger picture that realistically illustrate the world of education and pedagogy." (Tschimmel *et al*., 2016, p. 31). Accordingly, students were asked to collect, as on a "pinboard", a set of elements (e.g. texts, images and artifacts), allowing them to think freely and creatively. Roque and Carreira brought into class nine inspiring elements, including a self-adhesive moon that glows in the dark, a pawn-shaped toy, a card game, a childhood poem and brushes. Each of these elements was presented orally before the class, and this narrative was later expanded through spontaneous interventions by other students in the room. The group took note of the contributions and after in-depth reflection chose to use the self-adhesive moon that glows in the dark as the main inspiring object. An articulated narrative embracing the various elements was the main methodological achievement of this phase. This narrative is always unique and spontaneous, as ideas succeed one another freely, prompted either by the presentation of the students who collected the elements or by the questions raised by other students in the classroom. While this exercise allowed students to perceive themselves as active actors in the teaching-learning process, it was crucial in linking them with the goals of the course, motivating and inspiring for further research steps.

In the broader framework of Mindshake Design Thinking Model Evolution 6[2], an "Intent Statement" is a convergent thinking tool, developed at the end of the Emergency phase. It is used to help finding the answer to the question "Why do we want to innovate?", and to guide subsequent phases. As Tschimmel puts it, "[m]ost of the time the decision to develop new content is based on a hunch, and feeling the necessity for change and improvement. […] Sometimes however it is not easy to describe those early ideas in words and your concepts have to 'mature'. The elaboration of an Intent Statement helps you to clarify your determination for innovative content development." (Tschimmel *et al*., 2016, p. 77). Therefore, an Intent Statement reconciles intuition and assertiveness, as this should result in a clear statement of the purpose and development to follow. The invitation to define the research objectives through this alternative formulation brought added advantages to the research process. In order to provide a clear and concise answer, students were invited to write their intention by adapting the structure "What is [my] intention?" (Tschimmel, 2018, p. 25). Such a clarification allowed to guide further data collection procedures, namely the profile of children to be observed (e.g. age and social background), and recruitment steps (e.g. sampling process within a specific class and school). By way of example, the recruitment of 7 and 9-year-old children was done through a game, thus ensuring that all children were equally likely to join the study. Providing all children with the time for a game, served two main purposes. On the one hand, it brought researchers closer to children, overcoming the epistemological frontier raised by the age difference. On the other hand, the use of a game, including the clarification and acceptance of the rules, meant that children

who were not part of the final sample did not feel resentful or excluded, perceiving that as a "natural" consequence of the rules of the game.

Additionally, the Intent Statement was determinant in preparing the research toolbox. The toolbox comprised three elements: the ethical commitment expressed in the "Informed Consent Statement", attached to the "Request for Authorization", the "Drawing Guide", and the "Interview Guide". The instruments used for data collection were drawings and interviews conducted with children. The drawings were asked first, in order to gain the children's trust, making them more relax with the researchers. The literature suggests that interviews with children should take place in familiar places, so that they feel as comfortable and safe as possible (Saramago, 2001). For this exercise, the school provided a room for such a purpose. The fact that this particular room was unknown to all the children interviewed made their reaction surprising. In the end, they were very excited because they got to know a new space, until then totally inaccessible to them. Given the age characteristics of the interviewees, the use of an everyday, and to a certain extent, familiar object, such as the smartphone to record the interview, also worked as a creative practice facilitating interaction in the context of social research (Costa, 2019).

Figure 1. The dark in the children's gaze. Source: Children's drawings (2019).

As qualitative researchers seek a holistic and deep understanding of the topics under analysis (Denzin & Lincoln, 2011), students were challenged to import from the Design Thinking model the "Insight Clustering" technique as a way to stimulate the qualitative analysis and interpretation phase. Insight Clustering is connected to brainwriting, "it helps to move from a divergent phase to a convergent phase by categorizing ideas and, at the same time, checking if the idea generation has been flexible (which means with ideas in several directions and thematic areas)." (Tschimmel et al., 2016, p. 85). Insight Clustering was key to understand

what is behind the children drawing and, ultimately, to understand it (figure 1). Therein, students were asked to listen and look at the data from a more reflexive perspective, focusing their attention both in the textual and visual dimensions. Combining different elements and dimensions, Insight Clustering allowed to be attentive to the specificity of the children gaze over the dark of the night, and to overcome common sense and simplistic understandings opposing reality and fantasy. In fact, as Sarmento points out, in children's cultures, "the process of imagination of the real is foundational in the mode of intelligibility" (Sarmento, 2003, p. 16). Despite being frequently associated with negative feelings, such as fear, and scary figures – of which "monsters", "witches", "ghosts", "vampires", "zombies", "evil and murderers clowns", "pumpkins", "black holes", "skulls" or "spirits" were the most cited and visually depicted on the drawings – children also associate the dark of the night with "fun", "discovery", "curiosity" and "imagination". Moreover, data analysis unveils the presence of other beings, both human (namely, parents, grandparents and siblings), and non-human in the day/night transition, such as toys and peculiar objects (e.g. "a blanket", "a pillow", "a flashlight", the "television command", a "planet-shaped presence light", "a nightgown" or "stars and moons that glow in the dark". All these stimulate the children's imagination, presenting them with multiple colors, shapes, characters, sounds and various other sensory stimuli.

4. Conclusions

This paper explored the importance and value of incorporating Design Thinking in the teaching and learning process in the field of social sciences, namely when researching children and childhood from a sociological perspective. From the teacher perspective, Design Thinking allows to mobilize a set of tools granting to teach in a more plastic and intuitive way the social research methodologies, making them more attractive to students. From the students' perspective, the use of a different and new terminology seems to favor a positive and enthusiastic environment, refreshing the often barren field of social research methodology, thus making students more willing to engage in the learning process.

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A Problem-Based Learning Implementation to a Psychology Course in Higher Education

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Abstract

The present work describes a Problem-Based Learning (PBL) activity implemented in an undergraduate course of Psychology of Groups. Additionally, considering the findings on the effects of PBL on cognitive and motivational components, we also explored the effect of the PBL activity on students' information processing strategies and intrinsic motivation using a pre-post design. Only 28 students (25% men) completed the measures at both point times (pre and post-activity). Although no significant pre-post differences was found for any of the measured variables, the observed trend of change revealed mixed results. While for some cognitive strategies (e.g., critical thinking, information management, information transference) a trend towards improvement could be observed between the pre-post phases, for strategies of information elaboration and information acquisition the trend was reversed. Despite the non significant results, the present work contributes to the field of research on PBL in higher education by describing and testing the effects of a PBL activity implemented in a social discipline, a field in which PBL implementation is rather scarce.

Keywords: *Problem-based learning; higher educaction; psychology of groups; information processing.*

1. Introduction

To respond to the needs of a society characterized by globalization, high technological development and low employability, the Bolonia Plan (1999) raised as one of its key elements the modification and adaptation of the traditional teaching style and the promotion of student-centered learning. However, recent reports (EURYDICE, 2015) reveal that the change in the teaching paradigm is relatively difficult. In this sense, it might be helpful to promote the use of new teaching methodologies in the classroom such as active methodologies focused on learning (e.g., problem or project-based learning). Following a constructionist perspective, this type of methodologies conceptualizes learning as a process in which the student is the main protagonist and actively builds knowledge. Accordingly, in the present work, we examine the effect of the implementation of a problem-based learning (PBL) activity on students' cognitive strategies related to information processing in an undergraduate course of Psychology of Groups.

1.1. PBL studies

PBL is a teaching-learning strategy in which the student actively manages their learning under the supervision of the professor/instructor. In general terms, it seeks to stimulate the motivation of the students and their sense of responsibility regarding the learning process (Boronat, 2008). Working individually or in small groups, students identify and search for the information necessary to respond to a real-life problem or situation previously raised by the professor. The situation or problem is designed so that, specific knowledge objectives are achieved through its solution. PBL was found to be effective for both content knowledge acquisition and the achievement of a series of skills, attitudes and values necessary both in the professional field and in other life fields (Bradley-Levine & Mossier, 2014; Guo *et al*., 2020; Kokotsaki *et al*., 2016). For example, it has been found that PBL increased students' intrinsic motivation to learn (Lima, 2021; Ocak & Uluyol, 2010), improved students cognitive skills such as critical thinking, synthesizing, evaluating, predicting, reflecting and engaging in scientific exploratory tasks (e.g., Boubouka & Papanikolaou, 2013; ChanLin, 2008; Horan *et al*., 1996; Stefanou *et al*., 2013). The impact of PBL has been tested across educational levels, from elementary school to higher education. However, a recent review of the studies developed in higher education (Gou *et al*., 2021) emphasized that few studies (e.g., de Lima, 2021) have applied PBL in humanities and social sciences discipline. In this sense, our work contributes to the field of research on PBL in higher education by describing a PBL activity implemented in an undergraduate course of Psychology of Groups. Additionally, considering the findings on the effects of PBL on cognitive and motivational components, we will also explore the effect of the implemented PBL activity on student's strategies of information processing and intrinsic motivation.

1.2. Context and description of the implemented PBL activity

During a previous academic course, several difficulties were detected among students when it came to understanding the different stages of the research process. A large part of the students struggled with basic aspects such as the search and selection of bibliographic material, or the lecture, the analysis and the synthesis of the information provided in the research literature. To help students to overcome this type of difficulties and facilitate the acquisition and development of basic and transversal skills in both the academic field and in the general context, a learning activity was designed following the PBL premises. The activity was carried out with the six practice groups of the course Introduction to Psychology of Groups studied in the 2nd year of the degree in Psychology. Each group had approximatively 25 students, thus each practice groups was divided into 4 or 5 small working groups. The proposed practical activity asks students to participate in a fictitious competitive call for research projects of the Education Ministry. Students had to propose and develop a research project on a subject of free choice related to the theoretical contents contemplated in the first four units of the course. The activity was divided into three phases in which the students had to carry out different group and/or individual tasks to facilitate the achievement of the proposed objectives.

Phase 1. Reading and understanding of scientific literature

In this phase, three short activities were carried out oriented towards the detection of learning needs, and towards the reading, the analysis and the understanding of scientific literature (e.g., research articles, book chapters) related to the content of the course. Each activity had associated an evaluable virtual task. In the first session, the students were presented with a PBL activity and methodology. Subsequently, in groups of a maximum of 5 people, the students applied different group decision-making techniques (Brainstorming or Phillips 66), previously explained by the professors, to detect their learning needs. Specifically, they had to answer the question: *What do we need to know and know how to do to prepare a research report*? (e.g., perform database searches). At the end of the session, the needs detected by each group were shared. The virtual task consisted of creating an entry in the WIKI (online portfolio) of the group in which the students described how they carried out the group technique, the detected learning needs of their group, and the conclusions reached after the joint group discussion in class. The learning needs detected by the students and agreed upon in the joint discussion are summarized in the following 6 points: to choose a topic for your research, how to search and where to find information, how to read and understand the information found, how to organize the information found, how to write (vocabulary, style, format, etc.), how to work in a group. In the second session, the activity carried out aimed at facilitating the reading and understanding of scientific literature. Using a research article and a series of guide questions developed by the professors of the course, the students were explained how to detect the relevant information in a research article. To carry out the virtual

task linked to this activity, each group chose a research topic and searched for a research article on that topic. Subsequently, each group created a new entry in their WIKI and analyzed the article conjointly, answering the guide questions. In the third session, each group shared the analyzed article. Specifically, each group presented to the other groups the chosen topic and a summary of the analyzed article. Furthermore, the difficulties encountered during the search and analysis process were shared, and an exchange of ideas between the groups took place to guide and provide possible solutions to the difficulties encountered. The virtual task consisted of the analysis performed by each group member of a research article related to the group's research topic following the guide questions.

Phase 2. Preparation and writing of the introduction of a research report

This phase included learning how to build, to structure and to write the introduction of a research report. In the fourth session, the students were explained different techniques for preparing a theoretical introduction, as well as the basic rules of the APA style. In the fifth session, the articles analyzed by each group were shared, briefly explaining how they planned to structure the information considering the criterion of theoretical coherence, as well as expressing the difficulties encountered in the process. Each group received feedback from both the professor and the members of the other groups. Both sessions were associated with a single virtual task that consisted of preparing and delivering a draft of the introduction.

Phase 3. Defense of the research project

The activity associated with this phase consisted of the public presentation of the research project in a free choice format (slides, poster, video, story-telling, role-play, etc.). The professors reminded students that the financing of their project depended in equal measure on the theoretical content as on their public defense thus, the presentation should be convincing, creative and original. The defense of the projects was carried out in two sessions (sessions 6 and 7). In each session, 2 to 4 groups presented their projects. The viewer groups evaluated the presenting groups and pose at least one question to each of the exhibiting groups. The questions asked by the classmates and the teacher constitute the feedback about those parts of the work that need improvement. The evaluation criteria for the presentations have been developed and provided to the students by the teachers. After the defense of the projects, the groups had a period of 10 days to prepare the final deliverable of the research project proposal (theoretical review on the chosen topic and objectives and research hypotheses from the reviewed literature).

2. Method

2.1. Participants

Only 23 students (25% men) completed the questionnaire at both time points (pre and post activity).

2.2. Measures

Students' intrinsic motivation, knowledge about search and bibliographic resources, strategies of selection, elaboration, acquisition, organization, management and transference of information and critical thinking were assessed. All measures used a seven-points response scale ranging from 1 (*totally disagree*) to 7 (*totally agree*) and were extracted from the CEVEAPEU questionnaire (Gargallo *et al*., 2009).

3. Results

The results of paired sample *t* test revealed no significant differences between the pre-post measurements of the assessed variables (Table 1).

Table 1. Pre-post differences for the measured variables.

		Mean	SD	t	df	Sig (bilateral)
Intrinsic motivation	Pre	5.99	0.92	0.216	22	0.831
	Post	5.96	0.79			
Knowledge of search resources and bibliographic resources	Pre	5.00	1.06	-1.453	22	0.16
	Post	5.26	1.12			
Information selection	Pre	4.89	1.01	-0.355	22	0.726
	Post	4.93	1.03			
Information elaboration	Pre	5.88	0.78	1.686	22	0.106
	Post	5.63	0.93			
Information acquisition	Pre	4.94	0.97	1.786	22	0.088
	Post	4.57	1.13			
Information organization	Pre	4.90	1.51	0.047	22	0.963
	Post	4.89	1.56			
Critical thinking	Pre	5.30	0.99	-0.891	22	0.383
	Post	5.45	1.13			
Effective management of information	Pre	5.02	1.27	-0.689	22	0.498
	Post	5.17	1.02			
Transference of information	Pre	5.84	0.72	-0.877	22	0.39
	Post	5.94	0.86			

4. Discussion

The aim of this study was to describe a PBL activity implemented in an undergraduate course of Psychology of Groups and to examine its effects on student's strategies of information processing and intrinsic motivation. The activity was implemented to help students to overcome the difficulties encountered when they are confronted with distinct phases of the research process. Specifically, we focused on the improvement of students' strategies of information search, selection and processing. The results indicated that the PBL activity did not affect significantly the measured variables. Interestingly, while for some cognitive strategies (e.g., critical thinking, information management, information transference) a trend towards improvement could be observed between the pre-post phases, for strategies of information elaboration and information acquisition the trend was reversed. It seems that the PBL activity impacted negatively on students' self-perception regarding their ability to acquire and elaborate information. Indeed Boubouka & Papanikolaou (2013) informed of mixed effects of PBL; the effect was not significant on student achievement, but significant and positive on self-perceived learning performance. Likewise, Schaffer et al. (2012) found that although the PBL increased students' self-efficacy, for others the PBL decreased it. The lack of significance of the results could be due to the small size of the sample. Likewise, it should be mentioned that the participation of the students has been voluntary and no type of reward has been provided (e.g., obtain an extra score). Furthermore, a closer look at the scores of intrinsic motivation suggests that our participants might have been the students with a higher interest and motivation in carrying out academic activities. Their interest and motivation could be associated with a constant level of dedication to academic tasks, which could explain the lack of variation in our results.

Finally, some aspects that need be improved have been detected, based on the feedback of the students and the observations of the professor. First, the students were allowed to freely decide the topic to investigate as long as it was related to the content of one of the first four units of the course. The election of the research topic was the first challenge for the students because, at that specific time, the students did not know the content of all the units. On the other hand, the wide range of topics to be investigated has also made this election difficult, even when counting with the teacher's guidance. Future modifications to the PBL activity should contemplate providing the students with more concrete information and fewer election options during this initial phase to facilitate the election of the research topic.

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Evaluation and improvements regarding the implementation of Project-Based Learning within the Innovative Development program

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Abstract

This research evaluates how Project-Based Learning (PBL) is implemented in the Innovative Development program that is taught at The Hague University of Applied Sciences. This paper offers insights about the way students and instructors experience PBL within this program, and how the implementation can be improved according to previous research in this field. By studying relevant literature, a list of important (organizational and didactical) factors regarding the implementation of PBL is created. Questionnaires investigating these factors are then circulated among the instructors and students of the program. The results of the questionnaires are analyzed against guidelines provided in the literature. Based on this comparison, recommendations for the improvement of the PBL approach within the program are provided.

The analysis shows that the program offers meaningful projects, and the students are properly prepared to collaborate. Nevertheless, the analysis also shows that the program still has room for improvement. The assessment methods are still unrefined, the students experience time-pressure while working on their projects, and the instructors can benefit from additional training to be better prepared for teaching in a PBL environment. Fortunately, the instructors indicate willingness to learn new PBL specific teaching skills.

Keywords: *PBL; project-based learning; organizational and didactical factors.*

1. Introduction

1.1. Project-Based Learning

Project-Based Learning (PBL) is a learning method that motivates learners to gain knowledge and skills through working on real-life projects (Krajcik & Blumenfeld, 2006). In this method there are neither scheduled lectures, nor theoretical exams. Students choose a project that is personally meaningful to them and work on it for an extended period of time (Krajcik & Blumenfeld, 2006).

Research shows the effect of PBL on the following eight life skills: responsibility, problem solving, self-direction, communication, creativity, time management, collaboration and work-ethic (Helle, Tynjala,& Olkinuora, 2006). Students who followed a 16-week PBL course for an experiment by Wurdinger and Qureshi (2015) showed improvement on five out of these eight skills. When PBL is successfully executed, students feel involved and motivated. By producing complex and high-quality work, this increases their learning motivation (Sumarni, 2015). Aside from causing a high intrinsic motivation, PBL is also said to cause high levels of student engagement. Whilst students work on their projects, they have to solve problems that come up during the process. This causes students to experience freedom and challenges, resulting in high levels of student engagement (Wurdinger, Haar, Hugg, & Bezon, 2007).

Even though PBL is widely encouraged, Holubova (2008) points out that there are also some disadvantages to the method. They describe that not all instructors are qualified to teach the way PBL needs to be taught. Another disadvantage is the lack of evidence-based instructional strategies that describe which facets of project-based learning are important for particular kinds of outcomes, so that educators can make informed choices in adapting project-based learning to their particular contexts (Holubova, 2008). Different sources offer discussion points regarding necessary improvements in PBL. Helle et al. (2006) state that there needs to be more theoretically grounded research about PBL. There should be a clearer definition of the goals within the curriculum, and the congruence between stated goals and the activity of the students should be more engaged and clearer (Helle et al., 2006). A great obstacle within PBL is the assessment. There are no clear guidelines about the way assessments should be graded and who should do the assessing. As a whole, the curriculum of PBL is difficult to optimize. The purpose of PBL is still vaguely defined and some organizational and didactical factors remain vague for both instructors and students.

1.2. The innovative development program

Innovative Development (ID) is one of the five programs within the ICT bachelor's degree that is taught at The Hague University of Applied Sciences (THUAS). The ID program employs a PBL approach wich offers freedom and flexibility. The students work on a new

project every semester for 18 weeks. Every student decides what project they want to work on. Students can come up with their own projects or choose from a list of projects offered by externl entities such as companies. The students who choose the same project are placed in a group. Every group is assigned to an instructor who supports them throughout the entire project. To guide their learning, there is a list of competences that require certain knowledge and skills to be achieved. In this so called 'competence tree', the competences are specified and divided into proficiency levels. For every project, the students decide which of these competences fit their project. The students and instructors regularly meet in progress appointments, where the students have to prove that they have gained enough knowledge and skills to achieve a certain proficiency level of the chosen competences.

1.3. Methodology

This research evaluates the way PBL is being implemented within ID and recommends ways to improve the implementation. To do so, desk research is performed to identify the organizational and didactical factors important for implementing PBL. Questionnaires based on these factors are sent out to the students and instructors of ID. The results of the questionnaires are compared to recommendations in the literature about how PBL should be implemented. Finally, a list of recommendations for improvements is provided.

2. Methodology

2.1. Didactical and organizational factors

We start by exploring the literature for ways to measures the organizational and didactical factors that are relevant for a proper implementation of PBL. The result is a list of important factors regarding these concepts, which are repeatedly mentioned in earlier research. This list includes the following factors: meaningful projects, element of choice, group work, guided inquiry, instructor support, assessment, and the competence of instructors.

2.2. Measuring instruments

Based on the above mentioned factors, two questionnaires are constructed. One questionnaire aimed at the Students while the other targeted the instructors. Both questionnaires focus on the same factors, but the questions are formulated differently to fit relevant situations for both students and instructors. To explore how the program is being taught, the questionnaires consist of open questions. This helps to gain interesting insights in the process. For example, about instructor support, to not only find out whether the students experience instructor support, but also in what ways they do so.

3. Results

To describe the results, the data gathered from the questionnaires is analyzed by applying the grounded theory approach. By doing this, the answers are reduced to labels that can be categorized. These labels show how PBL is being implemented in ID and what opinion instructors and students have on this implementation. This chapter describes how the important organizational and didactical factors (discussed in Section 2.1) are implemented in ID based on the answered questionnaires.

3.1. Meaningful projects and an element of choice

3.1.1. The current implementation in ID

The first step in a PBL cycle is for the students to decide what project they will work on. When the instructors collect projects for the students to choose from, they look for several qualities. First, it has to be a real project that comes from a real owner. The collaboration with the owner is important throughout the entire project, so the project owner has to be willing to actively collaborate for a period of 18 weeks. Second, the project has to be challenging and flexible.

3.1.2. Student experience

The students expressed satisfaction with the projects they are offered, saying that they are meaningful and interesting for them. All students who answered the questionnaire agreed that they are free to choose what project they want to work on and can even propose their own project ideas.

3.2. Group work

3.2.1. The current implementation in ID

The students are placed into project groups, based on the project they have chosen. In the first year of ID, the students get training for the collaboration skills that they will need for the remainder of the program. Students learn how to make team agreements, give proper feedback, and receive feedback. Every project cycle of 18 weeks is divided into so called ‘sprints’ of three weeks. At the beginning of a sprint, the groups make a list of the goals they have for that period. The project groups keep track of their tasks and progress using a Scrum board, on which they organize what they have to do, what they are currently doing and finally what is done. This method doubles as a progress log, since the board shows exactly what tasks have been done within a sprint. At the end of a sprint, the project groups evaluate the progress, reflect on how the sprint went, and prepare for the next sprint.

3.2.2. Student experience

Students often have to change their approach after a sprint, the main reason for this being a lack of time. Most of the students said they experience time-pressure when working on a project. Some students mentioned that using a Scrum board supports them in helping each other, because they can easily see what tasks need to be worked on.

3.3. Guided inquiry and instructor support

3.3.1. The current implementation in ID

Every school day is commenced with a 'daily start', where announcements are made and students get the opportunity to ask questions. Every instructor is assigned to two to four project groups, as well as to approximately 10 students for individual support. project groups have regular appointments with their assigned instructor. In these meetings, the instructors coach the groups, look at their planning and keep track of the competences they are working on at that moment. In an individual meeting, the students and instructors focus mainly on the students' role in their project groups and on their study progress.

3.3.2. Student experience

The students are satisfied with the contact with their instructors, saying they can easily reach out to an instructor to arrange an extra meeting or a lecture on a certain topic. Some students have pointed out that they would appreciate more personal guidance, while others are content with the way that this is currently organized.

3.4 Assessment

3.4.1. The current implementation in ID

The students receive a grade based on their progress during a project. At the end of a project cycle, the instructors also decide whether the students has achieved the required proficiency level of the competence they have worked on.

3.4.2. Student and instructor experience

Both the instructors and students pointed out that the assessing and grading remains unclear within ID. The instructors said that it is clear to the groups what the focus points of the assessment will be. The students, however, said they are often uncertain of the way the assessment will be performed and what exactly will be assessed.

3.5. Instructors' competence

3.5.1. The current implementation in ID

To get prepared for teaching in a PBL environment, an instructor noted that he performed observations in a program that was already implementing PBL and read into the literature. All of the instructors who answered the questionnaire are willing to learn more about PBL, to improve their teaching approach in the program.

3.5.2. Student experience

There were no complaints from the students about the competence of the instructors.

4. Analyzing results based on the PBL factors

The previous section contains the results of the questionnaires, showing the way PBL is currently implemented in ID. When comparing the way the important factors are being described in previous research, and the way they are being implemented in ID, there are some noticeable differences. This section analyses the results described in Section 3, based on the recommendations in the literature. This analysis, along with the student and instructor suggestions, give insights on how the implementation of PBL can be improved within ID.

4.1. Meaningful projects and an element of choice

It seems like the instructors put effort in finding meaningful projects and succeed while doing this. The students who answered the questionnaire agree that the projects are personally meaningful to them. They also get to decide exactly what project they would like to work on, which proves there is a certain element of choice within the program. According to Lam, Wing-yi Cheng and Ma (2009), a meaningful and challenging project highly increases students' motivation.

4.2. Group work

Sumarni (2015) describes the necessity of teaching students how to interact in a group and manage conflict within the group, when they do not have experience with working in groups. The students' satisfaction with the collaboration within their groups, could be caused by the attention that is paid to collaboration skills in the first semester of the program.

The project groups are formed based on the project the students decide to work on. To positively influence the collaboration within the groups, instructors could also take the individual students' skills into consideration. According to Sumarni (2015), instructors should combine students with opposite competences to make groups that support and help each other.

All students who answered the questionnaire say that they experience some level of time-pressure. By including time-management in the list of skills the students work on in the first semester, the time-pressure that the students experience while working on a project may possibly be lowered.

4.3. Guided inquiry, instructor support and assessment

The students do not have a clear vision of the way their project will be assessed, when they start working on a new project. This could be improved by the students and instructors clearly writing down agreements regarding the assessment, so both know what to expect. Helle et al. (2006) mention that given PBL's independent character (student's initiative, self-regulation, self-reflection), self-assessment should be a part of assessment. Including this in the final assessment, can improve the overall assessment process.

Students also point out that some of the lectures they requested, on broad research topics, can be of interest for multiple groups. They suggest that there could be a small, optional, course scheduled about these topics.

Finally, several students mentioned they would appreciate guidance on a more personal level. It is highly recommended to focus on the teacher-student relationship as much as possible, to help the students stay motivated (Sumarni, W., 2015). There are also students who are not at all interested in this type of personal guidance. By offering optional student- instructor sessions, the instructors could possibly respond to the individual students' needs.

4.4. Instructors' competence

According to Sumarni (2015), the transition from a traditional classroom to a PBL environment can be difficult for both experienced and novice instructors. To increase the instructors' skills, Sumarni recommends developing a learning program for instructors that is based on the PBL approach. This could be valuable to both the current instructors, who have said to be willing to learn more about PBL, as well as to future instructors joining ID.

5. Conclusions and recommendations

5.1. Conclusions

This research explored how the implementation of PBL can be improved within THUAS' ID program. To answer this question, the ID implementation was analysed against the most important PBL factors in the literature. The analysis of the results reveals some positive points within the current implementation of PBL. The most notable positive points are:

- Choosing meaningful projects;
- students' collaboration skills;

- instructors' flexibility and will to learn more about PBL.

In contrast, the analysis also shows negatives in need of improvements. These are:

- More attention to time-management skills;
- clarity regarding assessment;
- possibilities for more personal guidance;
- improving instructors' skills regarding the PBL approach.

5.2. Recommendations

Further research should focus on applying structure within the ID program. Besides that, the assessment method needs improvement. This issue, however, is a recurring factor in most of the literature available on PBL. There is no standard assessment method that can be applied to every project.

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How flipped classroom teaching methods in first year studying succeed

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Abstract

Flipping the classroom is a method to let students study on their own and then take time to discuss their questions and do extended hands-on lectures or exercises in class – or in the case of the covid-19 pandemic during plenary online sessions. First year mechanical engineering students use different teaching materials (mainly lecture videos, lightboard videos and micro-module lectures) to study from a distance and comprehend the principle underlying science in theory. Then the online plenary lectures offer the opportunity to apply their knowledge and transfer different scientific aspects of the course to get the bigger picture. Exercises, worked solutions, self-assessed tests and peer-instruction during present time help students to check on their learning progress. However, the self-study periods and (online) plenary sessions need to be guided carefully. To meet the course learning outcome and overcome the diversity of a first year class various practical leads have to be fulfilled to turn flipped classroom teaching into success.

Keywords: *Inverted classroom; flipped classroom; online teaching; lecture videos; first year students; material science.*

1. Introduction

Diversity of learning history, social aspects hindering full time studying, job commitment and deficient preparation from highschool are some of multiple aspects to challenge lecturer in higher education first year classes. Often lecturer face a number of students only interested in passing rather than learning about the important basics required to pass consecutive classes, the second semester or compulsive laboratory courses. Flipping the classroom: Berret (2012), Brame (2015), Fischer and Spannagel (2012), Braun *et al*. (2012), Seteren *et al*. (2019), Pfennig (2019, Pfennig (2020) seemed to be the appropriate medium to gain student`s attention, motivate them right from the start to continuously study and acquire good exam results assuring each to easily pass the graded exam the second semester: Pfennig: (2016).

The flipped classroom constitutes a role change for instructors, who give up their front-of-the-class position in favour of a more collaborative and cooperative contribution to the teaching process. …The flipped model puts more of the responsibility for learning on the shoulders of students…. Activities can be student-led, and communication among students can become the determining dynamic of a session devoted to learning through hands-on work. What the flip does particularly well is to bring about a distinctive shift in priorities—from merely covering material to working toward mastery of it: Educause (2016)

The principle of flipping the classroom requires students to study the science on their own without time limit and then take time to raise questions and discuss details, solve hands-on problems, perform group work and master difficult problems in class. Because the method clearly enables students to discuss early and communicate in equal measure: Pfennig (2016), Pfennig (2018) Material Science at HTW Berlin, Germany is taught based via “design-led” teaching approach: Ashby et al. (2013) including flipped classroom teaching scenarios.

Although Setren *et al*. (2019) report success for the flipped classroom teaching method only for MINT courses neglecting progress for economic related teaching Gulley *et al*. (2016) state that the understanding and retention of course material was improved along with effective use of time in class. Generally, students are given more responsibility for their learning progress during the semester which was found to encourage critical thinking: CSU (2015), Lord (2012) and results in deeper learning outcomes: Goto and Schneider (2010), Simon *et al*. (2010). Additionally, inverting the classroom has a positive effect on self-efficacy beliefs and intrinsic motivation: Thai *et al*. (2017).

With the covid-19 pandemic and the need to transfer face-to-face time into online-sessions, however, the self-study periods and (online) plenary sessions need to be adapted carefully. This paper shares the most important (and sometimes astonishing) insights of 7 years inverted classroom teaching along with praxis examples from an introductory material science course.

2. Practical leads for inverted classroom teaching

The Material Science course introduced earlier: Pfennig (2018), Pfennig (2019), Pfennig (2020) offers cumulative assessment of micro-modules and therefore a manageable work load for approximately 45-70 students per semesster – especially in a fully online teaching environment, such as summer and winter semester 2020/2021 (37/68 students). Students may individually chose, combine and study from alone or in study groups from a distance. Exercises, worked solutions, self-assessed tests and peer-instruction during present time help students to check on their learning progress. To meet the course learning outcome and overcome the diversity of a first year class many practical leads have to be fulfilled to turn flipped classroom teaching into success. The author refers to success in accordance to formative assessment: Pfennig (2018/1) including formative assessment such as detailed questionnaires, tests, quizzes etc. as well as to evaluations throughout and at the end of the semesters as well as discussions with collegues teaching teaching advances courses such as design or manufacturing engineering. Out of 20 the author will introduce her 7 main practical leads for succeeding in a blended learning and fully online learning environment:

2.1. Start with low threshold tasks when assessing the first flipped classroom lecture

To secure students that they have studied well and motivate everyone right from the beginning we have made very good experience with low threshold first problems. These can be of scientific depth, but also be used to get acquainted with the organization of the CMS (content management system), where to find content, how to upload files, how to find group members and where to find the personal course credits.

Example Material Science: In material science it is very important to know microstructures because they explain e.g. mechanical and thermal properties of engineering materials. Students worked on short lectures showing many different pictures of microstructures and had to put them in order as an “end-of-the-lecture” quiz. Everyone scored fully! Online sessions were used to match components with known microstructures and properties and ranked according to memory cards in break-out sessions.

2.2. Close guidance of self-study period is highly advised

Self-study periods have to be guided to achieve a positive learning outcome. That is: lectures need to be assigned precisely, Tasks and quizzes explained, lecture videos have to have an overall research/learning question and guided by self-assessing questions (figure 1, which may then be used to assess the course formally in a second step). Assigning pages in pdfs, lectures or papers to prepare for the next (online) meeting runs the very likable risk of students remaining unprepared or with insufficient background knowledge. Also, students are insecure of what to prepare and if they study “the right” content – especially first semester students.

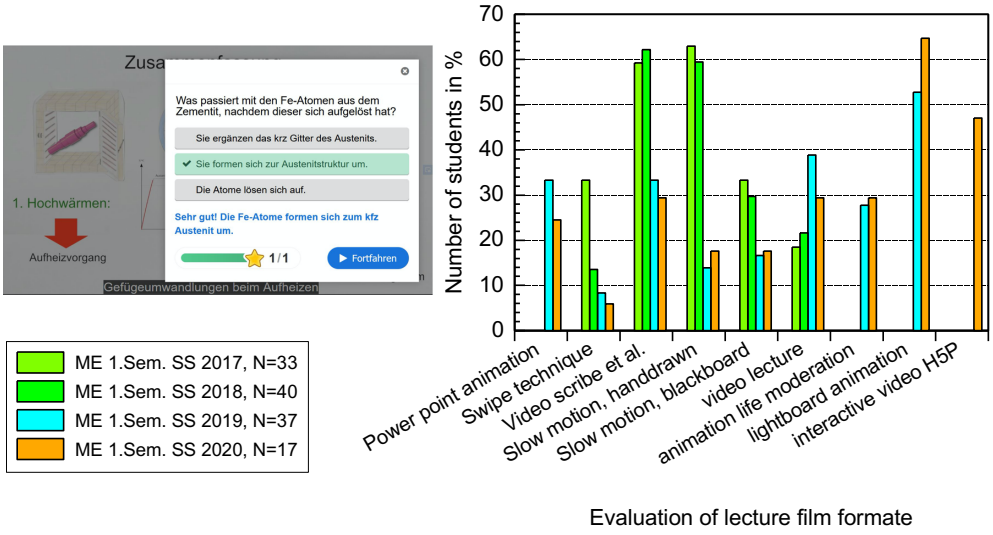

Figure 1. Evaluation of lecture video format and example of a H5P interactive lecture video with subtitles.

Example Material Science: We provide around 80 peer-to-peer reviewed lecture videos: Pfennig (2018), Pfennig (2019) (*https://www.youtube.com/user/cutsandtalks*). However, these are converted into H5P interactive lecture videos (*https://h5p.org/*) with various multiple choice content questions throughout the video. Also subtitles are added to give students both opportunities: reading and listening while watching. The learning output is much higher and "joy of use" greater according to students` feedback (figure 1).

2.3. The learning outcome was more successful in homogeneous study groups (break-out sessions)

Although heterogeneous groups are stated many times before to be more successful than homogeneous study groups this did not account for the face-to-face (online) sessions when flipping the classroom. For every student to meet the minimum course requirement there was no use if they were part of a group with one or two students solving all problems without the chance of understanding or trying out for the solution themselves. It was necessary for students to understand that the flipped classroom teaching model does not require mastering the scientific content but having the idea what the meaning of the self-study content is and to integrate their (half) knowledge in hand-on problem solving. Errors most likely lead to deeper understanding. Note, that these finding are clearly of subjective teaching experience of the author and might not agree with other lecturers in higher education or other findings/studies. This is a well-acknoledges statement to be critically discussed in future.

Example Material Science: Here: phase diagrams: Pfennig (2018/2). During regular and online semester students are asked to group themselves according to depth of understanding.

The lecturer explains in detail why this grouping is important to admit insecurity or shaming, mobbing or even resigning from the (online) session. Generally, this has not been a problem since 2015! In contrast, students were rather thankful to either be challenged or get the chance of working in their own study tempo, be guided and have the chance of asking questions without the full audience. This flipped classroom teaching session succeeded in present: Pfennig (2018/2) and also online (break-out sessions) in 2020/2021.

2.4. Learning outcome, assessment and workload should be clear from the beginning and transparent throughout the entire semester

Fairness and transparency are one of the most important issues to enhance self-instructed learning as indispensable principle of the flipped classroom method. Students need to know about their study progress and grading. Fading study motivation is the most acknowledged reason for early drop out of first year students. If everyone knows exactly what he/she is aiming at (in terms of passing and assessment) study motivation is high for every student to reach the personal course objective.

Example Material Science: Weekly assignments provide a timeline with deadlines, percentage of grading for each activity (figure 2), requirements for the week and certain tasks along with classification in the holistic course setting in a Moodle course. Alerts and messages remind students of not yet compiled work. Since 2016 no first year student failed material science (note, the overall grading did not significantly improve over the traditional course assessment via final exam: Pfennig (2020) and Pfennig (2018).

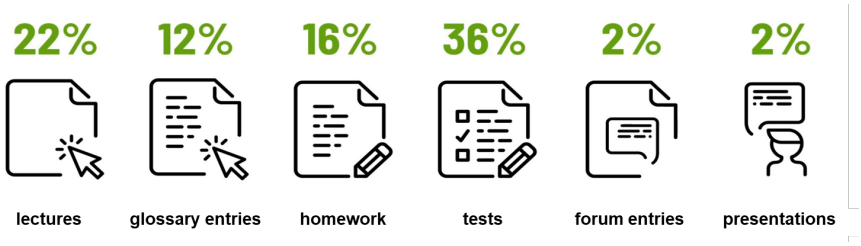

Figure 2. Transparent grading of the cumulative course assessment.

2.5. Organize the CMS (content management system) formally not according to content. Alternatively use the weekly solution

Student feedback clearly demanded to organize the learning contents in the Moodle course according to the format of the learning material rather than learning history or content. It seems to be much easier for students to navigate a complex CMS if the activities are in order of format (even if the lecturer wanted to provide a smooth learning guidance along the various activities. Alternatively, the weekly course format may be chosen from the CMS offering the same close guidance as the format structuring does.

Example Material Science: Top of the Moodle course are assessed activities, weekly assignments, compilation of lecture films and compilation of lightboard lectures. Every theme is set up following the same protocol: interactive links (to various additional teaching material, such as mind maps, scripts, PPT, etc.), micro-lectures, problems with worked solutions, lecture videos, interactive videos and tests (figure 3).

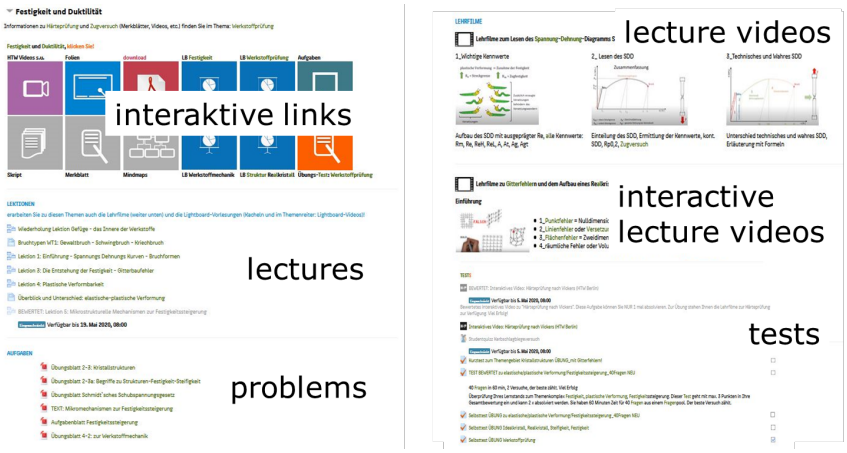

Figure 3. Organization of the Moodle course according to format – not content.

2.6. Use templates to summarize the learning outcome of each study session

When students work in micro groups appreciation and evaluation of their efforts and results need to be given directly in order to conclude a flipped classroom session successfully. Also, results from different groups may be compiled easily and provided easily for the entire class – after careful revision by both - lecturer and plenum.

Example Material Science: Usually, during face-to-face (online) time students work on solutions or presentation of (study) results following a strict template combining: the problem, the solution (written or graphical), transfer to mechanical engineering and difficulties. These “filled- in templates” are then distributed digitally for the entire course after presentation and content/graphic revision.

2.7. Do not use online-sessions for content transfer. Solving problems, discussions and hands-on projects are much more effective

When lecturers repeat the scientific content from the self-study period weak students or students who did not study at all do not feel the need to study by themselves. Hence, they are constantly unprepared and fall behind the course objective fast. On the other hand willing and high performing students feel betrayed because their work and effort is not acknowledged. Solutions may be classroom response where the lecturer has the possibility

to explain details according to the answers, especially the distractors. Offering the students time for Q&A is another approach to give knowledge input without lecturing. It is recommended to use the (online) face-to-face time for transfer and worked problems.

Example Material Science: In general, each plenary session (online or face to face) starts with classroom response (*invote, flinga, mentimeter, kahoot,* etc.) accompanied by students asking questions that are answered by the plenum and lecturer. Then students deal with theoretical or hands-on problems presented and discussed in class (these could even be hand-made models made from aluminum foil and toothpicks! practicing and visualizing 3-D imagination of lattice structures). Therefore, one students (voluntarily) takes notes for everybody and two students facilitate the discussion, with the lecturer staying behind. Templates of the different results (written or pictures) wrap up the particular session.

3. Conclusion

Flipping the classroom challenges lecturers but it also offers a profound solution to achieve a more homogenous learning outcome. Students may individually choose, combine and study from alone or in study groups from a distance. To meet the course learning outcome and overcome the diversity of a first year class the author shares her 7 main practical leads to succeed (online) in the flipped classroom teaching method:

1. Start with low threshold tasks when assessing the first flipped classroom lecture.
2. Close guidance of students` self-study period is highly advised.
3. The learning outcome is more successful in homogeneous study groups.
4. Transparency of learning outcome, assessment and workload right to begin.
5. Organize the online course formally (not content). Alternative: arrange by the week.
6. Use templates to summarize the learning outcome of each study session.
7. Use (online) face-time for interacting hands-on problems not content transfer only.

These practical leads are based on individual teaching experience of the author and might not be in agreement with other studies or lecturer experiences (especially study groups is a sensitive topic). All of these leads will be of close survey in future classes and critically discussed throught future semesters.

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Teaching experience: Inequalities in prices of drugs to fight against COVID-19

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Abstract

As the Sars-CoV2 pandemic continues to grow, researchers around the world are urgently seeking new treatments to prevent infection, cure those infected, or lessen the severity of the disease. Although there are several recently approved vaccines, clinical trials are underway to "re-use" drugs normally indicated for other diseases. This teaching experience studies the market for 8 pharmaceutical products used to fight the pandemic (remdesivir, favipiravir, lopinavir/ritonavir, chloroquine, hydroxychloroquine, sofosbuvir, pyrfenidone and tocilizumab) in 13 countries (Bangladesh, Brazil, China, Egypt, France, India, Malaysia, Pakistan, South Africa, Sweden, Turkey, United Kingdom and United States). Through the analysis of prices and costs, we reflect on the difficulty of access to treatment according to the country.The objective is to deepen knowledge of the pharmaceutical market: (i) to demonstrate in a tangible way the differences between production costs and final prices of medicines, (ii) to perceive the difficulty of access to certain treatments depending on the country, (iii) to reflect on what initiatives should be implemented in an international emergency context such as the one we are experiencing.

Keywords: *Covid-19; drugs; pharmaceutical market; prices; costs.*

1. Introduction

As the Sars-CoV2 pandemic continues to grow, researchers around the world are urgently seeking new treatments to prevent infection, cure those infected, or lessen the severity of the disease. As of 9 January 2021, 87.5 million cases have been confirmed and 1.9 million people have died. Although there are several recently approved vaccines, clinical trials are underway to "re-use" drugs normally indicated for other diseases (Li and LeClercq, 2020). The shorter development time and reduced costs of using existing compounds are particularly advantageous compared to the discovery of new drugs in a pandemic situation, where time is of the essence.

Antiviral drugs include the nucleotide analogue remdesivir, which was previously used experimentally but without success against Ebola (Siegal et al, 2017), favipiravir, used to treat influenza (Hayden and Shindo, 2019), the HIV protease inhibitor lopinavir/ritonavir (Cao et al., 2020), the antimalarials chloroquine and hydroxychloroquine (Yao et al., 2020), and the direct-acting antivirals sofosbuvir and daclatasvir (IRCT, 2020). In addition, treatments to improve lung function and reduce inflammation, such as pyrfenidone (WIPO, 2017) and tocilizumab (ClinicalTrials.gov, 2020), are being evaluated in clinical trials.

Most of the clinical trials reported so far are small pilot studies, often non-randomised, making interpretation of the current evidence difficult. If the results of these new trials are favourable, there is a possibility of rapidly increasing the production of the most promising drugs. Low- and middle-income countries will need access to these treatments at minimum prices to ensure that all who need them can be treated. Even in high-income countries, the disease burden could be so great that access to medicines at minimal cost may also be necessary. The HIV epidemic has been controlled by mass treatment with antiretroviral drugs around the world at very low unit cost. Large donor organizations, such as the Global Fund to Fight Immunodeficiency, Tuberculosis and Malaria and the United States President's Emergency Plan for Immunodeficiency Relief, are ordering drugs to treat more than 20 million people with HIV, at prices close to the cost of production (PEPFAR, 2019; The Global Fund, 2020). This system enables low- and middle-income countries to access high-quality drugs at affordable prices.

This educational project is designed for students in Economics, Business Administration, Political Science and Sociology. The objective is to deepen knowledge of the pharmaceutical market: (i) to demonstrate in a tangible way the differences between production costs and final prices of medicines, (ii) to perceive the difficulty of access to certain treatments depending on the country, (iii) to reflect on what initiatives should be implemented in an international emergency context such as the one we are experiencing. This will be done by consulting statistical bases and reading support documents on the structure of the

pharmaceutical market. It is better to develop this practice in small groups and then share it in order to favour "withing groups" and "between groups" interactions.

2. Preparation of price and cost information

The minimum production costs of medicines can be estimated by calculating the cost of active pharmaceutical ingredients, which is combined with the costs of excipients, formulation, packaging and a profit margin to estimate the price of the 'finished product', i.e. the ready-to-use medicine (Hill et al., 2018). Table 1 shows, for each drug, the duration of treatment and the number of doses to be administered each day, the daily cost of treatment and the total cost.

Table 1. Characteristics of each drug. Daily cost and total cost.

	Length of the treament	Daily doses	Total treatment cost ($)	Daily cost ($)
Remdesivir	10 days	2 the 1st day; 1 other days	9	0,93
Favipiravir	14 days	2 per day	20	1,45
Lopinavir	14 days	2 per day	4	0,28
Hidroxcicloroquina	14 days	1 per day	1	0,08
Cloroquina	14 days	1 per day	0,3	0,02
Azitromicina	14 days	1 per day	1,4	0,2
Sofosvubir	14 days	1 per day	5	0,39
Pirfenidone	28 days	3 per day	31	1,09
Tocilizumab	-	2	177,5	355

Source: Own work using data from Hill et al. (2020). For Tocilizumab the table has been completed using information from Table 1, Cost-Comparison Table for Biologic Disease-Modifying Drugs for Rheumatoid Arthritis - Tocilizumab (Actemra) - NCBI Bookshelf (nih.gov).

Price information was obtained through published lists for each medicine in a number of countries (Bangladesh, Brazil, China, Egypt, France, India, Malaysia, Pakistan, South Africa, Sweden, Turkey, United Kingdom and United States) to provide a representative sample of prices in countries with different levels of economic development, although all the medicines analysed in this study are available in the selected countries. Where more than one price was available for the same medicine, the lowest price was chosen. Table 2 shows the price of full treatment for each drug and country.

Table 2. Price for complete COVID-19 treatment ($).

	Remdesivir	Favipiravir	Lopinavir	Hidroxcicloroquina	Cloroquina	Azitromicina	Sofosvubir	Pirfenidone	Tocilizumab
Bangladesh	600	-	-	3	0,2	5	168	124	690
Brazil	600	-	-	-	-	19	4289	-	-
China	600	231	17	19	5	7	-	1379	1.950
Egypt	600	-	-	-	-	-	-	-	606
United States	3.120	-	503	18	93	63	18610	9.606	3.383
France	2.340	-	97	5	-	44	-	2.344	-
India	600	112,8	40	2	1	5	7	100	806
Malasya	600	-	-	7	2	11	-	-	-
Pakistan	600	-	-	-	-	-	6	-	510
United Kingdom	2.340	-	144	4	8	11	7832	2.561	914
South Africa	600	-	15	-	5	35	-	2.490	566
Sweden	2.340	-	172	3	4	16	-	2.196	-
Turkey	600	-	149	3	-	-	-	1.499	650

Source: Hill *et al.* (2020). For remdesivir and favipiravir, information has been completed using Remdesivir developed country price announced | Medicines Law & Policy (medicineslawandpolicy.org) y India's Glenmark cuts price of COVID-19 drug favipiravir version to $1 per tablet | Reuters. Price for treatment with remdesivir was 600$ in developing countries, 2.340$ in developed countries and 3.120 in United States.

3. Content of the practice

The practice begins with the reading of two documents: "Patents, price regulation and innovation in the pharmaceutical industry" and "Drug price differentials across different retail market settings", both available on the internet (see references). After this reading, the following introductory questions are posed:

1. What special characteristics differentiate medicines from other goods?
2. What type of market do you consider to be the pharmaceutical market?
3. Does it share characteristics with a market of perfect competition? Given your answer to this question, do you consider that there may be a market failure in the pharmaceutical market?
4. What are the advantages and disadvantages of pharmaceutical patents?
5. Do you consider that the knowledge on which new pharmaceutical products are based is a public good?
6. With the information in tables 1 and 2, a series of exercises are proposed.

Exercise 1: Calculate the average price and standard deviation for each drug. What do you notice?

Table 3. Mean and standard deviation for each complete treatment for COVID-19.

	Remdesivir	Favipiravir	Lopinavir	Hidroxicloroquina	Cloroquina	Azitromicina	Sofosvubir	Pirfenidone	Tocilizumab
Mean	1,195.38	171.90	142.13	7.11	14.78	21.60	5,152.00	2,477.67	1,119.44
SD	949.78	68.92	140.72	6.40	25.35	19.36	5,420.58	2,602.49	947.38

Source: Own work

- There are medicines with a very low average price (hydroxychloroquine, chloroquine and azithromycin), but there are also very expensive ones (remdesivir, pirfenidone, sofosvubir).
- Within a single drug, there is also wide variability between countries (perfenidone, tociluzumab).

Exercise 2: Calculate the mark-up ratio for each drug and each country, taking into account the price and cost data for the entire treatment. Also calculate the mean and standard deviation of the mark-up ratio for each drug:

$$Mark-up\ ratio\ = \frac{Price - Marginal\ cost}{Marginal\ cost}$$

Table 4. Mark-up rate for complete COVID-19 treatment.

	Remdesivir	Favipiravir	Lopinavir	Hidroxicloroquina	Cloroquina	Azitromicina	Sofosvubir	Pirfenidone	Tocilizumab
Bangladesh	65.67	-	-	2.00	-0.33	2.57	32.60	3.00	0.94
Brazil	65.67	-	-	-	-	12.57	856.80	-	-
China	65.67	10.55	3.25	18.00	15.67	4.00	-	43.48	4.49
Egypt	65.67	-	-	-	-	-	-	-	0.71
United States	345.67	-	124.75	17.00	309.00	44.00	3,721.00	308.87	8.53
France	259.00	-	23.25	4.00	-	30.43	-	74.61	-
India	65.67	4.64	9.00	1.00	2.33	2.57	0.40	2.23	1.27
Malasya	65.67	-	-	6.00	5.67	6.86	-	-	-
Pakistan	65.67	-	-	-	-	-	0.20	-	0.44
U. Kingdom	259.00	-	35.00	3.00	25.67	6.86	1,565.40	81.61	1.57
South Africa	65.67	-	2.75	-	15.67	24.00	-	79.32	0.59
Sweden	259.00	-	42.00	2.00	12.33	10.43	-	69.84	-
Turkey	65.67	-	36.25	2.00	-	-	-	47.35	0.83
Mean	131.82	7.60	34.53	6.11	48.25	14.43	1,029.40	78.92	2.15
SD	105.53	3.10	34.92	6.15	84.34	13.62	1,083.86	83.73	2.43

Source: Own work

- The lowest profit margin corresponds to tocilizumab, favipiravir, hydroxychloroquine and azithromycin.
- The highest profit margin corresponds to sofosvubir.

Exercise 3: Find the GDP per capita for each country (e.g. World Bank statistics) and compare the price of the full treatment with the GDP per capita of each country.

Table 5. Percentage of complete treatment price with respect to per capita GDP.

	GDP (per capita $)	Remdsivir	Favipiravir	Lopinavir	Hidroxicloroquina	Cloroquina	Azitromicina	Sofosvubir	Pirfenidone	Tocilizumab
Bangladesh	1,855.7	32.33	-	-	0.16	0.01	0.27	9.05	6.68	37.18
Brazil	8,717.2	6.88	-	-	-	-	0.22	49.20	-	-
China	10,261.7	5.85	2.25	0.17	0.19	0.05	0.07	-	13.44	19.00
Egypt	3,019.2	19.87	-	-	-	-	-	-	-	20.07
United States	65,297.5	4.78	-	0.77	0.03	0.14	0.10	28.50	14.71	5.18
France	40,493.9	5.78	-	0.24	0.01	-	0.11	-	5.79	-
India	2,099.6	28.58	5.37	1.91	0.10	0.05	0.24	0.33	4.76	38.39
Malasya	11,414.2	5.26	-	-	0.06	0.02	0.10	-	-	-
Pakistan	1,284.7	46.70	-	-	-	-	-	0.47	-	39.70
U.Kingdom	42,330.1	5.53	-	0.34	0.01	0.02	0.03	18.50	6.05	2.16
South Africa	6,001.4	10.00	-	0.25	-	0.08	0.58	-	41.49	9.43
Sweden	51,615.0	4.53	-	0.33	0.01	0.01	0.03	-	4.25	-
Turkey	9,126.6	6.57	-	1.63	0.03	-	-	-	16.42	7.12

Source: Own work using data from GDP per capita (current US$) | Data (worldbank.org).

- Treatment with some drugs is relatively expensive compared to the country's GDPpc: remdesivir accounts for 28% in India, 32% of GDPpc in Bangladesh, 46% in Pakistan; pirfenidone accounts for 16% in Turkey and 41% in South Africa.

Exercise 4: Look at public health expenditure per capita (e.g. World Bank statistics) and compare it to the price of full treatment. Comment on the results.

Table 6. Percentage of complete treatment price with respect to per capita health expenditure.

	Public health expenditure (per capita, $)	Remdesivir	Favipiravir	Lopinavir	Hidroxcicloroquina	Cloroquina	Azitromicina	Sofosvubir	Pirfenidone	Tocilizumab
Bangladesh	7.12	8,426.97	-	-	42.13	2.81	70.22	2,359.55	1,741.57	9,691.01
Brazil	353.54	169.71	-	-	-	-	5.37	1,213.16	-	-
China	282.68	212.25	81.72	6.01	6.72	1.77	2.48	-	487.83	689.83
Egypt	36.07	1,663.43	-	-	-	-	-	-	-	1,680.07
United States	5,355.79	58.25	-	9.39	0.34	1.74	1.18	347.47	179.36	63.17
France	3,441.17	68.00	-	2.82	0.15	-	1.28	-	68.12	-
India	19.63	3,056.55	574.63	203.77	10.19	5.09	25.47	35.66	509.42	4,105.96
Malasya	218.65	274.41	-	-	3.20	0.91	5.03	-	-	-
Pakistan	15.24	3,937.01	-	-	-	-	-	39.37	-	3,346.46
U.Kingdom	3,392.09	68.98	-	4.25	0.12	0.24	0.32	230.89	75.50	26.95
South Africa	284.28	211.06	-	5.28	-	1.76	12.31	-	875.90	199.10
Sweden	5,089.96	45.97	-	3.38	0.06	0.08	0.31	-	43.14	-
Turkey	301.69	198.88	-	49.39	0.99	-	-	0.00	496.87	215.45

Source: Own work using data from Domestic general government health expenditure per capita (current US$) | Data (worldbank.org).

- The unaffordability of some of the treatments becomes even more apparent when comparing their price with public health expenditure. In India, the cheapest treatment is 5 times the public health expenditure in per capita terms. In Sweden, some treatments account for a tiny percentage of public health expenditure (hydroxychloroquine, chloroquine, azithromycin), but others account for more than 40% of public expenditure per capita (remdesivir, pirfenidone).
- Few drugs are marketed in some countries, which means that there are very few options to choose from. In Pakistan, the cost of treatment ranges from 39 to 3,000%, in Brazil it ranges from 5 to 1,200%.
- The differences between tables 5 and 6 highlight that GDP per capita is not an "ideal" indicator of economic well-being. In countries with low GDP per capita, public expenditure on health is even lower and this may make it impossible for the public health system to purchase medicines to combat the coronavirus.

Exercise 5: Reflect on the above results and suggest some measures that could improve affordability and access to treatment.

- This analysis shows that medicines to treat cOViD-19 could be manufactured at very low prices. If promising results from key clinical trials emerge, there is a possibility to increase production of generics and provide treatment to millions of people at very low unit prices.

- Large orders are needed to encourage generic companies to manufacture medicines at low prices, as is the case for AIDS, malaria and TB medicines.
- Other mechanisms are in place to optimise drug manufacturing. With joint procurement, a number of countries can order medicines together, to take advantage of economies of scale. There can be volume-price guarantees to purchase large quantities of medicines at fixed prices for a certain number of years.
- Prequalification of major companies by the WHO can be recognized by any country as an indicator of the quality of the medicine, including adherence to good manufacturing practices and the stability or viability of the medicine over its stated shelf life, along with the bioequivalence of generic to branded versions.
- We need open 'technology transfer' so that the methods used to manufacture key medicines can be shared with any country that decides to produce them locally.

4. Conclusion and recommedations

This teaching experience has been very satisfactory, both from the point of view of the students' involvement and work, as well as their own assessment of the subject studied. In the first place, they have valued very positively the relevance of the project. Secondly, it has helped them to use international statistical portals that they had never used before. Thirdly, it has helped them to reflect on the difference between prices and costs, and how this difference translates into the profit margin. The comparison of prices and costs in the tables above shows that there are treatments that, if effective in combating Covid-19, could be moderately expensive (less than $30 for a standard course of treatment). However, in many cases, the differences between prices and costs are stratospheric.

Fourthly, they have carried out an in-depth reflection on the existing disparities in access to medicines. In this situation, they considered, by an overwhelming majority, that although patents aim to promote knowledge by creating a monopoly around the product or innovation developed, in the particular case of the Covid-19 pandemic, health should be prioritised, and therefore, there should be a free transfer of technology, not only at the level of medicines developed, but of all the trials carried out. It is essential that generic medicines are accessible to all people, because the health of some is good for the health of all (positive externality).

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Teach Multivariable Functions Through Applications and GeoGebra

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Abstract

In this paper some representative examples of a project proposed to second year environment and civil engineering students are presented. The project aim was to deepen the understanding of multivariable functions, stimulating students' creativity and connecting concepts to the content of other disciplines and to the real-world situations through examples that the students themselves have found as applications to engineering. To visualize the problems, students had often utilized GeoGebra, tool widely used during lectures to visualize theoretical aspects and to better explain the exercises. The appreciation of students involved in this activity and their relationship with GeoGebra is also presented. Students appreciated very much this approach as highlighted analyzing their written reports about the activity and GeoGebra use.

Keywords: *Calculus; multivariable functions; GeoGebra; engineering applications.*

1. Introduction

Multivariable calculus is one of the most important parts of mathematics syllabus for engineering students. It is offered as a prerequisite course to other courses. However, multivariable calculus is one of the most difficult courses for most engineering students to study in their field. Various problematic areas have been identified, as the difficulty in coordinating procedures and manipulating concepts, poor problem-solving skills, the inability to select and use appropriate mathematical representations, the translation of real-world problems into calculus formulations, absorbing complex new ideas in a limited time, the students' beliefs, and their learning styles (Kashefi *et al*. 2011).

Faculties whose students need to use mathematics in learning their disciplines recommend mathematics classes to be made more relevant to their students (Abramovich & Grinshpan, 2008). Engineering faculty have indicated that an engineering perspective may improve both students' motivation for learning mathematics and students' ability to transfer their mathematics learning to engineering contexts (Czocher, 2010; Pennell, Avitabile & White, 2009; Varsavsky 1995). One of the problems in the early years in an engineering curriculum is that mathematics is taught as a separate subject. Moreover, it is beneficial for students to acquire practical experiences with real-world relevance too. Planning a course should not underestimate the three levels that influence students' behavior: the cognitive level, which concerns the learning of specific concepts and methods discipline; the meta-cognitive level, which concerns the control of subjects on their learning processes; and finally, the affective or non-cognitive level, which considers the beliefs, emotions, and attitudes of the learner (Zan *et al*. 2006). "Technology can play a role in each of these levels, including the non-cognitive one, as it can deeply influence the beliefs, emotions and attitudes of learners, on the other hand, it is itself subject to rooted convictions and can provoke strong emotions" (Albano & Ferrari 2008).

The use of information technologies and systems of dynamic geometry makes it possible to include a wide visual range in the educational process, thereby activating the imaginative thinking of students and helping them to holistically perceive the proposed material. The use of information technology allows the teacher to manage the demonstration of visual material more effectively. Mathematical concepts are identified and represented through various representations, which reflect possibly different features of a concept, but simultaneously complement each other. Treating a concept within a certain representation (representational mode or register) and successfully converting between different registers of representation, is considered as a prerequisite for conceptual understanding. Teaching GeoGebra, support multiple representations that can simultaneously demonstrate a function in numeric, algebraic, and graphic models. This feature helps students to understand abstract concepts, Nobre *et al*. 2016, Ponce Campuzano, et.al. 2018, Takaci et. al. (2015), and Tatar and Zengin 2016 explored students' learning outcomes in classes that applied GeoGebra to the teaching

of calculus (see also Alessio *et al*.). GeoGebra supplemented lessons also enhanced students' motivation (Liu *et al*., 2011; Reis, 2010; Reis & Ozdemir, 2010; Vargas & Gamboa, 2013) and their mathematical reasoning and problem-solving skills (Acuña, 2014; Akanmu, 2016; Albaladejo *et al*., 2015; Granberg & Olsson, 2015; Muzdalipah & Yulianto, 2015).

The aim of this research is manifold, to investigate: the ability of students to connect their knowledge acquired in other courses (physics or engineering) where multivariable functions are used; the ability to transfer the same knowledge to real problems; the ability to use GeoGebra to represent a problem involving multivariable differential calculus and solve it; if the proposed work has found the interest of the students.

2. Methodology

The course of Mathematical Analysis 2 is a second course of calculus (9 credits corresponding to 72 hours of lessons) held in the first semester to second year students of Environment and Civil Engineering. It is preceded, among others, by Mathematical Analysis 1 (12 credits), Linear Algebra (6 credits) and Physics 1 (6 credits), it is simultaneously taught with Topography and Rational Mechanics. Mathematical Analysis 2 includes topics (in the order chosen for the lessons) as first and second order differentials equations, curves and curvilinear integrals, differential and integral calculus in several variables, vector calculus, the systems of linear differential equations with simple studies of stableness and Fourier series. Many students end up preparing the exam in mathematical analysis 2 in the third year after having successfully passed mathematical analysis 1 and linear algebra exams, slowing down their educational path. GeoGebra has intensively used to explain the properties of graphs of functions of several variables, the domain, the range, level curve or surface, the intersection of solid figures, the contours, and so on.

As optional additional work, assigning 3 extra bonus points for it, students were asked to find possible applications of the material studied to engineering and to present them to the class during the lessons. This work involves about eighty civil and environmental engineering students from the University of Udine, a town in the north-east of Italy. Most of them enrolled in the second year of studies but also third year or off-course students, who have not yet passed Mathematical Analysis 2 exam. Moreover, to students who participated in the project were also asked to make an optional report about their impressions of the work done and about GeoGebra. The request was the following: "write a report on your experience in preparing the proposed work on the engineering applications of the topics covered in class. If and how it helped you in understanding the theoretical topics and in connecting them with those of other courses. Explain if and how using GeoGebra helped you understand the course topics".

3. Results: The projects and the impressions

Twenty-five students, out of eighty, prepared and presented their project during the lessons. Some of those related to other courses such as Rational Mechanics and Topography. Among twenty-five projects prepared by students, in this article, we have chosen to present three, about multivariable differential calculus. The choice was made to highlight some of the main advantages of using this activity that was the purpose of this work: finding links with the courses that students are following or followed in the past, or alternatively topics covered during high school; trying to model real problems using mathematical representations; acquiring some skills to solve a problem that could arise in the workplace. Here we also present some significant passages of the impressions, contained in the reports, about the project and their use of GeoGebra of the three students previously chosen.

3.1. Isabel: An application in topographic field

The objective Isabel work was the study of the environment and its conformation with an alternative (perhaps hypothetical) mathematical method that simplifies the topographic operations usually used to mimics the terrain. She also obtained a Plano-altimetric representation (through the level curves) and the maximum and minimum data of the territorial reliefs.

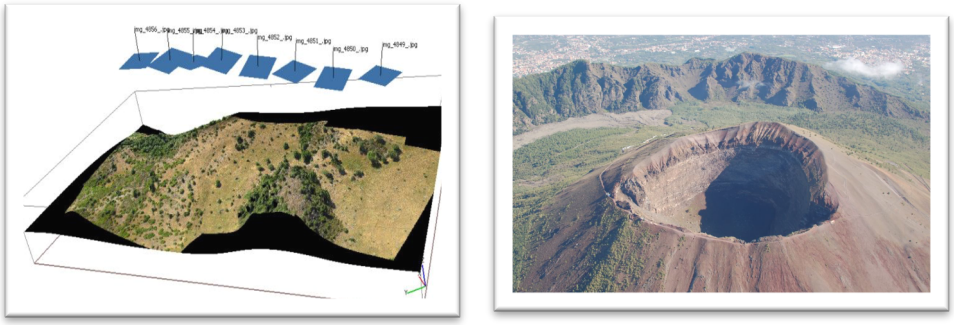


Figure 1. Environment conformation and Topographic method.

Among the functions chosen by Isabel there were:

$$f(x,y) = \sin(x)\cos(y) \qquad f(x,y) = \sin\left(\sqrt{x^2+y^2}\right) + 1$$

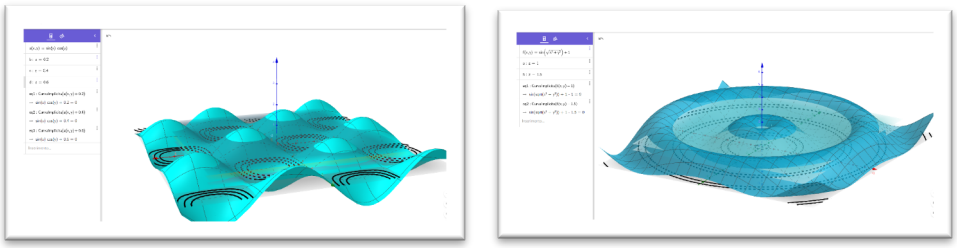


Figure 2. Two examples of functions chosen ad level curves with GeoGebra.

Through the graph of the functions and the level curves $f(x,y) = c$ (Figure 2.), she directly obtained the Plano altimetric representation of the territory on the xy plane. She found the tangent plane of the function and maxima and minimum points. Students are not always able to connect the topics they encounter in other courses, sometimes the simple use of a different language confuses them, it is therefore necessary to show these links, and if they are the students themselves who find understanding, then it is even more effective.

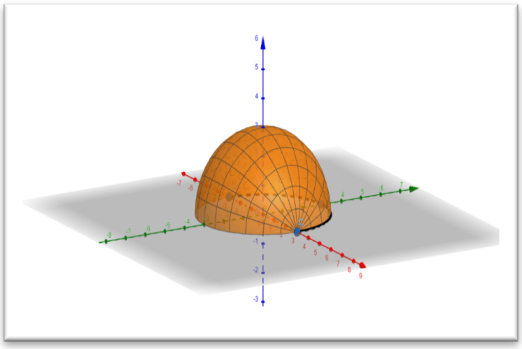
About the impression of the project Isabel emphasizes the usefulness of the project to find links with other disciplines, in fact she wrote: "I found the project an excellent idea to make the students more interested in the subject, as a stimulus to look for something to propose and commit them to find real connections between the course and a wider context. I believe that, if you have found an interesting idea (but it is not easy) it can be a job to be developed later, with skills acquired in other courses". She also enjoyed using GeoGebra, in fact she said: "I had never used GeoGebra before, but it was very useful, I would like to learn the methods of representation using GeoGebra in more complex cases too".

3.2. Gioele: Models of multivariable functions in some elements of historic buildings. Domes and Arch

The domes of ancient churches are a demonstration of multivariable functions application. An example can be identified in the "basilica di Sant'Antonio di Padova (1310)", one of the main places of worship in Veneto. The Arch of Constantine (315), a triumphal arch located in Rome, is another example. Figure 3 illustrates the choices that Gioele made to select the functions and how he chose to display them using GeoGebra.

$$a = \text{Superficie}(c, 180°, \text{asseX})$$

$$\rightarrow \begin{pmatrix} \cos(u) \cdot 3 \\ (\sin(u) \cdot 3)\ \cos(v) \\ (\sin(u) \cdot 3)\ \sin(v) \end{pmatrix}$$



$$f = \text{Superficie}(a, 360°, \text{asseX})$$

$$\rightarrow \begin{pmatrix} 1 - 2\,u \\ (-1 + 0\,u)\ \cos(v) + 0\,u\ (-\sin(v)) \\ (-1 + 0\,u)\ \sin(v) + 0\,u\ \cos(v) \end{pmatrix}$$

$$g = \text{Superficie}(c, 360°, \text{asseX})$$

$$\rightarrow \begin{pmatrix} -1 + 2\,u \\ (-2 + 0\,u)\ \cos(v) + 0\,u\ (-\sin(v)) \\ (-2 + 0\,u)\ \sin(v) + 0\,u\ \cos(v) \end{pmatrix}$$

$$h = \text{Superficie}(d, 360°, \text{asseX})$$

$$\rightarrow \begin{pmatrix} 1 + 0\,u \\ (-2 + 1\,u)\ \cos(v) + 0\,u\ (-\sin(v)) \\ (-2 + 1\,u)\ \sin(v) + 0\,u\ \cos(v) \end{pmatrix}$$

$$i = \text{Superficie}(b, 360°, \text{asseX})$$

$$\rightarrow \begin{pmatrix} -1 + 0\,u \\ (-1 - u)\ \cos(v) + 0\,u\ (-\sin(v)) \\ (-1 - u)\ \sin(v) + 0\,u\ \cos(v) \end{pmatrix}$$

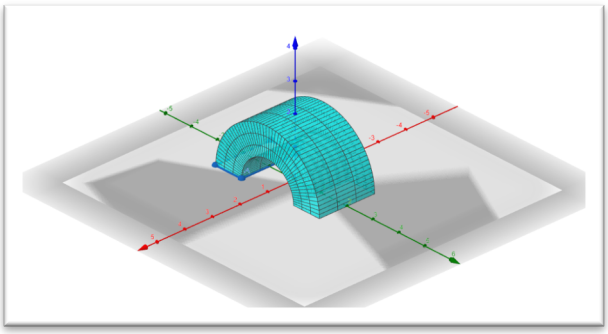


Figure 3. Domes and Arch.

Having introduced at the same time all the types of functions (of several variables, curves, surfaces) covered by the course allowed Gioele to obtain a representation very close to reality. In fact, after having chosen as the representation of a dome, the function $f(x,y) = -\frac{x^2}{a} - \frac{y^2}{b} + c$, his attention immediately shifted towards the use of the rotation surfaces of curves.

Unlike the other two, Gioele is a third-year student who felt the need to follow again the course since the teacher changed, previously the course was carried out in the traditional way. In fact, he wrote: "I was really pleased to follow again the analysis course 2 with this kind of approach since it was very useful not only for understanding this subject but also for deepening the comprehension of other courses" and he continued writing: "I found the teaching activity related to mathematical applications in the engineering field stimulating and allowed me to have a broader overview of my future profession. Sometimes in some degree courses there is no correlation between the theory that is learned and the consequent use from a practical point of view. Having carried out an activity of this type has also allowed me to find, through reasoning, alternatives to the problems that may arise during my professional activity". Gioele's desire to connect the topics dealt with the future working reality is therefore evident. About GeoGebra he wrote: "I believe that the use of GeoGebra has been of great help as regards the intermediate phase between learning and applications; thanks to a graphic vision, I believe that the acquisition of theoretical arguments is very simplified, allowing a first physical vision of the problem too". He also highlighted the importance of the tool to understand more deeply the theoretical contents of the course. He continues writing for the general approach used: "The study of certain concepts in this way has allowed an easier understanding of the same topics seen in other courses allowing a significant simplification of the learning phase. I find this type of approach very useful, especially in mathematics subjects because I personally believe that many concepts are delicate to understand and noting concrete results you have further help".

3.3. Thomas: Calculate the dimensions of the ideal cut section for a tree trunk

The shape of a trunk is irregular, as the various cross sections; he therefore wanted to determine what are the dimensions of the rectangle, with vertices belonging to the "tangent" circumference that maximize the resistance modulus $W = \frac{1}{6}bh^2$ (see Figure 4).

The set of pairs (b, h) of the first quadrant representing the rectangles inscribed on the circumference of diameter d are precisely the pairs that are located at a distance d that belonging to $D = \{(b, h) | b^2 + h^2 = d^2, b \geq 0, h \geq 0\}$.

Using the Lagrange multiplier theorem, Thomas found the maximum point $\left(\frac{d}{\sqrt{3}}, \sqrt{\frac{2}{3}}d\right)$.

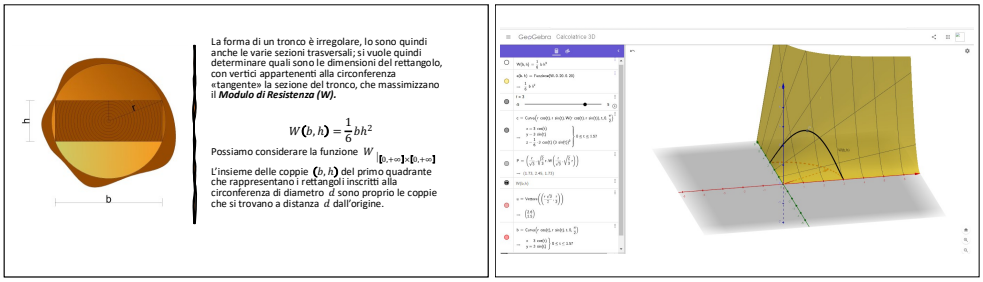


Figure 4. The problem. The graphical interpretation and the solution.

In this case, Thomas' ability to model the problem and solve it both analytically and geometrically with GeoGebra is highlighted. He was capable to relate the three-dimensional representation, in particular the curve identified by the substitution of the constraint, with its projection on the xy plane. It is important to note the choice of the slider to show how the maximum is obtained. About the impressions of the project, he wrote: "Having performed this exercise helped me to understand how to display functions in multiple variables, in fact I had never thought that the modulus of resistance function could be displayed as a function of two variables". Having to look for examples of functions of several variables forced Thomas to reflect on what the various possibilities could be, in fact at first time he presented a similar example but for functions of one variable. The transition from functions of one to several variables is in fact recognized as an epistemological obstacle. About GeoGebra he wrote: "The use of Geogebra was very useful for the graphical display of functions in two variables, curves and vector fields, but in general of all the functions that can be viewed in a three-dimensional space. Carrying out exercises, example accompanied by images created with GeoGebra seemed to me an excellent approach to clarify analytical concepts through geometric interpretations. It was also helpful to integrate the theoretical slides with figures created using GeoGebra".

4. Conclusions

Students' beliefs about the relevance of mathematics are considered as one of the factors that can play an important role in their attitude and motivation. A recent study of first year university students in engineering focused on improving perceptions of the relevance of mathematics in engineering, Flegg (2012) has described the use of context-based learning by applying mathematics to real-life problems as a promising approach.

The transfer of mathematics into the context of engineering seems difficult. Therefore this paper proposes a project that involves the students firsthand in order to incorporate mathematics with the principles of engineering.

The experience with the students was very encouraging. Both second-year, third-year and off-course students benefited from the initiative. The first because they had to reflect on the true meaning of the new concepts in order to find possible applications, connect the topics just learned with those they were taught at the same time in other disciplines, they also became aware of further applications that they will encounter in subsequent courses such as Construction Science and Hydraulics or in the workplace. For third-year or off-course students it was used to recognize mathematical concepts seen in other engineering courses. For everyone, preparing and presenting a project to the whole class served to test their exhibition skills too. The activity was highly appreciated by the students as evidenced by the words of the students themselves. The use of GeoGebra was very useful both to understand the concepts and examples shown during the lessons but also a valid tool that accompanied the students in the individual solving of the exercises. It is interesting that they were the students themselves who chose how to apply the tool in their project. The fact of them choosing it according to their personal interest and applying it and seeing the professional utility is a change with respect to the obligation to perform a task already predefined by the teacher.

The experience with the students was very positive and encourages its use in the coming years as well.

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A Proposed Framework for the Growth of Online Learning Communities

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Abstract

The abrupt shift to full online learning due to COVID-19, displaced students and teachers, created multiple barriers in teaching and learning, and caused some instructors not being able to build and maintain an online learning community. This situation resulted in students' detachment from their instructor and peers causing lack of motivation and increase of failure chances. First the paper explores the challenges and opportunities of building and online learning community highlighting the needs, and reviewes some past frameworks in the field. Second, a framework proposed identifies four factors that help the growth of online learning communities. Those factors are; teacher presence, social presence, cognitive presence and students' emotional engagement. Further the framework specifies type of actions and activities that teachers/instructors should be adopting throughout the course. The paper adds to the growing knowledge on Coronavirus effects on the educational sector and highlights the need for the efficeint use of technology in education.

Keywords: *Online learning community; Covid-19; teaching presence; social presence; cognitive presence; emotional engagement.*

1. Introduction

With the breakout of COVID 19 in 2020, 195 countries have mandated school closures (UNESCO, 2020) affecting all levels of the educational systems, as there was an abrupt transition to online learning (World Bank, 2020). Most teachers and instructors were not ready for this shift (Middleton, 2020), which increased the possibility of students being disengaged and dropping out (García and Weiss, 2020). Researchers have been informing an increase in students' disengagement and detachment from learning since shifting to full online learning through the pandemic (Duraku & Hoxha, 2020).

This situation triggered all educational professionals to try to design solutions for this preceding problem. According to Middleton (2020), "Educators, educational researchers, and policymakers have been presented with perhaps the biggest challenge of their careers." The OECD (2020) report marked using platforms to create learning communities and teachers' communication with students as a need for professional development to enhance online learning. This paper is addressing this challenge by proposing a practical framework to build and maintain an online learning community to reduce what Karahalios & Donath (2003) identify as 'social spaces', and to ensure continuity of learning. The research questions are as follows:

1. What are the factors enhancing online learning communities?
2. How can we build and maintain a successful online learning community?

2. Literature Review

The literature review will be first discussing challenges and opportunities for building online communities. Then, reviewing some examples of online learning community frameworks in literature.

2.1. Building Online Learning Communities: Challenges and Opportunities

The definition of the term was viewed differently by different researchers. The Office of Learning Technologies (1998) defined it by its components; community, learning, network technology. Community learning can refer to a situation in which learning occurs as a social learning process (Tu and Corry, 2001). A network is defined as a pattern of communications and relationships. They are essential tools for mobilizing community participants around local social issues. Network technology are systems used as a medium of communication that can be synchronous (real time communication) or asynchronous (time-delayed communication) systems (Tu and Corry, 2001).

According to McMillan and Chavis (1986), a sense of community is "a feeling that members have belonging, a feeling that members matter to one another and to the group, and a shared

faith that members' needs will be met through their commitment to be together" (p.9). Tu and Corry (2001) define it from a social aspect as "a common place where people learn through group activity to define problems affecting them, to decide upon a solution, and to act to achieve the solution" (p.1). They aim towards a learning community that is more than sharing information, where learners apply appropriate information to knowledge construction and advance to the level of a community that learns.

Researchers agree that for online learning to succeed it needs a 'community of learners', where there are social engagements in strong social networks with quantity and quality of interactions (Oliveira, Tinoca, & Pereira, 2011). On the other hand, compared to traditional classrooms, online education can be a lonely experience due to the separate place and the absence of body language and the interaction atmosphere (Differding, 2003). According to Lambert and Fisher (2013), "Online technologies, when appropriately utilized, can encourage community among distant learners and challenge learners beyond what might be possible in courses without technology." (p.2)

Building an online learning community needs its members to be consistent in enhancing factors that build a community. One of Clark (1998) principles to build an online learning community was that learning communities are not built, but they grow by themselves. He identified clear guidelines communicated from the beginning and sustained as a must for its growth. Barab et. al (2004) proposed the same idea that online learning communities cannot be constructed. Their development requires facilitation of collaborative relationships that is to be maintained.

2.2. Frameworks for building online learning communities

Due to the importance of building an online learning community in technology-based instructions, some frameworks appeared in research identifying and organizing factors that can be implemented to build this community.

Garrison et. al. (2000), provided a conceptual framework that provides the elements for a learning community that support learning experiences. Their framework is consistent with John Dewey's work seeing inquiry as a social activity. They called it the Community of Inquiry (COI). This framework is based on three critical elements in using online asynchronous, text-based communication in higher education; social presence (SP), cognitive presence (CP), and teaching presence (TP).

Blayone et. al. (2017) presented a divergent vision of the Community of Inquiry model (COI), the Fully Online Learning Community (FOLC). FOLC is like COI in being a social-constructivist learning model with learning constructed as different interactions categorized in several presences. However, FOLC incorporates SP and CP only. It subsumes TP fully within the other presences. This difference emphasizes the idea of community and learners'

empowerment. In addition, the FOLC adds to SP and CP, digital space as contextual construct that can strengthen SP and CP. The FOLC incorporate several sub-models addressing different layers of the learning experience responding to problems related to higher education.

Khoo and Cowie (2010) designed a practical framework that highlights the appropriate conditions for the development and conduct of online learning communities. The framework represents learning in a strong social learning community as an activity based on five principles that is; mediated, distributed, goal- directed, and participatory. They translated their framework into practice by identifying actions, web-tools, and teaching strategies for each principle.

3. The Proposed Framework

From the literature review above we can understand that the growth of an online learning community depends on teachers instilling different community factors by consistent actions and activities throughout the course.

Teaching Presence coming first factor as it is seen as a base that help students develop social presence, and promote students' cognitive presence (Garrison et. al., 2010). Social presence comes next as it is promoted by teachers giving opportunities to share authentic personal and professional elements with the instructor and peers. (Garrison, et. al., 2010). Cognitive presence needs student first to feel social presence and teaching presence. (Garrison & Cleveland-Innes, 2005). Those three components derive students' emotional engagement and consequently participating in building this sense of community. Those four main factors are enhanced by actions and activities that instructors adopt throughout the course.

The framework is based on tow ideas; the first is identifying main factors that help grow an online community, and the second specific type of actions and activities that teachers should be adopting throughout the course to ensure consistency.

3.1. Factors for the growth of an online learning community

3.1.1. Teachers' Presence

According to Garrison & Arbaugh (2007), teaching presence is "as a significant determinant of student satisfaction, perceived learning, and sense of community" (p. 163). Teaching presence has three dimensions; the instructional design and organization, facilitation of discourse, and direct instruction that online instructors "do" (Garrison & Arbaugh, 2007). Those dimensions promote a pedagogy that engage students thinking, share views consider other views, reflect on their own, rethink previous positions, and integrate new ideas in their cognitive structure. (Shea et. al., 2006). The goal directed collaborative interaction support

the sense of connectedness between students. Teaching presence promote students' sense of trust, collaboration, shared educational objectives, and support (Garrison et al., 2000). Teachers are to promote high levels of interaction with students, prompt feedback, active roles for learners, a greater emphasis on student cooperation over competitiveness, (Garrison, Anderson et. al. 2000). Teachers' availability to students increase students sense of connectedness. Phirangee, et. al. (2016) found that students felt more connected when instructors took an active role in facilitating discussions. Tomas et. Al. (2015) reported students valued timely feedback and support from teaching staff.

3.1.2. Social Presence

Social presence is the ability of participants to establish themselves as real in a virtual environment (Berry, 2019; Garrison et al., 2010). Due to asynchronous environments have less affective communication, some researchers view it as less likely to promote social presence (Short et al., 1976). On the other hand, other researcher argue that the impersonal communication can be 'hyper-personal' (Walther, 1994). Participants in an online learning community can create social presence by showing their identity through verbal immediacy behaviors alone (Richardson & Swan, 2001). Social presence and sense of community is promoted by students working together in online assignments requiring peer or group work (Waycott et. al., 2013).

3.1.3. Cognitive Presence

Cognitive presence refers to the student's ability to reflect, reconstruct, and conform meaning (Berry, 2019; Garrison &Arbaugh, 2007). Cognitive presence depends on the instructors' ability in reflexive facilitation techniques that provoke Students to question, critique, and reflect in dialogue with peers and driving moments of learning. (Berry, 2019; Garrison et al., 2010). Online content management systems and Web 2.0 web sites provide instructors with opportunities to integrate online resources where students can explore, create, and share their new knowledge encouraging deeper engagement with learning (Jacobs, 2003). Those systems allow for students to be engaged in active, experiential and praxis-oriented learning experiences through scaffolded hands-on activities and experiments embedded in the online modules and tutorials. (Tomus et. Al., 2015).

3.1.4. Emotional Engagement

Mahdy (2020) reported the effects of the lockdown on university students. Participants responses identified 'Loss of interest' to be one of the main problems resulting from online learning. Students' emotional engagement is highly influential on students' participation in any learning community (Zappala, 2012). For online environments to facilitate constructivist, collaborative, and student sceptered teaching approaches, instructors have to give attention to fostering student engagement, stimulating intellectual development and building rapport with students. (Beldarrin, 2006)

3.2. Types of actions and activities for the growth of an online learning community

To produce a practical framework for teachers/instructors can easily use in their courses, it has to guide them through with actions taken throughout the learning process that enhance factors building online learning communities. The Framework is based on the idea that feeding the learning process with consistent actions or activities that enhance factors of building an online learning community helps the community to grow (Clark, 1998; Barab, Kling, & Gray, 2004). The following table summarize some activities and actions taken throughout the course, and match those actions to factors that build online learning communities. It also identifies types of web tools used with different actions.

Table 1. Actions and Activities throughout the course that enhance factors building online learning communities.

Times of the course	Actions Aspects	Examples of Activities	Factors
Before the beginning of the course	Planning Learning & Inquiry	inquiry activties, authentic real-life research issues, plan resources and tasks accordingly. discussions, presentations & collaborations.	*TP** *CP**
	Planning Virtual spaces	communication plan of consistent times, ways, announcements, posting and submitting assignments, a community space, and organise your virtual classroom/platform.	*SP**
At the beginning of the course	Introduction activities	students post their personal information. Greetings Post at the beginning of the course (video/text with instructor's photo) Ice-breaker activity.	*EE**
	Set the scene	Setting guidelines, regulations and clarifying expectations and deadlines. Collaborating in setting a class community agreements with students.	*EE* *SP* *TP*
At the beginning of the week	Community meeting	share a goal for the week - What do you want to focus on. Weekly updates/prompts to remind students about the week's topics and how they are to participate.	*TP* *SP* *EE*
At the end of the week	Community meeting	Group reflection, students share their feelings, fears, …etc. address the outcomes in your future morning meetings.	*SP* *EE*
Ongoing In Asynchronous tasks	Monitoring & Giving Feedback	Prompt feedback to student queries - Peer feedback - Consistent monitoring of students achievemtns and giving positive feedback - informal formative assessment like; checking understanding frequently.	*TP* *CP*
	Asynchronous Type of Tasks	generate discussion. Opportunity for students' analyze and share individual postings in knowledge building activities. Use of resources and inquiry activates such as; gathering, analyzing, presenting data, defining issues; and defending conclusions.	*TP* *SP* *CP*
	Infuse Teacher's presence	building in personalized graphics, using pictures or avatars. - Screen simulations or voice- over presentations is to use Camtasia, Jing, or Captivate.	*TP*
	Support	Assign office hours. - Have ready a frequently asked questions link - Answer e.mails promptly.	*TP* *EE*
	Infuse Collaboration	Establish a "virtual hallway" or a discussion forum. Chat and instant message. Complete collaborative class projects. Foster purposeful collaboration and dynamic discussions.	*SP* *CP*
Ongoing In Synchronous meeting	Beginning	Check-ins:An attention activity	*EE*
	Body	mentoring, monitoring, referring, and linking to students' ideas, interacting with students that involves; initiating discussions, asking probing questions, using humor, using self-disclosure, responding quickly and frequently, use visuals and concept maps, and create opportunities for students to share their work.	*TP* *SP* *CP* *EE*
	Ending	Encouraging closure; positive specific feedback after the session, follow up to what they learned.	*TP* *EE*
At the end of the term	Reflection	Setting personal goals and revising goals.	*EE*

**TP: Teaching Presence *SP: Social presence.*CP: Cognitive Presence * EE: Emotional Engagement*
This framework was applied with higher level students. The effectiveness of the framework from instructors prespective rated 32% very effective, 54% effective, 14% no difference.

4. Conclusion

Establishing learning communities in online courses can solve the problem of students' disengagement and increase success chances. For students to grow the sese of community, teachers and instructors need to be consistent in using online communication tools in engaging students in authentic tasks and activities directed to support the growth of a leaning community. This paper is proposing a practical framework to develop online learning communities from a sociocultural perspective. The framework discusses factors that develop a community; teaching presence, social presence, cognitive presence, and emotional engagement. The framework also proposes the use of specific actions, and gives example of activities to be done by teachers and instructors throughout a course.

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Exploring The Influence of COVID-19 on Initial Teacher Education in Malta: Student Participation in Higher Education

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Abstract

The COVID-19 pandemic forced a rapid transition from onsite to online learning spaces for initial teacher education (ITE); with Universities adopting new modes of pedagogy and assessment. This study explores: (1) how Maltese ITE undergraduate early years and postgraduate primary education students dealt with remote forms of learning during the early stages of the pandemic in Malta, and (2) the teaching/lecturing modes used, by lecturers, for remote learning, assessment and the impact on student wellbeing. The data were gathered through an online quantitative survey designed to collect information about ITE students' views. Students' responses obtained strongly suggest that in the eventuality of an ongoing 'post-vaccination COVID' era, ITE within HE programmes should consider revisiting the course content and delivery, supporting and fostering, blended and online approaches. A 'blind spot' reflecting the struggle for independence, autonomy, and control during COVID-19 in a postcolonial Maltese Higher Education context also emerged. The insights gained highlight how ITE students' views on their experiences of predominantly online pedagogy and assessment, and how the impact on their wellbeing within a Maltese HE context can serve to promote the development of ITE programmes. These results also emphasize the need to promote participatory research amongst university students as key to inform HE policy and practice.

Keywords: *Initial teacher education; online learning; COVID-19; student participation; Higher Education.*

1. Introduction

The SARS-CoV-2 (COVID-19) has led to a global health crisis that has impacted the quality of education and the mode of delivery, process and outcome of learning at all levels of education (United Nations, 2020). Many countries were forced to close educational facilities such as Universities. This closure has considerably disrupted the quality of teaching/lecturing within Universities and altered students' learning trajectories. COVID-19 has also created opportunities for teacher education (United Nations, 2020) with an increase in students enrolling in teacher training programs (Worth & McLean, 2020). It has also heralded the implementation of a digital transformation in teaching/learning in HE institutions; which usually take years to implement (Adedoyin & Soykan, 2020). A critical challenge relates to how students interact with digital teaching and learning, in that littl is as yet known about the impact of online teaching and learning in ITE (Carrillo & Flores, 2020). In Malta, during the first six months of the COVID-19 pandemic, the University of Malta, experienced a rapid transition from onsite face-to-face to remote teaching and learning, affecting education, including ITE (Carrillo & Flores, 2020). This paper gives a voice to the students at the University of Malta and explores the influence of COVID-19 on their undergraduate/postgraduate ITE experiences through student participation.first section starts on page two. Paper length must be between 4 and 8 pages (A4 size), incorporating all text, references, figures and tables. These guidelines are strict: papers failing to adhere to the guidelines (by being more than 8 pages, altering margins or not following the template) will be rejected without consideration of their merits.

2. Literature review: The impact of COVID-19 on HE and ITE

An important consequence of COVID-19 for HE was the shift from face-to-face instruction to synchronous/asynchronous online modes of teaching and learning. Many universities, including the University of Malta (UM), already possessed a virtual learning environment (VLE). This sudden shift to online modes created challenges/hardships to academic staff/students (Allen, Rowan & Singh, 2020) and had major academic, financial, social and physical implications for students (Donsita-Schmidt & Ramot, 2020). Universities adopted new modes of assessment such as writing blogs, portfolios, production of interactive digital posters, podcasts, presentations, etc. Many assessments and exams were also held online (Donsita-Schmidt & Ramot, 2020). ITE also experienced added challenges related to their trainee teachers' practical work experience in schools (Donsita- Schmidt & Ramot, 2020). As school closure reduced the placements available, this also resulted in lost opportunities for teaching practice. Student teachers could find more time to read and to reflect in-depth, achieving improved overall grades (La Velle et al., 2020). Universities adopted different strategies to overcome ITE challenges such as having online work placements. However, online modes of teaching and learning are not always motivational to university students;

and Maltese student teachers may not be any different. Isolation also impacted students' psychological wellbeing (Arnhold, et al., 2020). The intensity of interaction prevalent in teacher training programmes such as collaboration and cooperation, led some students to experience stress/burnout and exhibit this through an apparent lack of enthusiasm to participate actively in online learning.

3. Aims and Objectives of the study

The study explored how Maltese ITE for early years and primary education dealt with remote online learning during the pandemic, and how the pedagogies experienced impacted students' learning and wellbeing. The study included two groups of students from the Faculty of Education (FoE) at the University of Malta: those following a 3-year Bachelor degree in Early Childhood Education and Care (BA) (training to work with 3- to 5-year-old children); and Master in Teaching and Learning (MTL) students training to become primary teachers (working with 5- to 11-year- old children). The aim of this research was to understand the impact of COVID-19 on ITE students' overall learning and wellbeing through a student participatory research approach. The specific objectives were to explore: trainee educators' perceptions and experiences of online delivery modes in ITE; the impact of the shift to online learning on relationships and wellbeing; and ITE students' preferences of online pedagogies. The main research question set was: 'What lessons were learnt from the rapid shift to online modes of delivery in ITE during the first wave of COVID-19 pandemic?'. This was extended to the following subquestions: 'What were ITE students' perceptions and experiences of online teaching and learning and quality of learning, and how did it impinge on their relationships and overall wellbeing?', and 'What online pedagogies and strategies did the ITE students prefer?'

4. Methodology

The research methodology involved an anonymous online quantitative survey among University of Malta ITE students' about their experiences and views of their educational and personal lives during COVID-19. The survey was divided in four-sections and included 29 items, mainly multiple-choice and 5-point Likert scales. The featured sections included items about: participants' demographics; teaching/learning during the pandemic; learning spaces; and relationships and wellbeing. Following ethical clearance obtained from the Faculty of Education Research Ethics committee at the University, the necessary permissions were obtained to disseminate the survey through the University channels. Responses were collected between July and September 2020. A total of 127 ITE students (BA group n=68, MTL group n=40, not stated n=19) from a whole student population of 206 participated in the study. The majority of respondents were female at 94.5% (n=120) while 5.5% (n=7) were

males. Students' ages ranged between 18 to 47 years. MTL students were on average aged 20.57 years old (s.d=3.788), whilst BA students 19.01 years (s.d=5.44). This older age for MTL students reflects the years needed prior to progression postgraduate professional Masters training in the case of primary school teachers.

5. Results

The students' responses reflect the use of a range of methods of online learning. The most popular were live online lectures, experienced very often by 52.4% of the students, and often by another 20.6%. Many students also had documents uploaded on the University's Virtual Learning Environment (VLE) ('very often' for 50.0% and 'often' for 29.6%). Recorded online lectures were also used, but to a lesser degree, as were group tutorials on Zoom/Teams. Forums (synchronous or asynchronous) were also not frequent, with 30.0% only using them 'sometimes'. There was also limited interaction during live online sessions, with one third (20.8% 'very often' and 12.5% 'often') using the mute button. Lectures were also teacher centred, as many (46.4% 'very often' and 34.2% 'often) declared that they took notes during the lectures. About half of the students (45.92%) used the chat. It is also worth noting that the great majority never changed their name on screen, or left the lecture to do something else. Students were asked to express the impact of the different online modes on their learning. As figure 1. below shows, over half of the students enjoyed spontaneous sessions as they found it easy to participate actively and ask questions. They also felt more 'normal' in the COVID circumstances, as well as felt that the lecturer could plan better. Contrary to live online lectures, many students (45.0%) did not feel that they learnt more with recorded lectures while for 27.9% it made no difference. Only over half (57.3%) listened to a recorded lecture before the next one was uploaded. About one fifth of the students also often discussed the lectures with their classmates, while another 47.5% did this sometimes. Only 13.5% sometimes listened to lectures together with their classmates. However, the majority of the students liked listening to recorded lectures according to their schedule (89.2%) and that they could stop the presentation to research material related to the lecture as they needed (80.9%). They (63.1%) also felt that it allowed them to discuss with classmates when they did not understand well. In comparing their learning experiences during COVID to normal university life, over 60% agreed that they spent more time following online lectures and doing task assignments. Their lectures did not decrease which shows that learning kept on going at a good pace. Their responses reflect divergent views with respect to whether it was easier to understand their lecturer when learning online, with about one quarter (26.3%) not liking it, about one third (29.1%) to whom it made no difference, and around 41% who found it easier. However, around half of the students found learning more difficult. 46% of students stated that they spent more time reading, and 41.67% said that they had more time to consolidate their learning.

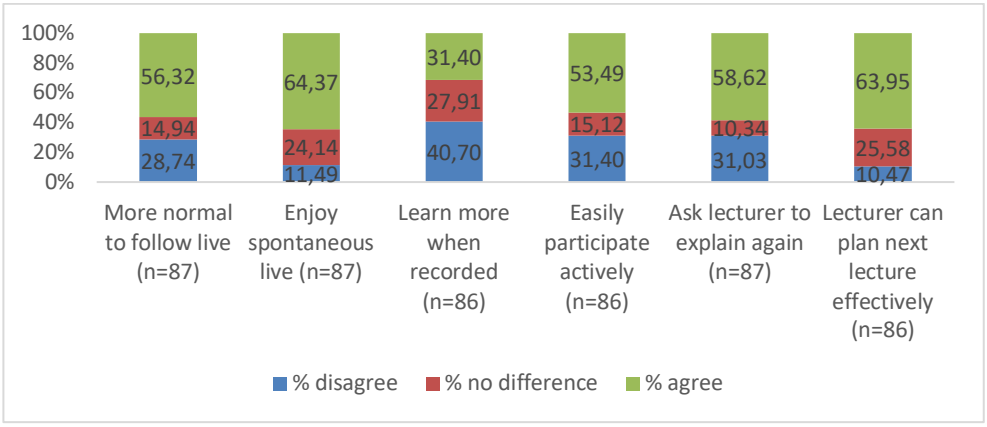

Figure 1. Impact on online learning.

There was an overall divergent opinion with respect to the quality of learning, with similar percentages stating that quality was higher, the same quality, and poorer (Figure 2). However, over half (60.0%) of the students stated that they missed the face-to-face interaction and around 40.o% were concerned about lack of support for learners. About one third were more worried about reduced teaching time and content. One major concern for many (66.20%) with respect to their wellbeing was that they could not maintain long hours of online engagement and that learning had become more teacher-centred (around 79%). They also did not like that there was a diminished level of student engagement (60.0%).

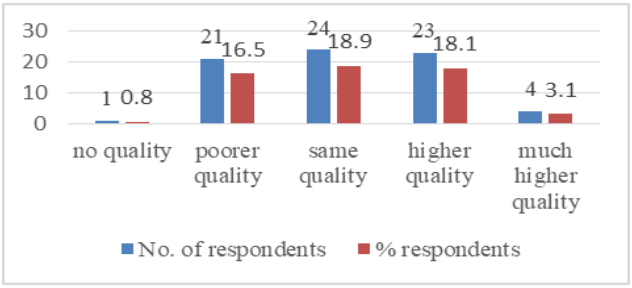

Figure 2. ITE's students' views on quality of learning during COVID.

These responses show that not only learning may have been harder for some during lockdown, but that even their wellbeing was impacted. On a positive note, quite a number of students seem to be resilient. In fact, many of the students indicated that the support of their family helped them deal with the COVID situation. As a Mediterranean country and culture, family structures are very important in Malta. This aspect has helped many of the students' wellbeing as they could deal better with the constraint of having to be physically separate from their friends. Students were also asked to indicate what they would keep from their learning experiences at post-COVID. It appears that, having experienced both online and

face-to-face learning at University, that over half appreciated the positive aspects of both approaches, and were also positive with respect to keeping a blended approach (Figure 3). This has implications to ITE at post-COVID phase.

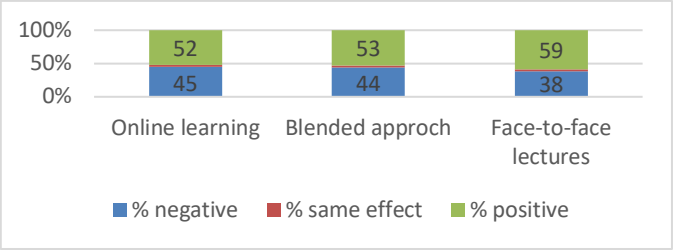

Figure 3. ITE students' preferences for different modes of learning.

6. Discussion

A conceptual model emerged from the impact of COVID-19 on ITE students. The model highlights tension in ITE students' psychological need and wellbeing; colonised legacies in HE; and a way forward for more inclusive learning for all. This first exploration study points strongly towards the need to conceptualize HE teaching and learning in ITE.

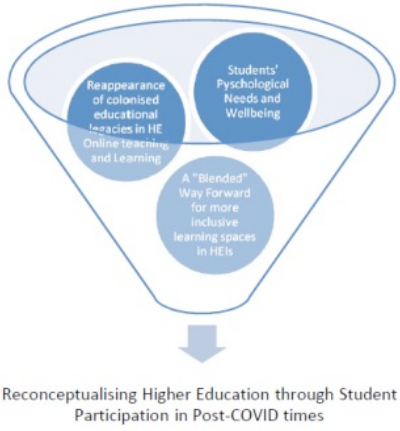

Figure 4. Conceptual model on reconceptualising ITE within HE.

Theme 1: Battling a Crisis Online - Students' Psychological Needs and Wellbeing: Students' responses highlighted how they battled with COVID-19 limitations. Their positive views of spontaneous interaction with other students and lecturers reflected a craving need to belong and connect (relatedness). The students' voices highlighted how they (60%) missed onsite

face-to-face lecturing and (66%) could not endure long hours of online engagement. These responses highlighted how the psychological need for wellbeing (Self Determination Theory) was not met for the majority of students who experienced stressful situations (Agormedah et al., 2020). This implies that if online lecturing is to be kept as part of students' teaching and learning modes in post-COVID, the number of daily online lectures need to be taken into consideration. The length of each online lecture could also be rethought together with the monitoring of quality eLearning is to be carried out.

Theme 2: A blind spot? Lingering colonised educational legacies in HE online teaching and learning in Malta: Using the Self Determination Theoretical lens (Deci & Ryan, 1985), competence and autonomy in the new adopted modes of online learning appear to have decreased. Most students (n=79%), declared that learning was more teacher-centred, involving passive note taking and using the mute all button (transmission of knowledge). Students need to feel in control of learning (autonomy) to develop mastery of knowledge and skills (competence). Students have differing needs depending on their cultural and environment contexts. Not everyone will seek autonomy if others control the situation and here is where the culture structure of Malta becomes important. Malta, as an ex-British colony, has inherited a legacy of formal education, elements of which are still reflected within its 21st century educational system (Baldacchino, 2019). Albeit the political, curricular and pedagogical efforts by local education professionals for a more progressive education philosophy, an existing 'blind spot', reflecting a dogged struggle for independence, autonomy, and control during COVID-19 in a postcolonial Maltese HE context has emerged. It is thus important for lecturers to engage in professional development on effective online teaching and learning to maximise and make remote eLearning more meaningful and responsive to today's students' needs.

Theme 3: The Way Forward - A Blended Approach for more inclusive learning spaces in a Post-COVID University of Malta? Individual differences in learning styles and preferences are rooted in childhoods and cultures and are reflected in the students' views on (i) the quality of remote online teaching and learning, and (ii) the preferences for future HE pedagogies. The University of Malta should take into account the students' voices by adopting a post-COVID blended and more inclusive teaching and learning approach through the integration of online and onsite face-to-face learning spaces. Also, in a post-COVID era, ITE within HE programmes should consider revisiting the course content and delivery through students' views to equip future teachers with the necessary values, knowledge and skills needed within their contexts.

7. Conclusion

This paper sought a deeper understanding of the impact of the COVID-19 pandemic on ITE students at the University of Malta. It highlighted the need to consider both students' learning as well as their wellbeing in ITE. Based on the findings, some recommendations for HEIs

include: lead by 'listening' rather than 'talking' within a shared democratic vision; embrace students' right to active participation in HE; extend wellbeing services and assistance through outreach programmes; provide spaces in ITE programmes to deconstruct the roots of education philosophy before moving forward (reconstruct); promote learning that recognises students' individual needs, and increase their wellbeing; build and sustain an infrastructure for integrating blended learning; and implement quality and more inclusive learning spaces. The study has its limitations tied to a focus on ITE students in one HE institution in Malta. However, from a geopolitical angle, the sharing of students' teaching and learning experiences within HEIs in Europe, may serve as a valuable input for forthcoming discussions regarding higher education policy and reforms among European governments, policymakers and educators. Ultimately, it is the core mission of the Bologna process to enhance the quality of learning and teaching in HEIs, and student participatory research is key to inform policy and practice.

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'How it started/how it's going': Aligning Teacher Educators' designs, approaches and identities in our new online reality

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Abstract

E-learning scholars have long predicted the conversion of conventional education to online learning spaces. That conversion has now happened. Regardless of what occurs in a post-pandemic era, teaching and learning will never be the same. Where does that leave teacher educators (TEs) who grapple with how to best prepare future teachers for the new era? The aim of our research was to determine the impact of supporting a small group of Chilean TEs in re-designing their online instructional approaches by aligning them with contemporary learning theories and goals. In the Chilean context, prior to the pandemic, e-learning was still on the periphery, and transitions from teacher-directed approaches had only just begun. In this 10-month qualitative inquiry, we focused on the TEs experiences online as they adopted sociocultural-based, 21st century instructional designs, and implemented strategies intended to promote agency and engagement in their students. The TEs long-held teacher-centric identities and approaches sometimes interfered in this trajectory. Yet, their heightened critical awareness of the ineffectiveness of traditional teaching paradigms in online settings combined with their grounded efforts and perseverance, resulted in positive evidence of 'real' change to their designs, practices and identities – changes many have been seeking in educational systems for some time.

Keywords: *Teacher education; online learning; sociocultural-based instructional design; identity; 21st century principles.*

1. Introduction

> "*Nothing has to stay the way it is…Anything that seems set in stone or inalterable can indeed change*."
>
> (Angela Merkel, address to Harvard University graduates, 2019)

The world irreparably changed in 2020. Nowhere is this more evident than in the contexts of health and education. In both areas, front line workers have had to make adaptations to their daily practices that have had serious consequences for many people. Yet, it is upon these individuals that the weight and responsibility has fallen to react at the ground level. In the field of education, with more than 1.3 billion students worldwide out of school (UNESCO, 2020), teachers have been scrambling to find ways to ensure that formal learning continues. TEs have had the added burden of grappling with preparing pre-service teachers (PSTs) for a future reality post pandemic that is yet unknown. This dilemma is being faced where both PSTs and TEs, like many others, struggle in online spaces for the first time. In 2019, Angela Merkel, the well-regarded Chancellor of Germany, could not have foreseen the current situation, but her words cited above certainly warned us of the impermanence of systems, even notoriously resistant ones, such as education.

An abundance of research documenting the educational challenges in this new evolving reality is just beginning to appear (Scull *et al*. 2020). Despite the volume of emerging scholarship, relatively few theory-based studies are reporting on the experiences of TEs and the implications that the 'new world order', or 'dis-order' is having on their practices. Given these unprecedented global events, many questions arise about the future of education. Where will teachers practice? Will it be online or in a blended scenario? Or if face-to-face, will their conventional practices suffice in the new world? Will the boundaries between formal and informal learning become even more blurred? In recent World Economic Forum reports (Scheleicher, 2021) those deliberating these questions and the future of education predict a more human-centred system, where digital literacy, adaptability and resilience will be key. The responsibility falls on TEs to model these qualities and the practices that promote them.

Considering the educational realities in 2020, the aim of our research was to examine the impact of supporting TEs in re-designing their practices online as they aligned them with contemporary learning theories and goals. We focused on a small group of Chilean TEs as they taught PSTs online for the first time. The following questions were formulated to guide the study:

1. From the perspective of this small group of TEs, in what ways were their teaching practices unsuccessful in transitioning to an online scenario?
2. What impact, if any, does a more human-centred and learner-centred design have on these challenges?

3. In the TEs views, what influence do these changes have on the way they see their roles, their own identities, and practices as educators?

2. Implementing contemporary theory and goals in online learning designs

For over two decades, scholars working in the area of technology and learning have extolled the potential of technology to bring about much needed change in higher education (Garrison & Kanuka, 2004) while some, like Prinsloo (2016) acknowledge major dissention and disappointment. From this debate coinciding with emerging global discourse around 21st century learning goals, online learning is proving to lead to multiple benefits - increased learner engagement, self-directed learning and regulation skills, creativity, and critical thinking (Charbonneau-Gowdy & Chavez, 2019). Adinda & Mohib (2020) have shown that such benefits are not an automatic result of the various affordances offered by technology, but rather dependent on the essential epistemological conformity that exists between instructors' professed approaches and their actual practices in online spaces. It is not enough to espouse 21st goals and contemporary learning theory in online learning spaces, if instructors' *designs* and *practices* fail to promote agency, social cognitive presence, and identity empowerment (Smith *et al*. 2016), reflective of these theories and goals. Thus, in the case of TEs teaching online for the first time, the confluence of their instructional designs, approaches and practices in online spaces had serious implications for the profiles that PSTs mediate and their future effectiveness as professionals in the aftermath of the pandemic.

Essentially, instructional designs based on sociocultural perspectives place emphasis on the roles of learners, their agency and the kinds of identities as learners they mediate in the learning context. These social learning/learner-centred designs are rooted in Vygotsky's (1981) groundwork to establish the critical implications of social interaction to higher order thinking. These designs often reflect 21st century learning goals, project-based learning, problem-based learning as well as adult learning principles (Garrison, 2017). In online environments, learner-centred designs are distinguished by a focus on knowledge building, support for interpersonal interaction, freedom of choice, opportunities for mentoring and feedback, access to a variety of educational and technological resources. Teacher-centred designs focus primarily on content configurations and textual management tools (Adinda & Mohib, 2020).

In a recent study, Margarayan *et al*. (2015) assessed and compared the instructional design quality of 76 Massive Open Online Courses (MOOCs). Their findings revealed that most of these courses fared poorly based on the assessment of their instructional designs. Of interest to our study was the framework built on key instructional design theories and models (Merrill, 2013), that the authors used to assess the quality of the online courses and the design approaches that supported them (p. 78-79). We found the framework and the key questions

used in their analysis (p. 80-81) applicable to our study and a way to concretize the sociocultural perspectives. Their study allowed us to draw inferences as to the causes of the challenges that the TEs were facing in their practices in our own inquiry and with this knowledge work towards design solutions.

3. Methodology

3.1. Employing a design-based research approach

A design-based research approach was used in the study. Design-based research is considered an emerging methodology, connected closely with educational contexts and involving teachers' situated use of Information and Communication Technologies. Typically, the research involves multiple iterations and collaboration between researcher(s) and practitioners and has a pragmatic influence on practice (Anderson and Shattuck, 2012, p. 16–18). In the present study, there were two iterative cycles coinciding with the two semesters in 2020 in the Chilean context.

The *first iteration*, from March to July 2020, served for analysis and exploration: analyzing the challenges TEs faced in online courses and exploring changes to strategies and course designs. Community-building strategies were considered a priority and included: TEs contact of absentee students, personal images/photographs and videos posted on course web environments in the pre course period and sharing of stories and interests in initial synchronous sessions. Increased opportunities to build student agency were planned, for example, group projects, pair work and involvement of students in assessment processes.

In the *second iteration*, from August to December, substantial design changes were constructed by TEs in their individual courses. Ways to operationalize the designs into practice during the semester included for example: using short "micro teaching chunks" instead of lecturing to teach content; exploiting discussion forums and learner-generated materials for teaching, building critical thinking and improving skills and knowledge; increasing feedback (peer and teacher); co-constructing rubrics with students; initiating group assessment; use of authentic material, flipped classroom scenarios and critical thinking discussions in synchronous sessions.

These two iteration cycles were followed by a period of reflection and evaluation through TE and PST interviews and online conversations with the researcher.

3.2. Context and Participants

The study took place in 2020 with a group of 4 full-time Chilean teacher educators, 2 males with 35 and 31 years of teaching experience and 2 females with 9 and 38 years of experience, plus a researcher. The TEs were teaching a variety of course subjects to 17 first year

undergraduate students enrolled in the English pedagogy teacher preparation program. Thus, neither the majority of students nor the TEs had ever met one another face-to-face. The courses included: Phonetics, Language in Use, Writing, Reading, Speaking and Listening.

In Chile, one of only three members of the OECD in Latin America, the advancement of English is considered a major priority of government. Despite economic stability, the country's system of education is still evolving to meet higher educational standards reflective of developed countries - a goal that many say will be determined by the quality of its teachers. Most HE students are first generation and from clearly divided socio-economic backgrounds. Obvious disparities exist in terms of access to IT resources and the cultural capital students bring to their study programs.

3.3. Data Collection and analysis

Qualitative data tools used as data sources included: both mid and end-of-year TE and PST interviews, a student questionnaire, observations of digital teaching environments and field notes. The field notes consisted of a) recorded data from six hours of Zoom design conversations between TEs and the researcher and b) student year-end reflective self-assessment portfolios (*n=17*). A student questionnaire after the first semester gathered feedback from student PSTs about their experiences online during the first cycle of the study.

Data was analyzed using a combined inductive-deductive process (Miles *et al*., 2014). After establishing a conceptual framework, a series of iterative steps were taken that included: I) inspecting the data sets for data that could inform the research questions, ii) multiple readings and considerations of the data sets, iii) condensing and coding the data for key concepts and ideas that related to the theoretical framework and literature review; iv) identifying and refining salient or common themes from coded data; v) forming a conceptual framework that could be corroborated by findings. Open communication between TEs and the researcher allowed for cross-referencing and added to the reliability and validity of the findings.

4. Analysis and Findings

In analyzing the abundant data from the various data sets of our inquiry, two key overarching themes were uncovered: 1) initial status quo designs and their impact on the practices, roles, and identities of TEs and PSTs and 2) TE's changing designs and the impact on their own practices, roles, and identities. A deeper analysis of these themes revealed that the transition from one design to the other had an important influence on practice and identity.

4.1. Impact of status quo designs online on practices, roles, and identities

When the directive came from above for TEs to conduct classes online on the institution's Blackboard system, Consuelo, Rosario, Javier and Héctor were faced with teaching a new

cohort of 1st year PSTs in a virtual space for the first time. All TEs reported that they were understandably *concerned*, *fearful*, *lacking in confidence* and *self-efficacy*, *overwhelmed*, and even *bored*, yet determined "to try to do our best" (Javier,1st Interview). Each of the TEs reacted quickly to attempt to understand the technological tools, the multiple affordances available with these tools and their limitations, and to apply each of their well-established personal instructional design frameworks for teaching the course. These designs were for the most part content-centred, information-driven and teacher directed, evident in the reliance on teacher-chosen and created course materials, lecturing and classic assessment formats. As Javier remarked reacting to a student questionnaire comment: "We gave everything to them. We are like mothers and they [PST students] are like children" (2nd Interview) illustrating the control and responsibility that TE's typically held for learning. In response, the PSTs showed increased absenteeism, boredom, and a reluctance to engage - cameras and microphones were kept off and there was little student activity on course websites. Ironically by the end of the first semester, when their preoccupation to engage PST students had met with little change, all four of the TEs reported feeling a loss of control and a sense of disempowerment. In response to his failed efforts to elicit discussion Javier remarked at the end of the semester: "I gave up!" (1st Interview).

At the same time, the TEs' traditional designs and practices had a significant impact on the PSTs on several levels. In reaction to the lack of personal contact and teacher-controlled practices, many students revealed feelings of *stress*, *being overwhelmed*, *unmotivated* and *anxious*, feelings that were confirmed across multiple data sets. In synchronous classes, the PST's refused to open their cameras or use audio; only a few would add comments to the chat. Many were absent as the semester progressed and some appeared only for assessments. The behaviours and sentiments uncovered from the various data sets indicated that there was a shared sense of disempowerment both on the part of TEs and the PSTs.

4.2. Contemporary learning theory designs' impact on practices, roles, and identities

After analyzing the emerging data from the first semester, the TEs felt: "forced to make changes and rethink our effectiveness" (Rosario, 1st interview) and to move *beyond their comfort zones*. In team collaborations with the researcher, they began to initiate an about-turn in their course designs. These new designs entailed new practices based on key features and proven instructional principles for effective 21st century-based online learning (Margaryan *et al*. 2015). In Javier's phonetics course, students posted explanations of their pronunciation issues and sought *feedback* from classmates, thus *building on their own existing knowledge* and *co-constructing new skills*. In all four courses, *authentic materials* were implicated – for example, invitations to faculty webinars offered by experts on "real teaching issues"; social media materials replaced Power Point presentations; reading assignments on current world issues replaced textbook content. *Critical thinking* was promoted in a variety of ways. In Rosario's course, students shared their assignments with

classmates to analyze mistakes and recommend improvements. Mind maps in reading served a similar purpose in Consuelo's course. Javier *significantly altered his assessment practices* – students in groups were challenged to spot transcription errors in authentic text rather than completing individual multiple-choice tests. In Javier and Héctor's courses *students took on the role of expert* by *collaborating* in groups *to create* and present chunks of theoretical content and involve classmates in related activities. Online forums organized by Javier encouraged students to *share opinions and expertise* and to *problem solve*.

These new instructional practices were accompanied by and supported *building community* online - increasing *group work*, sharing personal stories and peers helping peers. Together they had important implications for the TE's roles and identities. As instruction became increasingly a shared responsibility, they began to assume the role as guides and facilitators, rather than lecturers. Javier noted: "I used to be in front of the class teaching them the main principles of phonetics and then practicing. This time it is flipped." (2nd Interview). His words reflect an emerging image of the TEs moving from the front of students to their sides, and assuming identities as trusting team players focused on working and learning together. Increasingly over the semester, the TEs portrayed identities as professionals that were characterized by confidence, creativity and resilience, identities that were acknowledged by the PSTs. Regardless of the TE's recognition that there was still much progress to be made, they also were aware that the changes made were irreversible. Rosario declared emphatically: "Even when we go back to onsite teaching, I will definitely not teach the same way I used to teach before this period of online teaching. I will definitely be moving away from my comfort zone all the time." (1st Interview). It is worth noting that in Hector's final class, all cameras and microphones were turned on.

5. Conclusion

Our findings provide clear evidence that there are solutions to the chaos and disruption in education presently. The findings of our study indicate that TEs can help lead that charge. The process began with the TEs recognizing that applying their well-honed conventional practices in their online courses led to unresponsive, disengaged, and discouraged PST behaviours and few signs of learning (RQ1). In response, the TE's took unusual steps to adopt new practices aligned with contemporary learning principles. Moving progressively from teacher-controlled to learner-driven practice in the new online setting resulted in promising signs of self-directed, creative, critically thinking, and responsible students, driven to learn and be collaborative (RQ2). As for the TE's, their bold steps to connect theory to their designs and practice required confidence, courage, creativity, and resilience. These indications of new professional identities were accompanied by 21st century teacher roles as trusted learning guides and creators of strong learning communities (RQ3). Despite the limited size of the study, the encouraging results call for further research in this area and in broader contexts.

This pandemic has caused many of us to see our ordinary practices, through new eyes; this study has evidenced the advantages of exploiting this opportunity for finding answers to the educational challenges that for so long have alluded us.

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Getting to know you: Student-faculty interaction and student engagement in online courses

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Abstract

Covid-19 presented many challenges to universities as brick-and-mortar courses were moved to an online format. This work is an unofficial study of learner-instructor interaction and student engagement in two 7-week online graduate-level courses conducted in Spring 2020, Fall 2020, and early Spring 2021. Research shows that instructor presence in online courses leads to increased student engagement, as well as motivation, well-being, and academic achievement. Student engagement is shown to have a direct impact on a student's emotional, behavioral, and cognitive successes. This work proposes that increased learner-instructor interaction in online courses using strategies lead to greater student engagement with the course, and greater student success in overcoming barriers and challenges to online learning.

Keywords: *Online courses; student engagement; learner-instructor interaction; Covid-19.*

1. Introduction

With the spread of Covid-19 in the spring of 2020, most, if not all universities, chose to move all their courses online. As quarantines and social distancing continued in various forms around the world, online learning became more of an expectation than an option. Beginning in Fall 2016, it was reported that 31.6% of higher education enrollments in the United States were in online courses (Seaman, Allen, & Seaman, 2018). Preliminary numbers state that 97% of college students switched to online instruction by June 2020 (Educationdata.org), while at the same time, university presidents were concerned with online course challenges such as maintaining student engagement, faculty training in online teaching, student success, and achieving academic standards.

The transition from face-to-face classes to online classes is a challenge under the best of circumstances, but as higher education moves into a 'new normal', faculty development and training can now assist in the event it is necessary to move online again. Organizations, such as Quality Matters (www.qualitymatters.org) and the Online Learning Consortium (www.onlinelearningconsortium) work with universities, faculty, students, researchers, and faculty development administrators to provide the tools, resources, and community that help faculty design, develop and facilitate quality and engaging online courses.

Having taught asynchronous online courses for five years, I have spent a great deal of time learning to produce quality courses for a graduate-level public administration program. At the time our university went into quarantine in mid-March, my three online classes were designed in line with the Quality Matters Rubric, 6th Edition. In the Spring of 2020, I was registered for a series of seven courses taught online through Quality Matters, which, upon passing, would allow me to earn the Quality Matters Teaching Online Certificate that "enables instructors to demonstrate their knowledge mastery of online teaching" (Quality Matters, 2020). While many of my colleagues were focusing on moving course material onto the LMS and learning Zoom, my primary focus was on my students. This piece presents my experiences teaching three asynchronous online courses during our Covid-19 quarantine year, particularly regarding learner-instructor interaction and student engagement.

2. Literature Review

2.1. Learner-Instructor Interaction

Learner-instructor interaction is not a new topic in academia and the research has shown there to be many benefits. Long before online courses, Chickering and Gamson (1987) found a strong association between learner-instructor interaction and student learning, and that frequent contact outside of class is valuable for student motivation, well-being, and intellectual commitment. Komarraju, Musulkin, and Bhattacharya (2010) discuss the role

these interactions play in students' academic progress, motivation, and achievement, though the identity of the aspect of the relationships that are helpful as well as why some faculty are more approachable than others are still unclear. Gray and DiLoreto (2016) found that many online students feel a disconnect from their classmates and instructor. The responsibility for a reconnect falls to the instructor through course structure, content, and feedback (Collis, 1998; Everett, 2015; Muirhead, 2004; Shearer, 2003). The role of the instructor is not just to teach content, but to establish a presence in the course from the beginning, to bring personality into the course content, and ask for and respond to student feedback on the course (Jaggars, Edgecombes, & Stacey, 2013; Shea, Li, and Pickett, 2006; Tu & McIssac, 2002).

Cox (2011) in a review of decades of research on learner-instructor interaction, developed two conclusions: "(1) interactions between faculty members and students have positive effects on student outcomes, and (2) such interactions do not occur as regularly as educators might hope" (p. 49). This study was conducted at a brick-and-mortar institution, as opposed to online. Traditionally, the interactions between faculty and students may be limited to office hours, first-year seminars/orientation programs, accidental meetings, university or department social events, or living-learning communities. But if brick-and-mortar interaction does not occur frequently enough, do online interactions occur frequently enough?

Newton-Calvert and Arthur (2018) discuss a "myriad of easy" (p. 173) to incorporate teaching presence into an online capstone course: emailing a pre-course toolkit out to students before the course starts, with the syllabus, an instructor introduction, and clear guidelines on instructor communication and availability. While instructor presence looks different online, it can be successful, particularly if the course is developed with the student in mind and focuses on various modes for student learners. Riggs and Linder (2016) developed active learning approaches for the asynchronous online classroom utilizing technological and pedagogical activities to mirror face-to-face teaching methods.

2.2. Student Engagement

As with learner-instructor interaction, student engagement is an often-studied topic and one that has many definitions. Bohemia *et al*. (1997) defined student engagement as "students' willingness, need, desire, and compulsion to participate in and be successful in the learning process" (p. 294). Upon completing a workshop on student engagement in online courses, Briggs (2015) saw online student engagement as overcoming social, administrative, and motivational barriers to online learning. Dixson's (2015) research measuring student engagement, defined it as "generally, the extent to which students actively engage by thinking, talking, and interacting with the content of a course, the other students in the course, and the instructor… is a key element in keeping students connected with the course and, thus, with their learning" (para 3). Finally, Kahu *et al*. (2014) stated that student engagement has

a direct impact on "a student success and achievement due to a student's emotional, behavioral and cognitive connection to their study" (p. 523).

Martin and Bolliger (2018) reviewed the relationship between interaction and engagement, finding that "engagement is developed through interaction" (p. 206) and when it comes to online learning, supporting that interaction is important. Research has identified three interactions in effective online courses: Moore (1993) identified (1) learner-to-learner interaction, (2) learner-to-instructor interaction, and (3) learner-to-content interaction. Leer *et al*. (2010) found a similar interaction with peers, instructors, and content, which "help online learners become active and more engaged in their courses" (p. 206). Martin and Bollier's (2018) study, based on Moore's (1993) framework, reviewed the various strategies, and whether age, gender, and years of online learning experience affected the students' perception of the strategies.

2.3. Student Satisfaction

Garrison, Anderson, and Archer (2000) developed a framework with significant elements that help explain student success in online courses: teaching presence, social presence, and cognitive presence. Focusing on teaching presence, focuses on three components of the online course: design and organization, facilitation, and direct instruction (Fiock, 2020). Community of Inquiry combined with an adaptation of Chickering and Gamson's principle of good practice, list instructional strategies that are common strategies for increasing instructor presence in online courses, such as prompt response to, showing personality, sense of humor, diverse activities, and being active in discussion boards.

Alqurashi (2019) studied factors that "predict and relate to student satisfaction" (p. 134), such as online learning self-efficacy (OLSE), learner-content interaction (LCI), learner-instructor interaction (LII), and learner-learner interaction (LLI). Interaction is critical in all learning, particularly online, whether it's between students, between the student and instructor, or between student and content. Many instructors assume that online courses mean there is no learner-instructor interaction, however, the results of this study show that online learning self-efficacy, learner-content interaction, and learner-instructor interaction are major factors in student satisfaction. While studies have agreed that interaction is a predictor of student satisfaction, there is still disagreement as to which type of interaction is the most significant predictor.

3. Unofficial Study

3.1. Spring2020: Under Quarantine

My university went into quarantine in mid-March 2020 and never came back from Spring Break. University administrators, the Faculty Development Center and the Online

Champions (representatives from each college chosen for their experience in online course design) worked to assist faculty in moving all face-to-face classes onto the LMOS, Canvas, for online access. Workshops were scheduled to explain various apps or programs, such as Kahoots or FlipGrid, practice using Zoom, which the University had only obtained a license for in Fall 2019, and answer any questions that came up.

All my classes had been designed directly onto the LMS from the beginning of the semester, so there was nothing for me to move online. Initially, I did not make any changes to my courses at all. Once the students 'returned' from Spring Break, it became clear to me that even though I had not had to move any of my courses or course work, there were changes that needed to be made to accommodate graduate and undergraduate students during this challenging period.

- Students were no longer penalized for late work. I let each class know the absolute latest I could accept their work based on when final grades were due to the university. I posted regular announcements (written and video) reminding each class of the due dates.
- Regular videos were posted to the announcements asking students if they were doing okay and reminding students that if there was anything I could do to assist them, to email me and I would do what I could.
- Course workload for each class was reduced. Three of my classes were completely online, to begin with, and demographically, all of my classes were primarily non-traditional or online students with jobs, families, and/or other responsibilities that prevent them from attending class on campus. Not being aware of what was happening on their side of the monitor, the best I could do was reduce their academic workload.
- Redo and resubmit for all assignments with low grades were permitted.
- When a student asked for help or if I noticed an issue and reached out to the student, the student and I worked together to solve the problem in order for the student to succeed.

3.2. Fall 2020 & Spring 2021: No More Quizzes

In August 2020, our university opened an e-campus with four graduate programs from the Business School and the Master of Public Administration program. The online courses were switched from 8-week semesters to 7-week semesters and go through a design, development, and review process following the Quality Matters guidelines and rubric. I designed and developed two 7-week courses that began the first day of classes, along with two full-semester courses, one undergraduate online course, and one stacked Zoom class. Both of the 7-week online courses pass the Quality Matters review at 100%.

In online class A, I removed and replaced all quizzes with discussion boards. Orlando (2017) and Darby and Lang (2019) question the standard instructions that require "respond by this day then come back and respond to two or your peers," because it doesn't "foster stimulated, authentic, and creative social interactions in which students can learn from each other" (Darby & Lang, 2019, p. 84). In other words, conversations don't normally happen that way. The instructions for my instruction boards read:

Instead of a quiz, let's discuss a real-world situation. For full credit, you will need to respond to the scenario, but you will also need to come back and participate in the discussion by responding to your classmates. In order to receive full credit in your initial response (15 points), you must respond to all three questions (5 points each). You must come back and respond to at least one of your peers before the discussion closes (5 points). Once the discussion closes, it will be locked, and no late submissions will be accepted. Responses to classmates such as "I agree!" "Great idea." and "Awesome!" are not considered responses. Your responses are expected to contain substance and explain why you agree or disagree. Supporting your response(s) with the course readings would be ideal!

Students commented that they preferred the discussion boards to quizzes, and by incorporating the module topics into the discussion board, additional assignments were unnecessary. Students also communicated that they did feel a sense of community in the discussion boards, which is important for student-student interaction in online courses.

3.3. Fall 2020 & Spring 2021: Getting to Know you

Instead of assigning a whole research paper in a 7-week course, particularly in an introductory public administration course, I only assigned the first part of the paper. Many of these students, non-traditional students, were returning to school after several years and unfamiliar with academic research, how to find academic research, what a literature review is, etc. The assignment was broken down into parts and a different part was assigned in each module in order to explain how to do academic research, what is considered academic research, developing a literature review, etc. Wray and Montgomery (2019) agree that non-traditional students deserve additional attention and discuss a webinar series that scaffolded research topics allowing students to develop the research skills needed to succeed.

One portion of the assignment required each student to meet with me. The meetings would run from 5 minutes to half an hour and the meetings were two-fold: one, it gave me the opportunity to get to know the students a little bit, and two, see how they were doing on their paper. After a greeting, my first question was, "Why did you decide to join our program?" We would discuss why the student applied to the program and plans upon graduation. Course suggestions may be offered, questions answered, and then the paper was discussed.

All students are graduate-level students of varying ages, ethnicities, and locations. Many students were nervous about meeting with me face-to-face but were fine within a few minutes. Conversations were easy flowing and there was some laughter in the conversations. I wasn't a complete unknown to the students as I regularly posted announcements, introductions to the module or topic, or responses to questions on assignments via video.

3.4. Fall 2020 & Spring 2021: Interactions

Many of the suggestions made to encourage interaction between faculty and students, I have been doing for over a year. I email online students two weeks and then one week before classes start with a copy of the syllabus. During the semester, I regularly remind students that their emails go into my cell phone and that I will respond to their emails relatively quickly. I end all my videos with "And as always, if there is anything I can do to help, please do not hesitate to email me or make an appointment with me using my calendly link."

I believe that the interactions between the students and myself in these two classes have had a positive impact on student learning. I have received student feedback and comments such as:

- "I wasn't sure if I was doing the assignment right and then I watched your video…"
- "I have never had a professor meet with me online like this before."
- "Dr. M, you were the only professor (this spring) to ask me how I was doing."
- "I feel so much less stressed since there are no late penalties."
- "Thank you for being so lenient on due dates."
- "Thank you for letting me redo that assignment."

4. Conclusion

While moving courses online during the pandemic was stressful, for me it was an opportunity to focus on student engagement. By making accommodations for all students from the very beginning, I attempted to take some stress out of an extremely stressful situation. The impact was that these changes are now a standard part of all my classes, online or face-to-face. I also believe that these interactions have helped with student engagement. There is a sense of community (student-student interaction) that I feel when I grade the discussion boards, which in general, have high response rates and quality responses, that I haven't see in previous semesters. In the 'Help Each Other' discussion boards, students are respectful, thoughtful, and helpful in the assistance provided to their peers. And based on the number of emails I receive from students on a regular basis, I know that these students are putting a lot of work into these classes. As their professor, it is my job to be there for them and to help them succeed, and to make that they are, indeed, satisfied.

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Hiding in Plain Sight: Literacy Development Possibilities in Initial Teacher Education

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Abstract

The development of literacy competencies among second-level school students has been highlighted, by the Programme for International Student Assessment as 'vital to succeed in society'. Literacy competency development has become the remit of all teachers, in all disciplines and initial teacher education programmes have a responsibility to address this. This paper aims to explore the provisions made within one Irish Initial Teacher Education programme, for the development of teaching strategies to enable literacy competency development within the technical-subject classrooms at second level. It also explores the perspectives of its pre-service teachers on this topic. A mixed method case-study was conducted, collecting data through questionnaires, dialogic-discussion groups, focus-groups and interviews. A key finding was the challenge in defining 'literacy'. This ambiguity left pre-service teachers and teacher-educators unsure of expectations in this regard and resulted in a missalignment between the theory being taught and pre-service teacher practice. Technical-subjects are unexpectedly rich in opportunities to develop literacy competency. However, only some pre-service teachers were recognising the potential for literacy development within these subjects. Further training is required to address the challenges highlighted in this paper and to equip pre-service teachers with the appropriate tools to meet the literacy demands of today's technical-subject students.

Keywords: *Literacy Competency; initial teacher education; technical subjects; pre-service teacher.*

1. Introduction

Societal needs are evolving rapidly, and this is further compounded by the COVID-19 pandemic. It is vital to ensure that today's young people are equipped with the competencies to adapt and to deal with whatever challenges are put in their way. One such competency is literacy, which has received significant attention in Ireland over the past decade. Ireland has always prided itself on having a 'world class' education system (Printer, 2020; Conway & Murphy, 2013). However, when The Organisation for Economic Co-operation and Development (OECD) published the results from its Programme for International Student Assessment (PISA) in 2009, Ireland's scholarly standards of literacy had fallen significantly (Cosgrove & Cartwright, 2014). In response to this, the Department of Education and Skills (DES) published Literacy and Numeracy for Learning and Life: The National Strategy to Improve Literacy and Numeracy among Children and Young People 2011-2020 (DES, 2011), with the hope of bringing about reform in this area. The reform most relevant to this research, was the Junior Cycle reform (age 12 – 15). The Framework for Junior Cycle (DES, 2015) suggests a shift in focus to 8 key skills, including literacy, across all subjects (NCCA, 2015).

This paper aims to explore the provisions made in one Irish Initial Teacher Education (ITE) programme, for the development of teaching strategies to enable literacy competency development within the technical-subject classrooms at second level. It also explores the programme's pre-service teacher's perspectives on this topic, seeking to investigate how literacy competency development can be incrementally embedded into the case-study ITE programme, at Galway-Mayo Institute of Technology (GMIT), Letterfrack. A mixed method case-study approach was chosen to capture the interpretations of its participants, which is discussed further in section 3. The following section explores literature relevant to this study.

2. Literature Analysis

The literature analysis highlighted several elements of interest to this study. Defining literacy for the purpose of this study proved challenging. This demonstrated the need to establish what literacy development meant from the perspective of the pre-service teachers (PST) and school-placement tutors (SPT). Secondly, the literature was explored to establish the provision within ITE for training PSTs to develop literacy competencies in the classroom. The literature was explored to establish how these subjects enable the development of literacy competencies.

There is no universally accepted definition for literacy (Cambridge Assessment, 2013). The term no longer just refers to the ability to read and write, but to a deeper understanding and a relevance to the world around us (O'Donoghue, 2002), with definitions varying significantly depending on the context. Both Irish stakeholder's (DES and NAERM) and

international assessment programme's (PISA and PIACC) definitions of literacy are demonstrated in Table 1. below.

Table 1. A Comparison of Literacy Definitions.

Where:	Name:	Whom:	How:	Why:
Ireland	DES	3 - 18 years old	Read; Understand; Critically appreciate	
	NAERM (ERC)	2nd class & 6th class	Construct meaning; Communicate through written language; Interact with existing knowledge	Participate in communities; Read to learn Enjoyment
International	PISA (OECD)	15 years old	Understand; Use; Reflect; Engage with	Achieve goals; Develop knowledge and potential; Participate in society
	PIACC (OECD)	Adult	Identify; Understand; Interpret; Create; Communicate; Compute	Continuum of learning; Achieve goals; Develop knowledge and potential; Participate in community and wider society

Source: Adapted from (DES, 2011; Shiel, Kavanagh, & Millar, 2014; OECD, 2009; OECD, 2019)

These definitions differ as they are tailored for the cohort for which they are dealing. One common thread among the definitions explored above, is the ability to "construct meaning" (Kennedy, *et al.*, 2012). Another consensus is that they relate to the everyday life of the learner. Through analysis of the literature, the author has adapted the above definitions to reflect what literacy means in the context of this study. The author has defined literacy as:

- The ability to engage with, identify, interpret, and use both existing knowledge and new learning from printed text, spoken language, broadcast and digital media to construct and communicate meaning, and develop knowledge and potential, to enable the achievement of goals and the participation in community and society.

Murphy, Conway, Murphy & Hall (2013) suggest that a high percentage of PSTs had what may be considered a 'traditional understanding' of literacy. They also suggested that the defining of 'literacy' can differ significantly, depending on the context of social practice.

It is now well established by a variety of policy makers, including the Department of Education and Skills (DES), the Teaching Council (TC) and the National Council for Curriculum and Assessment (NCCA), that ITE is a key component in improving the literacy standards of Ireland's young people. Murphy *et al*. (2013) discussed the lack of responsibility taken by post-primary teachers, they had studied in this regard, suggesting a belief that literacy was "taken care of" in primary school. The Junior Cycle reform, whereby the

methods of assessments are changing, will enable the development of literacy competencies to have a more natural place within the curriculum. In the context of ITE, it is important to develop the ability to teach literacy (Garbe, 2017), but it is equally important to focus on the personal literacy skills of PSTs.

With the DES emphasising that "all teachers should be teachers of literacy" (DES, 2011, p. 47), there was a significant culture shift for teachers of subjects other than the core English and Irish subjects (Burke & Welsch, 2018). Traditionally literacy would not have been considered the remit of the post-primary teacher (MacMahon, 2014; Murphy, Conway, Murphy, & Hall, 2013). However, literature has shown that technical-subjects promote literacy, problem-solving, critical-thinking and higher-order learning (DES, 2011). With a significant amount of design-based content and the utilisation of problem-solving skills required within the technical-subjects, they provide many opportunities for the development of literacy competencies. Schooner *et al.* (2017) identify problem-solving and critical-thinking as key skills in design, stating that these competencies are addressed in technology and design education, as part of the subject matter and have been for centuries.

3. Methodology & Methods

This research focused on the ITE programme at the Department of Creative Education, GMIT, Ireland. Graduates of the programme, Bachelor of Science (Honours) in Education (Design Graphics and Construction) are qualified to teach post-primary level technical-subjects; Graphics & Wood Technology at Junior Cycle and Construction Studies and Design Communication Graphics at Senior Cycle. This research was grounded in a constructivist/interpretivist paradigm, which seeks to interpret meaning from the experiences and perspectives of its participants (Adom, Yeboah, & Ankrah, 2016). The chosen methodology for this research was a mixed method case-study, an approach chosen to obtain information on the development of literacy competencies from those involved in the programme, including programme staff, school-placement tutors (SPT) and pre-service teachers (PST). Ethical approval was obtained from the ethics committee at GMIT, and 94 participants gave informed consent to partake in the study. The data collection methods used in this research included questionnaires (no=84 – PSTs, SPTs & Educational staff), dialogical reflection groups (no=10 – 10 at each table including all cohorts mentioned above), focus-groups (no=2 - SPTs & management staff) and expert interviews (no=2 – literacy experts). The utilisation of multiple methods of data collecting facilitated the validation of the data collected through triangulation (Denscombe, 2010). The methodology used to analyse the gathered data was a thematic analysis using manual coding to generate themes and patterns.

4. Findings and Discussion

This section explores the findings from the primary research, in light of literature in the field; the challenges in defining 'literacy', literacy development within the case-study ITE programme and finally, the practice of developing literacy competencies within technical-subject classrooms.

4.1. Defining Literacy

There was an incremental approach to the development of both personal and pedagogical literacy competencies within the programme, which was apparent from an exploration of the programme documents, and from a notable shift in the vocabulary being used by the four different year groups, in questionnaire responses. The defining of 'literacy' ranged from what might be considered a traditional understanding of the term in 1st year, "Understanding of how to read and write", to a deeper understanding in 4th year, "Being able to use the skill of reading and writing to strive in the wider community. Being able to use the skills to develop as a human capable to strive in the 21st century", which aligns closely with many of definitions explored earlier. The word 'understand/ing' was used by 27 (of 69) participants. However, 13/20 were 1st year responses and 9/16 were 2nd year responses, indicating a belief that literacy is more than reading and writing but were unable to expand on this. Two participants from 3rd and 4th year referred to "critical-thinking" and "higher-order". Educational staff's (no=15) literacy definitions demonstrated a deeper knowledge of what we now understand to be literacy, "the capacity to effectively use and interpret text and symbols, including reading and writing", with 7 referring to "communication", 6 referring to "using/applying", 4 referring to "interpreting" and 3 indicating a connection to "society/life". However, when SPTs (no=5) were asked to define literacy in a focus-group, there was hesitation from all participants, indicating a lack of confidence in their ability to define the term.

4.2. Literacy Development within ITE

One finding that emerged from this study was a PST's awareness of the responsibility of all teachers in developing literacy competency in the classroom, regardless of the education level. Murphy *et al*. (2013) discussed the lack of responsibility taken by post-primary teachers in this regard. Interestingly, when the PSTs (no=69) in this study were asked to indicate the stage of their education that they most developed their literacy competencies, 29 responded "primary" and 27 responded "post-primary", indicating an awareness of the shared responsibility of both primary and post-primary teachers. Although the PST questionnaire responses indicated that they were confident in both their own abilities (71% agree, 23% neither agree nor disagree) and their abilities to develop literacy competencies within the classroom (55% agree, 30% neither agree nor disagree), SPTs indicated a disjunction

between students' perception of their abilities and what staff were witnessing. One SPT suggested that "the students are ticking boxes and they don't see it [literacy] as something that is an integral part of the lesson", which indicated that many PSTs did not prioritise literacy development in their teaching.

4.3. The Practice of Development within Technical-Subject Classrooms

One objective of this study was to establish what provisions were being made in terms of teaching strategies to develop literacy competency in the classroom. The PSTs were questioned on training they had received on how to promote and develop literacy competencies within the classroom. The responses indicated that 4 (1st year participants) of the 69 PST participants were not aware of strategies being explored within different modules. An examination of the Approved Programme Schedule, indicated that provisions are being made for the development of both personal literacy competencies and literacy competencies development in the classroom. However, it was not clear whether the PSTs were making the connection between the theory being taught on the programme and the application of that theory. When asked what strategies the PSTs were using in their teaching practice, the most common response was "word wall" (30 /69), which was a response in all year groups. However, the 3rd and 4th year groups also suggested strategies that engage learners in critical-thinking through presenting (no=5), creating posters (3) and other creative strategies such as Irish language promotion, portfolio creation, reflection, flipped-classroom and student research. When comparing the PST's literacy definitions with their strategies to promote the literacy competency in the classroom, there was a misalignment between the two. This was corroborated in the SPT focus-group, with one SPT suggesting that PSTs "will only make that link [between theory and practice] once literacy is explicitly named within the lesson", implying that PSTs were not making that vital connection between the two aspects of literacy competency development. Literature suggests that technical-subjects provide students with ample opportunities to develop literacy competencies. However, few PSTs on this case-study programme did not recognise that potential. This was echoed in the SPT focus-group, with one SPT suggesting "an inherited belief from previous generations, that these subjects have traditionally been seen as low literacy subjects."

5. Conclusion

This research sought to establish what provisions were made for the development of teaching strategies to enable literacy competency development within the technical-subject classrooms at second level and also to explore the PSTs' perspectives on this topic. There was evidence of the development of literacy competencies and pedagogical strategies to enable the development of literacy competencies in the classrooms, within various modules on the programme. However, there was a lack of clarity around the meaning of the term 'literacy'

and therefore, difficulties in recognising and implementing teaching strategies to assist this development. Literacy development within an ITE programme requires significant consideration and the design of 'what' and 'how' this is embedded needs to allow for both personal literacy development of the PSTs, as well as the ability to recognise and develop literacy competencies within their own classrooms. Defining the boundaries of literacy education and all its complexities when placed in the context of ITE should be emphasised as an integral part of the programme design. There is evidence of the potential, within teaching technical-subjects to engage students in literacy competency development. Further training for programme staff and PSTs would address the challenges highlighted in this paper and equip teacher-educators with the appropriate competencies to adapt and meet the literacy demands of technical-subject students.

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Contributions of the SocialNEET project to the development of skills for active life

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Abstract

The SocialNEET project, promoted at the Polytechnic Institute of Bragança, between November 2020 and February 2021, whose main goal is the (re)integration in the labour market of young people, through the creation of innovative social business solutions and finding employment in companies or associations in the social sector. It provides learning for active life and education for entrepreneurship, through the participation of facilitators (students of higher education) who will simplify the connection between mentors (successful entrepreneurs and consultants) and young NEET (not in education, employment or training), in the sense of creating life projects, social projects or innovative social business and job search solutions in companies or associations in the social sector. The essential focus of this article corresponds on the training of facilitators (N=10) and its objective is to understand the capacities developed by them in this process, as well as the limitations felt and the strategies to minimize them. For this purpose, a qualitative case study was carried out based on the documentary analysis of the training, namely an observation grid, a questionnaire to the trainees and the reflective analysis of the trainers. We conclude that the strengthening of soft skills, intercultural communication and education for entrepreneurship may be the priority ways to promote social improvements and thus contribute to the 2030 Agenda.

Keywords: *Soft skills; intercultural communication; social entrepreneurship; youth employability.*

1. Introduction

The creation of opportunities for youth employment, namely for NEET (not in education, employment, or training) in the age group between 18 and 29 years old, is among the main public policies promoted by the European Union (EU) as a way of promoting more equal territories. In this sense, through the EEA and Norways Grants Funds for Youth Employment, it finances the SocialNEET Project in seven European countries (Slovenia, Spain, Greece, Italy, Latvia, Poland, and Portugal), with the main objective of generating opportunities for young people to enter the labor market or create knowledge to promote self-employment, fighting social inequality, meeting the 2030 Agenda (SocialNEET, n.d.). The SocialNEET Project provides spaces for the provision of training workshops on entrepreneurship education, to contribute to the development and recognition of soft and hard skills in NEET young people, skills increasingly required in job search. The SocialNEET Project, in Portugal, had its NEET meeting point, promoted by the Polytechnic Institute of Bragança (IPB), acting in the training of higher education students to assist the NEET youth training process, contributing to the training process of professionals better prepared for the need of the job market and for breaking the paradigm of the search for the first job.

This work consists of a mixed case study, aimed at understanding the perceptions developed by higher education students, called facilitators (N = 10), in the support of the training process for young NEET. In addition to an observation grid used by trainers to record actions, interactions or iterations and results from relevant moments, the main instrument for data collection used was an online questionnaire or survey, in Google Forms format, applied to facilitators at the end of the process NEET training. This paper presents a brief introduction about the SocialNEET Project, following the state-of-the-art of SocialNEET, the methodology of the work, the perceptions and reflections of the activities developed by the facilitators and the final considerations of the study.

2. SocialNEET: State of the Art

Education should be the main factor to reduce social disparities among young people and, although in the last decades their number has increased in the school context, this has not translated into positive numbers in employability, since in the year 2020, more of 5.5 million young people were in NEET status in the EU (Lorinc, Ryan, D'Angelo, & Kaye, 2019).

In this sense, the challenge of promoting more equal territories on the European continent is to offer training opportunities that contribute to the promotion of NEET employment, as this is a public with great difficulty in accessing the labor markets (Lorinc et al., 2019). In addition, 2030 Agenda, –which is a plan of action for people, planet and prosperity, composed by 17 Sustainable Development Goals (SDG) and 169 targets, in the SDG 4, "Quality Education", advocates increasing the educational offer for young people who

contribute to improving literacy skills, "technical and professional skills, which lead to employment, work decent and entrepreneurship" (United Nations, n.d.). It should also be noted that, with the globalized economy, stimulating entrepreneurship means providing young people with skills to create their own jobs and, thus, lead them to social improvement (Gonçalves, 2020).

In this context, since 2017, the EEA Grants Funds has a plan of action to address more than 25000 young people by the actions in education or training, support to active job search, create jobs in NGOs and start up a business. The actions are held by the Fund for Youth Employment, in 25 projects like the Active Citizen Fund and SocialNEET (EEA Grants, n.d.). SocialNEET is part of a European social policy recommendation for the creation of an ecosystem aimed at combating youth unemployment, by promoting opportunities for NEET employability in the third sector, namely in social organizations, and in traditional employment models, as well as in entrepreneurship education, to create business models that lead to social improvement (SocialNEET, n.d.).

2.1. Young NEET

The acronym NEET is used in the EU to define groups of young people between 15 and 34 years old who are not working in society, being considered a serious economic and social problem for the 27 Member States (Giret, Guégnard, & Joseph, 2020; Jongbloed & Giret, 2021). SocialNEET training seeks, through the provision of education for entrepreneurship, to contribute to the reduction of social disparities through the creation of self-employment, promoting the breaking of the first job paradigm and, therefore, fighting stereotypes linked to NEET terminology. According to Jongbloed and Giret (2021), the NEET terminology contributes to increasing the exclusion of young people from relationships in society, promoting the creation of stereotypes that cause their greater vulnerability in the labor market, since they are conceptualized as young people with few developed skills and low capacity for problem solving, with little appreciation of the professional curriculum, leading to social aggravations such as scarce employment opportunities, low pay and poverty. Still, according to Jongbloed and Giret (2021) and Lorinc et al. (2019), the NEET condition acts in the ability to recognize the soft skills and well-being of young people, which can lead to depression, low self-esteem, causing problems in relationships with family and friends, in addition to other social problems. In this sense, it is important to have an educational / training intervention aimed at self-valorization, the (re)construction of a positive and realistic image of oneself, which allows the identification of your abilities and potentialities, as well as the areas of competence that need to be worked and developed.

2.2. Facilitators of the youth NEET

The creation of opportunities that contribute to the understanding of public social policies is an urgency in European territory and should be part of the training offer of higher education institutions, since the access of young people to education promotes improvements in social conditions and leads the construction of more inclusive spaces and a more equal society (Gonçalves, 2020; Lorinc et al., 2019). Therefore, training professionals who are more attentive to social needs, with the ability to intervene and propose innovative solutions must be among the training competencies offered to students in the various areas of higher education, and so it is understood that promoting spaces for entrepreneurship, associated with the concept of soft skills and intercultural communication, enables the construction of critical thinking, the development of knowledge and a greater capacity for intervention by future professionals (Blázquez, Zaldívar, & Leite, 2018; Gonçalves, 2020; Pinto & Reshma, 2021). For Gonçalves (2020), the knowledge provided by entrepreneurship contributes to the development of soft skills such as resilience, leadership skills and teamwork, fundamental requirements for the job market.

In this sense, the education for entrepreneurship offered by SocialNEET training contributes to the training process of future professionals more aware of their role as a global citizen, acting in the construction of business opportunities that lead to social justice and a better generation of income, going to meeting of sustainable development. We can affirm that training facilitators, to act as peers in the training of young NEET, contributes to the development of individual and corporate responsibility of those responsible, in order to agents of social change in the context of professional performance.

2.3. Entrepreneurship education of the NEET Facilitators

Entrepreneurship, in all its typologies, has been a way to reduce inequalities, either through the creation of innovative business models or through the promotion of projects of that lead to personal development that is reflected in improvements for society (Gonçalves, 2020). The 2030 Agenda clearly shows entrepreneurship education in the SDGs as a goal to be achieved in favor of sustainable development (United Nations, n.d.). It is necessary to educate the individual for social and business skills, to awaken creativity and innovation, and to train professionals with the ability to recognize soft skills and intercultural communication as elements of strategic thinking to achieve social equity (Blazquez et al., 2018; Gonçalves, 2020). In the perspective of Vieira and Marques (2014), soft skills are a set of personal and interpersonal skills that provide ascendants or competitive advantages for employment, for sustaining employability, and for promoting entrepreneurship.

3. Methodological framework

3.1. Contextualization of the project

In Portugal, more specifically in Bragança city, the NEET meeting point, destined for clarifying and making available the SocialNEET training offer, was promoted by the Polytechnic Institute of Bragança (IPB). The first training session took place at the School of Education (ESE/IPB), between November 2020 and February 2021, in a blended learning approach. The sample was constituted on a voluntary basis, through registration on forms made available on the school's web portal, being formed by higher education students in different training areas (N=10). The training for NEET facilitators consisted of the following modules:: i) intercultural communication through the course "The peculiarities of intercultural communication"; ii) recognition of soft skills and self and straight knowledge ; and iii) education for entrepreneurship , using idea generation processes in the context of Design Thinking and the Walt Disney Creative Process , using brainstorming, SCAMPER (S: substitute, C: combine, A: adapt, M: modify, P: put another use, E: eliminate and R: reverse), empathy map and the business model canvas proposed by Alexander Osterwalder (Gonçalves, 2020). The training also had a practical part , where the facilitators, through the learning by doing methodology, were able to make use of the acquired knowledge, acting in the intermediation between trainers and NEET young people, in the training processes, asking the mentors and trainers when they need.

3.2. Methodology and procedures for collecting and processing information

The research was based on a mixed case study (quantitative and qualitative) to analyze the gains promoted by SocialNEET training. The data collection was carried out through an online questionnaire or survey, in the Google Forms format, divided into two parts. One of which was aimed to the sociodemographic understanding of the respondents, with data collection on: the type of facilitators (Challenge-Based Innovation or voluntary), sex, age, level of education and experience in the labor market. The second part was composed of thirty-six items divided into three blocks of twelve items each for understanding the perception of the competencies of: i) intercultural communication; ii) recognition of soft skills; and iii) education for entrepreneurship, being evaluated on a five-point multi-item opinion scale (Likert scale), where one represented "did not contribute anything" and five "contributed a lot". The survey was made available to the facilitators at the end of the SocialNEET training and the treatment of the data proceeded using a specific statistical program the IBM SPSS Software (Statistical Package for the Social Sciences). In addition to this data collection instrument, an observation grid was also used where each of the trainers recorded the most relevant actions, interactions, and iterations that he considered important, not forgetting the identification of individual or group results.

3.3. Characterization of participants

The participants in this study correspond to two different typologies: volunteer facilitators and CBI facilitators (participants enrolled in the "10% up to you" program of the IPB platform for entrepreneurship, employability, and training innovation (https://if.ipb.pt), namely in the Challenge-Based Innovation (CBI) module). This module corresponds to real challenges launched by structures of the IPB or external partners (in this case the SocialNEET project team), who throughout a semester, carrying out teamwork, demonstrated and developed technical and transversal knowledge and skills necessary for the execution of a work plan. The volunteer facilitators corresponded to other types of facilitators who were not obliged to complete any specific program other than that required in the SocialNEET project. The number of respondents was 10 facilitators, 80% of whom are CBI facilitators (N=8), and 20% of whom are voluntary facilitators (N = 2), of whom 80% are female (N=8; CBI and volunteers) and 20 % male (N=2; CBI). The age of the facilitators is between 20 and 43 years (N=10), with an average of 27 years for individuals, and a standard deviation of 1,059 years. Regarding the level of study, 80% are studying at undergraduate level (N=8), and 20% at master's level (N=2).In a total of 10 respondents, 90% of the facilitators (N=9) claimed to have some paid work experience, and only 10% (N=1) said they had no work experience. This demonstrates that the facilitators, although still in the process of higher education, in parallel with their studies, experienced the opportunities and challenges for entering in the labour market.

4. Reflections on the activities carried out

The activities developed in SocialNEET training sought to contribute to the development of skills in facilitators, in order to prepare more active professionals for the creation of opportunities to enter the job market. Among the skills worked on, intercultural communication, provided facilitators with a reflection on the importance of culture and the ability to communicate in business relationships, being worked through the course "The peculiarities of intercultural communication", taught by Professor Skaiste Kalininaite from the Department of Communication at the Kaunas University of Applied Sciences, Lithuania. In this context, the facilitators' perception of the skills acquired in the training process obtained a global average of 52.0 points and a standard deviation of 6.815%, with the lowest averages for the statements: i) reflect on the creation of stereotypes and their negative effects on society; ii) knowing how to communicate with others; and iii) communicate openly, clearly, and frankly (4.00). The highest averages (4.6) were found in the statements: i) expand my knowledge about intercultural differences between peoples; ii) understand the importance of respect in sharing spaces between different nationalities; and iii) realize the importance of understanding culture within business relationships. The overall value found in the analysis of the responses was greater than 3, allowing to infer that the course for intercultural

communication contributed to the development of intercultural communication skills in NEET facilitators.

Following the SocialNEET training, the soft skills recognition competence addressed through group dynamics on the theme of self and hetero knowledge, the facilitators worked on the ability to understand that personal and professional skills are transferable between knowledge fields, the same being considered important elements for teamwork. The results found for this competence obtained an average of 52.6 points and a standard deviation of 7.862%, the statement with the lowest average: reflecting on me and getting to know me better (4.20) and those with the highest averages: i) to help me know my neighbor (others); and ii) working in a diversified team (4.70). Through the analysis of the data, it can be inferred that the SocialNEET training contributed to the construction of the individual's critical sense and the self-recognition of soft skills as an asset for the valorization of the curricula of future professionals. For the field of entrepreneurship, the use of the learning by doing methodology allowed the facilitators a practical experience for which they were trained. In this sense, the global average obtained was 51.1 points and a standard deviation of 8.504%, with the lowest average for the statement: learning to draw a map of empathy for customers (3.9), and the highest averages for: i) develop skills that enabled me to act as a facilitator (4,6); and ii) know and use free tools useful for the process of building a project (4,5). Therefore, it can be inferred that, sometimes, entrepreneurship education makes use of tools that some students have difficulties in understanding, requiring more time for learning. That said, it can be inferred that SocialNEET training contributed to the development of entrepreneurial skills of the facilitators through the contents worked on, namely within the scope of Walt Disney Process, which contributed to the development of understanding of business models and the acquisition or improvement of innovation and creativity skills in the facilitators' profile.

The training process where also an important part of the gains for the facilitators, and it was clearly evident in the evaluation of CBI facilitators that in the end of the project had to demonstrate communication skills, presenting clearly, reasoned and sustainable ideas and solutions developed, achieving all facilitator a positive marks.

In a global way, it can be said that the SocialNEET project contributed positively to the development of the entrepreneurial spirit, intercultural communication, and soft skills competences in higher education students, thus making them professionals better prepared to face the training challenges and future challenges in the labor market.

5. Conclusions

The SocialNEET Project, through a profile that recognizes the importance of the education for entrepreneurship and of the soft skills and intercultural communication, promoted reflection for the development or improvement of personal and professional skills, in higher

education students, to contribute to a more critical and participatory performance of these future professionals not only in this training for NEET, but also in society in general. Through peer facilitation (NEET and facilitators), it provided the group of facilitators with an opportunity for tutoring and practical skills within intercultural communication, the recognition of soft skills and entrepreneurship education.

Through the training actions of the project, the facilitators were able to understand that entrepreneurship means much more than a business model, being above all a way to build knowledge, and allow the construction of a more equal society.

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First-year university students entrepreneurial competence: Exploring the relationship between grit, creative self-efficacy and entrepreneurial self-efficacy

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Abstract

Grit, creative self-efficacy and entrepreneurial self-efficacy have been associated with the development of entrepreneurial behaviours that can prepare students for a rapidly changing world of work. The main purpose of this study is to analyse the relationship between the three variables amongst first-year university students. A positive relationship, albeit modest, was found between grit and the two measures of self-efficacy. Furthermore, findings suggest that grit can be considered a predictor variable for student self-efficacy beliefs in the context of entrepreneurship. However, this relationship was found to be weak and not to offer significant opportunities for the improvement of student creative and entrepreneurial self-perception, beyond those already contemplated in social cognitive theory. Moreover, results revealed a significant and robust positive relationship between creative and entrepreneurial self-perceptions in university students. The strong relationship found between creative and entrepreneurial self-efficacy renders an opportunity to develop informed interventions directed towards improving student entrepreneurial self-perceptions. In this regard, the results suggest the importance of cultivating creativity in educational institutions.

Keywords: *Creative self-efficacy; entrepreneurial self-efficacy; grit; consistency of interest; perseverance of effort; entrepreneurship.*

1. Introduction

Entrepreneurship is widely recognised as an essential engine of economic and social development (Ribeiro-Soriano, 2017). The importance of entrepreneurship has been particularly highlighted in the face of the worldwide COVID-19 pandemic, which has exposed the world to great uncertainty (Etemad, 2020). Given its relevance, there is considerable interest in the study of the variables that influence the development of entrepreneurial competence (Barba-Sánchez & Atienza-Sahuquillo, 2018; Newman et al., 2018).

Entrepreneurship is fraught with difficulties and uncertainties that require differentiated skills (Lopez-Ñunez et al., 2020). In this regard, research has found that self-regulation processes play a key role in entrepreneurial competence (Gielnik et al., 2020). Among these regulatory processes, the role of self-efficacy has been highlighted. According to social cognitive theory, self-efficacy is a motivational mechanism that promotes the development and achievement of objectives. It has been defined as having confidence in one's own abilities to organize and execute courses of action to bring about certain achievements (Bandura, 1997). Self-efficacy is not a global trait but rather a set of beliefs regarding the ability to perform tasks in specific domains (Bandura, 2006). Of particular relevance in entrepreneurship is entrepreneurial self-efficacy, which has been associated with greater entrepreneurial intentions (Newman et al., 2018). In addition, there is growing theoretical and empirical work that asserts the importance of creative self-efficacy in the development of an entrepreneurial career (Fuller et al., 2018).

Another self-regulatory process that has recently generated attention in the field of entrepreneurship is grit (Salisu et al., 2020). Grit has been defined as the inclination to maintain interest and strive toward meaningful and challenging personal goals (Duckworth et al., 2007). Thus, two components distinguish the construct of grit: perseverance of effort and consistency of interests (Duckworth et al., 2007). Recent evidence suggests that grit facilitates entrepreneurial action (Salisu et al., 2020).

The need to investigate the relationship between self-efficacy and trait-like personality variables like grit has been indicated (Stajkovic et al., 2018). According to Bandura (1997), self-efficacy not only affects the choices people make, but also their perseverance. From this perspective, there is evidence that indicates that self-efficacy partially or fully mediates the relationship between grit and academic outcomes (Usher et al., 2019). Nonetheless, other authors such as Wolters & Hussain (2015) consider grit as a precursor to self-efficacy. Their results show that perseverance of effort is a significant and positive predictor of student confidence in their regulatory skills and academic development. Along the same lines, the study by Pasha-Zaidi et al. (2019) confirms the motivating role of grit and its predictive role for self-efficacy and self-regulation levels among university students.

The main purpose of this cross-sectional study is to explore the association between creative self-efficacy, entrepreneurial self-efficacy and grit among first-year university students. The examination of such variables among first-year students renders an opportunity for higher education institutions to design educational strategies aimed at promoting entrepreneurship throughout the university experience. Self-efficacy and grit are considered as relevant factors in entrepreneurship, and the development of entrepreneurial competence is a common objective of European educational policy (European Union, 2019). Nonetheless, there is limited information regarding the relationship between creative self-efficacy, entrepreneurial self-efficacy and grit.

2. Methods

Participants were first-year university students enrolled in degree programs in two broad fields (technical and social sciences) at Mondragon Unibertsitatea and Florida Universitària (Spain). Data collection was carried out at the beginning of the academic years 2018-19, 2019-20 and 2020-21. Students participated in the present study on a voluntary basis. The total sample was 1,958 people, 49% men and 50% women. The mean age of women was 18.32 (DT = 1.74) and that of men was 18.65 (DT = 2.03).

2.1. Instruments

Grit-S Scale (Grit-S, Spanish adaptation by Arco-Tirado et al., (2018); original by Duckworth & Quinn, (2009). The Short Grit Scale (Grit-S) assesses the capacity to work strenuously toward challenges, maintaining interest and effort over years in order to achieve long-term goals. It has two subscales, Consistency of Interest (CoI) and Perseverance of Effort (Per), both comprising four items which respondents rate using a 5-point Likert-type scale (from 1= "Not like me at all" to 5 = "Very much like me").

Creative Self-Efficacy (CSE) *Scale* (Tierney & Farmer, 2002). This instrument measures a person's self-perceived capacity for creative work. It comprises three items that respondents must rate on a 7-point Likert scale ranging from 1 (Totally disagree) to 7 (Totally agree). The instrument has been widely used in educational settings and it has shown good psychometric properties (Hass et al., 2016; Robinson-Morral et al., 2013).

Entrepreneurial Self-Efficacy (ESE) *Scale*. This was assessed using a series of items developed by Zhao et al., (2005) to measure self-efficacy in relation to specific entrepreneurial tasks. Respondents are asked to indicate on a 5-point Likert scale how confident they are (1= no confidence; 5 = complete confidence) in their ability to identify business opportunities, create new products, think creatively and commercialise an idea or new development.

3. Results

Table 1 shows the results of the descriptive analysis.

Table 1. Descriptive statistics.

	CSE	ESE	CoI	Per
N	2135	2085	1318	1311
Mean	15.40	14.45	13.28	14.69
SD	2.07	2.41	2.69	2.44
Min	3.00	4.00	4.00	4.00
Max	21.00	20.00	20.00	20.00

Bivariate correlations are displayed in Table 2. Significant positive relationships were found between the four variables analysed. The range of correlations (.143 to .500) suggests moderate relationships within the variables; furthermore, the magnitude of the relationships was higher for the self-efficacy variables.

Table 2. Correlational Analysis.

		CSE	ESE	Per	CoI
CSE	**Pearson**	1.000	0.500**	0.189**	0.143**
	Sig.		0.000	0.000	0.000
ESE	**Pearson**	0.500**	1.000	0.138**	0.143**
	Sig.	0.000		0.000	0.000
Per	**Pearson**	0.189**	0.138**	1.000	0.339**
	Sig.	0.000	0.000		0.000
CoI	**Pearson**	0.143**	0.143**	0.339**	1.000
	Sig.	0.000	0.000	0.000	

The results of the regression analysis indicated that the models that are able to explain the highest degree of variance are those with creative self-efficacy and entrepreneurial self-efficacy as dependent variables, the models respectively explained 26.4% and 25.4% of the total variance. Individual beta coefficients for all models are reported in Table 3.

Table 3. Regression coefficients.

	CSE		ESE		Per		CoI	
	Std β	**Sig**	**Std β**	**Sig**	**Std β**	**Sig**	**Std β**	**Sig**
CSE			0.419	0	0.096	0.000	0.030	0.137
ESE	0.551	0			0.033	0.207	0.057	0.014
Per	0.152	0	0.039	0.207			0.281	0
CoI	0.059	0.137	0.085	0.014	0.347	0		

4. Discussion

In this study, a positive and strong relationship has been found between student creative and entrepreneurial self-efficacy, which is not unexpected given the importance of creativity in entrepreneurship (Smith et al., 2016). Moreover, this result tends to support previous findings that indicate that multiple self-efficacy beliefs account for anticipatory entrepreneurial cognitions (Schlaegel & Koenig, 2013). With respect to grit and self-efficacy beliefs, a positive but weak relationship has been found. The results of the regression analysis provide further information and seem to suggest that grit is a precursor to creative and entrepreneurial self-efficacy. This result is consistent with previous studies showing the predictive role of grit for general self-efficacy levels among university studies (Pasha-Zaidi et al., 2019; Wolters & Hussain, 2015). However, these studies measured self-efficacy at the domain-general level and not in the context of entrepreneurship. In this context, the results of this study seem to confirm the role that grit can play as a facilitator of entrepreneurial action (Salisu et al., 2020), by means of a positive, albeit weak, influence on creative and entrepreneurial self-efficacy. Nevertheless, in view of this weak relationship and the limited information in existence regarding the malleability of grit (Wolters & Hussain, 2015), it is suggested that interventions to improve students' creative and entrepreneurial identity should be directed towards developing their self-efficacy through the different pathways considered in social cognitive theory.

With regards to the research limitations, more information regarding the different learning contexts developed in each of the universities, together with intersectional approaches contemplating students' gender identities, ethnic culture and socioeconomic variables could provide critical insights on how to nurture entrepreneurial self-perceptions across all students. In addition, the sample was recruited from two Spanish universities, additional research is necessary to explore the external validity of the presented findings with regard to other countries and universities. Nonetheless, this study has shed further light on the

relationship between grit and self-efficacy. Moreover, the finding of the positive relationship between creative and entrepreneurial self-efficacy has important implications as it renders an opportunity to develop informed interventions directed towards improving student entrepreneurial behaviours. In this regard, the importance of cultivating creativity in educational institutions is highlighted. Cultivating creativity, in addition to being a key objective of contemporary education (Alvarez-Huerta et al., 2021), seems to have a positive influence on the entrepreneurial development of students. In relation to this, further exploration of the pedagogical practices that might help foster creativity would have important practical implications, in light of the results.

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Personal Employability and employment outcomes in a university sample: a study before and after COVID-19

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Abstract

Labor market uncertainty makes it difficult to get (and keep) a high-quality job, even for graduate students. Moreover, this situation has worsened due to the COVID-19 pandemic. The aim of this study is to test the influence of personal employability on maintaining (or being able to find) a high-quality job in a sample of young university graduates who faced the job market crisis caused by the COVID-19 pandemic. We focus on the four personal employability dimensions of Fugate et al.'s (2004) model: career identity, personal adaptability, human capital, and social capital. Our hypotheses state that the four dimensions of employability are positively related to employment status and job quality indicators (salary, horizontal fit, job satisfaction). The results obtained in a sample of 136 university graduates show that social capital contributes to being employed after several months of job market uncertainty due to COVID-19. Moreover, career identity positively predicts horizontal fit and job satisfaction. The study shows the importance of social capital and career identity in uncertain job market situations to foster positive employment outcomes.

Keywords: *Personal employability; job quality; employment status; young graduates.*

1. Introduction

Work is a crucial part of most people's lives, in terms of both time and significance. In the case of individuals who have earned university degrees, they are expected to not only find a job, but also to find and keep high-quality employment in return for their educational investments. However, merely having a university degree is not sufficient to get (and keep) a great job, especially under conditions of labour market uncertainty such as those recently produced by the COVID-19 pandemic. For this reason, enhancing graduates' employability has become one of the goals of the European Higher Education Area (EHEA Ministerial Conference, 2012). When addressing employability, different approaches can be used (Lo Presti & Pluviano, 2016). We focus on personal employability or the individual factors (career identity, personal adaptability, and human and social capital) that "enable workers to identify and realize career opportunities" (Fugate *et al*., 2004, p. 16). Personal employability is particularly important because it does not depend on the labor market situation (Rothwell & Rothwell, 2017), and it can be trained (e.g. Luca & Heal, 2007, Janasz & Forret, 2008). Taking these considerations into account, this study aims to assess the impact of personal employability on maintaining (or being able to find) a high-quality job in a sample of young university graduates who faced the job market crisis caused by the COVID-19 pandemic.

1.1. Personal Employability

We focus on the four personal dimensions of Fugate *et al*.'s (2004) model: Career identity, personal adaptability, and human and social capital. Career identity refers to who the person is or wants to be professionally, and it represents the motivational element of employability (Fugate *et al*., 2004). Personal adaptability refers to "the willingness and ability to change behaviors, feelings, and thoughts in response to environmental demands" (McArdle *et al*., 2007, p. 248), and it helps individuals to identify and realize career opportunities (Fugate *et al*., 2004). Human capital refers to personal factors such as education, work experience, training, knowledge, skills, and abilities (Fugate *et al*., 2004; McArdle *et al*., 2007). Specifically, we focus on generic competencies that are valued in most types of jobs (such as teamwork or time management) (Luca & Heal, 2007). Finally, social capital refers to the interpersonal aspects of employability: networks that can provide career-related information and the opportunity to identify and fulfil career opportunities by offering guidance, sponsorship, and support (Seibert, 2001; De Janasz & Forret, 2008).

1.2. Job Quality

Considering the suggestion made in the European Union's Employment in Europe (2002) report, we use González-Romá *et al*'s (2018) multidimensional conceptualization of job quality. These authors conceptualized it as the extent to which: (1) a job has certain objective desirable characteristics; (2) there is a fit between the job requirements and the employee's

characteristics; and (3) the job produces positive subjective experiences, such as job satisfaction. In the present study, we consider pay, the fit between graduates' field of study and their jobs (i.e. horizontal fit), and job satisfaction.

1.3. Hypotheses

Career identity is the motivational factor that provides graduates with direction, structure, and focus when they look for a job (McArdle *et al*., 2007) and, particularly, the high-quality job they want (González-Romá *et al*., 2018). It should also help them to make an effort to keep jobs they like. Empirical research supports these relationships (McArdle *et al*., 2007; Day & Allen, 2004). Personal adaptability should help graduates to take advantage of changes and see opportunities that other individuals may not see (Van der Heijde & Van der Heijden, 2006). This characteristic should help them to find jobs and, particularly, high-quality jobs. In fact, personal adaptability is considered a key factor in career success (O'Connell *et al*., 2008). Regarding human capital, it is expected that individuals' investments in education and continuous development will increase their value to organizations (González-Romá *et al*., 2018). This should help them to find a job (or keep the jobs they have) and, especially, a job with a better salary and promotion opportunities, as found in metanalytical results (Ng *et al*., 2005). Finally, the social resources provided by interpersonal connections (i.e. social capital) are essential for obtaining information about job opportunities and resources (Seibert *et al*., 2001), and they should facilitate access to (and maintenance of) employment and high-quality jobs. Empirical research supports the positive impact of social capital (e.g. González-Romá *et al*., 2018). Considering that the four employability dimensions are individual resources that can be especially helpful in a labor market crisis, such as the one caused by COVID-19 (Eichhorst *et al*., 2020; ILO & OECD, 2020), and based on the arguments provided above, we hypothesize the following:

The four dimensions of employability will be positively related to employment status, preventing unemployment during the crisis (H1), and to job quality indicators, leading to better salaries, more horizontal fit, and greater job satisfaction (H2)

2. Method

2.1. Participants and procedure

We contracted the services of a Spanish market research company that managed a respondent panel. Employed members of its panel were invited to participate in the study, provided that they were not self-employed. Initially, 235 young (up to 30 years old) university graduates enrolled and participated at Time 1 (T1, January 2020). The COVID-19 lockdown started in March 2020. In October 2020, nine months after T1, 179 participants remained in the study at Time 2 (T2). Because we discarded 55 participants who showed careless response patterns

on any of the three instructed response items presented at each time, the final study sample consisted of 136 graduates. Among them, 58.8% completed a bachelor's degree, 38.2% a Master's degree, and 2.9% a PhD. The average age was 27.2 (SD = 2.09), and 45.6% were male. At T2, 85.3% were employed, and 14.7% were unemployed. Focusing on employed participants at T2, 80% of them had the same job they had at T1, 16.9% had changed jobs once, and 3.1% had changed jobs twice.

2.2. Measures

Personal employability. It was measured at T1. *Career identity*: It was measured with González-Romá *et al*.'s (2018) 4-item scale, rated on a 6-point Likert scale (1. Strongly Disagree, 6. Strongly Agree). *Personal Adaptability*: It was measured with a 3-item scale developed for this study (e.g., "I am able to adapt to the changing circumstances of my environment"). Items were rated on a 5-point graded scale (1. Not at all, 5. A lot). *Social Capital*: It was measured by means of a 4-item scale based on González-Romá et al. (2018). Items were rated on a 6-point Likert scale (1. Strongly Disagree, 6. Strongly Agree). *Human Capital (generic competences):* It was measured with a 6-item scale based on Hernández-March and colleagues (2009), focusing on the following competences: oral and written communication, problem solving, time and resource management, teamwork, continuous learning, and taking responsibility. Items were rated on a 5-point Likert scale (1. Low degree, 5. High degree). Cronbach's alphas ranged between .70 and .86. Exploratory factor analysis (EFA) supported the expected four-factor solution, which explained 52.51% of the variance.

Employment outcomes. They were measured at T2. Employment status was assessed by asking participants whether they were employed (1) or unemployed (0). Regarding job quality, salary was measured by asking participants about their monthly net salary, with seven response options ranging from 1 (less than 450 €) to 7 (more than 2,100 €). Horizontal fit was measured by means of the following question: "To what extent is your current job related to your university degree subject?" (see González-Romá *et al*., 2018). The response scale ranged between 1 (not at all) and 5 (a lot). Finally, job satisfaction was measured with the 3-item scale proposed by González-Romá *et al*. (2018), referring to participants' degree of satisfaction with the job they performed, their pay, and their opportunities for professional development. Items were rated on a 6-point Likert scale (1. Strongly Disagree, 6. Strongly Agree). In the present study. Cronbach's alpha was .75. EFA supported a one-factor solution that explained 51.95% of the variance.

2.3. Analysis

We controlled for gender, age, educational level, and the number of job changes during the period assessed, and we tested our hypotheses by means of Multiple Regression. When the outcome was employment status, we used logistic regression. For the three job quality

outcomes, we used linear Regression (for horizontal fit and salary, results were cross-validated by means of ordinal regression). All analyses were carried out with IBM-SPSS-26. Predictors were standardized for all regression analyses.

3. Results

Table 1 shows the descriptive statistics and correlations among the study variables.

Table 1. Means, Standard Deviations, and Correlations among variables.

	Mean	SD	1	2	3	4	5	6	7	8	10	11	12
1. Gender T1	.54	.50											
2. Age T1	27.20	2.09	-.13	--									
3. LS T1	1.38	1.74	-.12	-.02	--								
4. JCH	.23	.49	-.04	-.07	-.11	--							
5. CI T1	4.32	1.06	-.05	.08	.25**	-.01	.85						
6. PA T1	3.97	.69	-.03	.13	.09	.03	.23**	.86					
7. HC T1	4.17	.43	.02	.06	-.02	.12	.22**	.46**	.70				
8. SC T1	3.19	1.03	.10	-.12	.16	-.08	.31**	.08	.25**	.86			
9. ES T2	.85	.36	-.05	.20*	.06	.01	-.07	-.06	.02	.16			
10. Salary T2	3.88	1.49	-.19*	-.05	.27**	.02	.23*	.13	.17	.18	--		
11. HF T2	2.94	1.33	-.15	.05	.58**	-.01	.43**	.19*	.14	.19*	.26**	--	
12. JS T2	3.95	1.06	-.18	.03	.30**	.07	.43**	.14	.07	.20*	.49**	.45**	.75

*Note. LS: Level of studies achieved; JCH: Job changes over time, CI: Career Identity; PA: Personal Adaptability; HC: Human Capital; SC: Social Capital; ES: Employment Status; HF: Horizontal Fit; JS: Job Satisfaction *p <. 05; ** p< .01. Reliabilities are shown on the diagonal. Salary, GF, and JS obtained only in employed participants. Thus, column 9 is not shown because job status is a constant when correlated with Salary, GF, and JS.*

Table 2 shows the results of the multiple regression analysis. Focusing on employment status at T2, social capital is the only employability dimension that enhances the probability of being employed about seven months after the COVID-19 crisis started. Contrary to our expectations, career identity is negatively related to employment status. In the case of job quality, only career identity was positively and significantly related to two of the three job quality indicators considered: horizontal educational fit and job satisfaction. These results partially support our two hypotheses.

Table 2. Regression Analysis.

Predictors	ES T2	Salary T2	HF T2	JS T2
Gender T1	.02	-.59*	-.31	-.32*
Age T1	.37*	-.06	-.00	-.01
CI T1	-.67*	.19	.45**	.38**
PA T1	-.17	.08	.14	.09
HC T1	.11	.17	.04	-.07
SC T1	.87**	.15	.08	.12

*Note. CI: Career Identity; PA: Personal Adaptability; HC: Human Capital; SC: Social Capital; ES: Employment Status; HF: Horizontal Fit; JS: Job Satisfaction. Regression coefficients are unstandardized * $p < .05$; ** $p < .01$ (one-tailed tests for regression coefficients). Only control variables that show significant effects are included.*

4. Discussion

The results obtained show that only one of the dimensions of Fugate *et al*.'s personal employability model, social capital, contributes to being employed after several months of job market uncertainty caused by COVID-19. Interestingly, although career identity is negatively related to employment status, it positively predicts several job quality indicators in employed graduates, particularly horizontal fit and job satisfaction.

Contrary to our expectations, personal adaptability is not related to any of the employment outcomes considered. The fact that the study was carried out during the pandemic may contribute to more adaptable individuals accepting a bad situation in these unexceptional times if they do not have strong career identities. For other individuals with high personal adaptability and strong career identities, the results may be more positive. Future research should explore the impact of the interaction between personal adaptability and career identity. Regarding human capital, although our results suggest that university degrees protect graduates from unemployment (only 12.7% of the participants lost the jobs they had at T1 and were unemployed, a percentage much lower than the general population under 30), generic competences do not play a role in fostering good employment outcomes (at least among university graduates). Future research should consider whether the importance of particular generic competences depends on the type of job.

It is important to point out that our study has a number of limitations. First, the sample size was small, especially when focusing on job quality indicators, which limits the generalizability of the results. Second, the study relies on self-reported data. It would be interesting to include the employer's perspective to understand what dimensions of personal

employability are considered crucial, especially in uncertain situations. Despite these limitations, the results have several important implications.

4.1. Theoretical implications

The pattern of results shows the need to differentiate between the four dimensions of personal employability because the effects of different dimensions depend on the employment outcome: employment status or job quality. Interestingly, whereas career identity fosters employment quality in uncertain contexts, individuals with strong career identities may prefer to stay unemployed (at least for a while), rather than accepting a job that does not match who they want to be professionally. These questions deserve further research that analyzes the role of moderators that may influence the effects of career identity.

4.2. Practical implications

Because there is evidence that the professional and practical orientation of university instruction improves some employability dimensions, such as career identity, as well as job quality indicators over time (e.g. vertical educational fit) (González-Romá et al., 2015a, 2015b), universities should work on developing instruction programs and counseling strategies designed to develop, at the very least, social capital and career identity.

4.3. Conclusions

Despite the aforementioned limitations of the study, our results show the importance of social capital and career identity in uncertain job market situations to foster positive employment outcomes.

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Entrepreneurship, Higher Education and R+D in Mexico

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Abstract

This research determines the impact of some higher education and R+D variables on different entrepreneurship outcomes in the states of Mexico during the period 2007-2017. By applying panel data analysis tracking the Mexican states over time and specifying an entrepreneurship model, the research shows that these variables affect the entrepreneurial outcomes heterogeneously depending on the type of venture; in particular, higher education and R+D variables are not significant in explaining entrepreneurship in general but most of them are significant in explaining higher education and knowledge based entrepreneurship. These results harmonize with the perspectives suggesting the important role of the higher education and R+D system in supporting entrepreneurship. Nevertheless, the results also underline the lack of relation of entrepreneurship with patents, posing questions on the degree of innovativeness of the ventures and the commercial use of inventions, the unequal distribution of higher education and R+D activities across states and the limited scope of the public policy efforts as to impact overall entrepreneurship.

Keywords*: Entrepreneurship; higher education; R+D; public policy.*

1. Introduction

Entrepreneurship is considered a crucial component of the mechanics operating for knowledge and R+D activities to transform into innovations and their virtuous effects on societies (Audretsch, 2001; Aparicio et al., 2016). Consequently, countries have implemented policies to boost high impact entrepreneurship through institutional reforms, supporting agencies and programs and human capital investments to sustain research, development and innovation. Under this scenario, higher education institutions (HEI's) play an important role by forming human capital and providing a variety of entrepreneurial related services to students, faculty and society. Mexico, accordingly, has implemented a set of policies during the last decades to strengthen its human capital for professional specialization, research and innovation in order to catch up with other countries, including the financial support of the higher education system for capacity building, competitiveness and expansion; the encouragement of education attainment, upgrading and scientific skills in faculty; the organization of peer-reviewed quality accreditation and certification of the undergraduate and graduate programs; the creation of diverse programs to support research: grants for researchers, the strengthening of scientific infrastructures at universities and research centres; the funding of basic and applied research in accordance with the regional's needs; and the joint funding of innovation projects linking industry and academic institutions, among other actions. These policies have improved the higher education and R+D performance indicators as suggested by the official sources the National Bureau of Statistics (INEGI) and the National Council for Science and Technology (CONACYT). This research determines the impact of these variables on different entrepreneurship outcomes in the states of Mexico during the period 2007-2017. The research shows that these variables affect the entrepreneurial outcomes heterogeneously; in particular, higher education and R+D variables are not significant in explaining entrepreneurship in general but the higher education and knowledge based. The results provide an assessment of these policies from the standpoint of entrepreneurship which derive in policy implications.

2. Entrepreneurship and the Role of Higher Education and R+D

Entrepreneurship may be defined as opportunity recognition and enterprise formation (Parker, 2009) and it is affected by the environment shaping the economy, as it entails interdependencies between economic development and institutions, which in turn determine factors such as the quality of governance and policies, the access to capital, the knowledge context and other resources, and the perceptions of entrepreneurs. Some works contending the relation of different stages of the entrepreneurial process and venture types with economic development are Wennekers et al. (2005) and Acs et al. (2008); other support the relation between entrepreneurship and the institutional environment and the national cultures such as Bruton et al. (2010), Alvarez and Urbano (2011), Baumol and Strom (2007), Liñán and

Fernandez-Serrano (2014), and Aparicio et al. (2016). Besides, the complex interactions between entrepreneurship and the macroeconomic, institutional and economic environment are Dvouletý (2018) and Brás & Soukiazis (2018).

The system of HEI´s has been considered as an important player in entrepreneurship by forming human capital, disseminating knowledge produced by scientific research and providing multiple services to society (Audretsch, 2014). HEI´s are critical for the commercialization of ideas, contributing with a favorable environment leading to innovation and entrepreneurship (Rasmussen and Gulbrandsen, 2006). They also contribute by educating entrepreneurs through formal courses and extracurricular activities, by providing entrepreneurship related services (Walter et al., 2013; Bergmann et al, 2016) and through the entrepreneurial activity of faculty and students (Åstebro et al., 2012). Besides, some HEI's have assumed the entrepreneurial university concept commercializing research through patents, spin-offs, and the supporting of start-ups, the provision of venture capital, the construction of physical scientific infrastructures, the organization of university-industry programs, and the founding of research centers, incubators and technology transfer offices. Diverse studies have provided empirical evidence regarding the university's impact on students' entrepreneurial intentions and activity and, in general, on entrepreneurship at the different stages of the process: Chrisman et al. (1995) found new ventures created by faculty or with significant faculty inputs; Walter et al. (2013) and Bergmann et al. (2016) show the importance of entrepreneurship education and industry ties; Guerrero et al. (2017) emphasize the positive effects of incubators; and Geissler (2013) demonstrated the impact of the entrepreneurial climate at universities. Besides, Fini et al. (2017) show the positive effects of the university institutional framework changes toward entrepreneurship.

3. Methodology

The research is based on an unbalanced panel data tracking 30 of the 32 states of Mexico during the period 2007-2017 which is built from diverse data sets. The states of Campeche and Tabasco were dropped to avoid any bias derived from the preponderance of the oil industry. Entrepreneurship (N_{it}^{s}) statistics were obtained from two sources: the National Survey of Occupation and Employment (ENOE) elaborated by INEGI[1]and the CONACYT[2] National Registry of Scientific and Technological Institutions and Enterprises (RENIECYT). The former source surveys individuals aged 15 or more and tracks the number of those labeled as independent workers including the self-employees and the employers by state on a quarterly basis grouped according to education attainment. The CONACYT source

[1] Instituto Nacional de Estadística y Geografía (INEGI) [National Institute of Statistics and Geography] https://www.inegi.org.mx/

[2] Consejo Nacional de Ciencia y Tecnologia (Conacyt) [National Council for Science and Technology] https://www.siicyt.gob.mx/

provides the number of organizations performing scientific and technological activities by state including mostly enterprises, but also private organizations and education institutions. The different types of entrepreneurs (N_{it}^{s}) included in the study are total ($ntotalp_{it}$), basic educated ($nebasp_{it}$), medium-high higher educated ($nemsp_{it}$) and knowledge based ($etecp_{it}$) relative to population. The context variable representing the level of development is the real per capita GDP (*GDPp*) provided by INEGI. The higher education and R+D variables (*X*) are the System of National Researchers (SNI) members-certified researchers (*snip*), the Faculty Development Program (PRODEP) certified faculty (*prodepp*), Patents (*patp*) and Talent (*tal*). The first three *X*-variables are transformed in per 100 thousand people terms and were obtained from the website Comparative Study of Mexican Universities (ECUM)[3] hosted by the National Autonomous University of Mexico (UNAM). Talent (*tal*) is expressed as the percentage of the population aged 25 or older who has either higher or technical education and was provided by The Institute for Competitiveness (IMCO)[4] using INEGI data. The *X*-variables were selected after a correlation analysis including in addition higher education students and undergraduate and graduate programs.

A log transformed Cobb-Douglas function of equation 1 is proposed for the empirical work.

$$(1) \qquad lN_{it}^{s} = \hat{\beta} + \hat{\beta}_c + \hat{\beta}_y ly_{it} + \sum_j^K \hat{\beta}_X^j lX_{it}^j + \epsilon_{it}$$

Where lN_{it}^{s} represents the natural log of the number of entrepreneurs of type *S*; $\hat{\beta}$ is the intercept and the parameters $\hat{\beta}_y$ and $\hat{\beta}_X^j$ are associated to the natural log of the level of economic development (y_{it}) capturing also the general context and the set of *K* variables X_{it}^j depicting higher education and R+D correspondingly. The sub-indexes *i* and *t* refer to the individual states and time included in the regression. The parameters associated with the left-hand variables ($\hat{\beta}_y, \hat{\beta}_{y2}$ and $\hat{\beta}_X^j$) are interpreted as the elasticities of the number of entrepreneurs to 1% change in their corresponding variables. A dummy variable to capture the effect of the 2008-2010 global crisis is included with the parameter $\hat{\beta}_c$. The error term is given by $\epsilon_{it} = \alpha_i + n_{it}$ integrated by an individual time invariant component α_i and an error term n_{it} which vary randomly across individuals and time periods. The assumption regarding α_i requires selecting Random Effects (RE) or Fixed Effects (FE).

[3] Estudio Comparativo de Universidades Mexicanas (ECUM) [Comparative Study of Mexican Universities], Universidad Nacional Autónoma de México (UNAM) http://www.execum.unam.mx/

[4] Instituto Nacional para la Competitividad (IMCO) [Mexican Institute for Competitiveness] https://imco.org.mx/

4. Econometric results and discussions

The econometric results are reported in Table 1. The models are estimated using 241 observations, given the lack of data of some states; they are global significant and exhibit an acceptable fit. The FE was accepted only in one regression. The lGDPp (y) variations are significant in explaining all types of entrepreneurs –except for the total– although with some divergences between ventures. On the one hand, for the basic educated entreprenerus (lnebas) of regression 2, the relation with respect the changes in economic development is linear and negative suggesting that as the states' per capita GDP reduces these types of ventures increases. The medium high-higher educated entrepreneurs (lnems) and the technological based (letec) represented in the regressions 3 and 4 correspondingly have a positive linear relation with respect GDPp. Hence, the level of development is associated differentialy to the entreprenerual outcomes reflecting their necessity-opportunity nature of the ventures and their differential responses to the economic activity.

Table 1. Econometric results.

	(1) lntotal $_{it}$		**(2) lnebas** $_{it}$		**(3) lnems** $_{it}$		**(4) letec** $_{it}$	
β	Coef.	p	Coef.	p	Coef.	p	Coef.	p
lGFPp $_{it}$	-0.160		-0.392	*	0.446	*	1.153	*
lprodepp $_{it}$	0.014		0.009		0.045	*	0.152	*
lsnip $_{it}$	0.014		0.006		0.059	*	0.096	*
ltal $_{it}$	0.152		0.113		0.169		-0.584	**
lpatp $_{it}$	0.012		0.008		0.021		0.043	
dcrisis08	-0.105	*	-0.086	*	-0.188	*	-0.054	
c	13.67	*	15.71	*	6.31	*	-4.63	
Obs	241		241		241		241	
i	30		30		30		30	
Within R2	0.39		0.21		0.60		0.35	
F-Test/Wald Chi2	125.48		55.72		300.59		18.69	
Prob	0.00		0.00		0.00		0.00	
rho	0.98		0.98		0.96		0.35	
F-Test (u_i=0)							32.84	
Prob>chi2							0.00	
Hausman Chi2	9.45		4.56		4.30		76.96	
Hausman prob	0.15		0.60		0.63		0.00	
Model	RE		RE		RE		FE	

*p<0.05; **p<0.1

The *X*-variables are not significant for the total number of entreprenerus (*lntotal*) nor for the basic educated (*lnebas*) (1 and 2): the later result does not surprise given the nature of the ventures started by the low educated individuals; the former reveals the predominant traditional and necessity-driven nature of entrepreneurship in Mexico and the limited size of the knowledge and the R+D sector as to impact the general level of entrepreneurship. As for the medium high-higher educated entrepreneurs (*lnems*) (regression 3), *lsnip* and also the *lproepp*, which represent indicators of higher education and R+D and human capital

specialization, are significant though small in impact as compared to the technological based (*letec*). This result may be due to the size of the sector of *lnems* which is much larger than the *letec*, making much more difficult that the limited higher education and R+D sector impulses perceptibly that group of firms. Talent (*ltal*) and patents (*lpatp*) are not significant in these cases. As for the technological based (*letec*), the significant *X* variables are *lsnip*, *lprodepp* and *ltal*, providing additional evidence on their relevance in contrast to entrepreneurship in general and the basic educated entrepreneris (*lnba*s). The *X*-variables *lsnip* and *lprodepp* have a significant positive effect on *letec.* The effect of talent *ltal* on entrepreneurship turned out to be negative, reflecting the hindering effect of education on entrepreneurship as proposed in Kangasharju and Pekkala (2002) and Sluis et al. (2008).

The *X*-variables in general, represented by those variables which were incorporated in the econometric model (*lsnip*, *lprodepp*, *ltal* and *lpat*) but correlated with the excluded *X*-variables, illustrate the effect of the higher education and R+D system in supporting higher educated and technological based entrepreneurs in Mexico, harmonizing with some perspectives supporting the important role of universities: Rasmussen and Gulbrandsen (2006); Åstebro et al. (2012); Walter et al. (2013); Audretsch, (2014); Bergmann et al. (2016). The results also reflect the important role that faculty professional and scientific specialization in individuals may be playing in supporting higher educated and technological based ventures either through faculty entrepreneurship, associates or university-enterprise linkages, which is consistent with Masakure (2015) and Jimenez et al. (2015). The significance of *lsnip* and *lproepp* in explaining the entrepreneurs of higher quality type may suggest the prevalence of faculty entrepreneurship as earlier proposed by Chrisman et al. (1995) and Åstebro et al. (2012). Despite the statistical significance of *lprodepp* and *lsnip*, the per capita number of patents (*lpatp*) turned out to be not significant, opposing the idea that entrepreneurship works as conduit for R+D to transform into innovation either through start-ups or spin-offs. Diverse studies report effects of patents on entrepreneurship, although they converge in that these effects are rather small: Goel & Saunoris (2017) reports evidence supporting that patents affect more startup entrepreneurship as compared to the modest effect on overall entrepreneurship; Meyer (2006) reports that despite start-ups and spin-offs play a role in transferring technologies invented by scholars, large firms and established small and medium-sized enterprises account for a much greater share of utilized academic patents. Thus, the null impact of patents in entrepreneurship reported previously may be due either to the rather small number of patents per capita, their lack of commercial use given their pure academic nature, and their commercialization via an existing firm through licensing or transferring.

5. Final remarks

The research results harmonize with the perspectives suggesting the important role of the higher education and R+D system in supporting entrepreneurship, maintained by various mechanisms such as professional and scientific specialization of individuals, faculty entrepreneurship and university-industry linkages. The results indirectly suggest that public policies improving the higher education and R+D system have also impacted entrepreneurship. However, the results also uncover the limited scope of such policy efforts as to impact overall entrepreneurship, the inequalities of higher education and R+D indictors across states, affecting also the nature of their entrepreneurial outcomes; and the limited patenting activity, which questions the commercial potential of inventions and the innovativeness of the ventures and limits the impact from higher education and R+D. The research provides some insights for public policy.

The public resources and programs should be augmented to intensify human capital formation for specialization and scientific development and entrepreneurship. This requires a shift in the higher education policy as to include more decisively entrepreneurship content to encourage the higher education institutions pursue programs and specific actions to support entrepreneurial education and startups for students, faculty and society. Private universities have taken steps forward toward an entrepreneurial education but the public system of HEI's must catch up in order to provide a higher degree of employability and innovation potential to their graduates and faculty taking advantage of their relatively stronger R+D structures. Moreover, the universities should improve their legal frameworks as to encourage the creation of intellectual property rights and facilitate transfers and commercialization of inventions either through university entrepreneurship or licensing to enhance high impact ventures. It is not that the public HEI's do not have initiatives associated to entrepreneurship but their scope is limited to some general actions and opportunities, which are disperse and uneven across departments, and usually not centralized and embedded in an institutional framework *ex profeso* to encourage entrepreneurship at the different stages of the entrepreneurial process. In general, these initiatives should be embedded in a proper system of linkages of universities with the industry and society and programs supporting the interactions of faculty and students with those sectors and other relevant actors to encourage collaboration.

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Creating a Virtual Leader Development Course Using the Design Thinking Process for Innovation

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Abstract

This paper examines how a U.S. Air Force (USAF) faculty team reimagined and redesigned an in-person Leader Development Course (LDC) to a virtual version (vLDC). Using the Design Thinking Process for Innovation (DTPI) and action research methods, a new, virtual course was imagined, designed, tested, and improved over a six-cycle-process. Data was collected via multiple sources from 121 participants (19 faculty/staff and 102 students) and analyzed using manual coding and NVivo Software. Results are organized into 22 categories under four themes (general course design, student experience, instructor experience and faculty development, and technology experience) showing a progressive refinement with key lessons learned that led to the final creation of the new virtual course. Of the five key features in action research (actions matter, context-specific research, multiple cycles and phases, inclusion of people as research target, and reflections), participants reported that multiple cycles and reflections were most important in relation to the DTPI so that change could be enacted that reflected participant voices in the design process of the virtual course. The application of the DTPI using action research methods produced results and lessons learned in the design process that contribute to the theory and practice on developing and teaching in a virtual learning environment. The study fills a gap in the scholarly field and informs other institutions on the process, failures, and successes of course redesign to a virtual version.

Keywords: *Design thinking process for innovation; action research; USAF; leader development.*

1. Introduction

The Leader Development Course (LDC) is an educational program that trains and teaches military/civilian leaders in the responsibilities of leading and commanding U.S. Air Force (USAF) organizations. The LDC was developed due to a leader developmental gap related to human domain skills identified in RAND (Research ANd Development) Corporation's "Improving the Effectiveness of Air Force Squadron Commanders" (RAND, 2017). One of the outcomes of the publication was the creation of the LDC, which was housed under the Eaker Center for Leadership Development within Air University (AU) located at Maxwell Air Force Base in Alabama. As the USAF's Pinnacle Institution, AU comprises several subordinate organizations that oversee enlisted education, officer education, officer accessions, and professional development for civilians and military members, along with seven academic centers and related publications and research. The Eaker Center for Leadership Development is responsible for planning and conducting the LDC.

The LDC is an 8-day intensive course of lectures, seminars, and experiential events that build skills associated with leading others in a military context (e.g., knowing self, establishing climate and culture, values-based decision making, negotiation skills, building effective teams, dealing with conflict, administering discipline and justice, physical fitness events, and coaching practice). The overall course objective is to "Improve leader development of officers and civilians approaching command selection in order to sharpen and focus leadership skills to achieve mission success through high-performing teams" (LDC-SC Smart Card, 2019). Students learn the content in week one and then, in week two, apply the knowledge in a variety of opportunities (e.g., case studies, experiential events, and virtual reality scenarios). The course culminates in a capstone experience involving augmented reality scenarios. Over 26 courses and 1500+ students, the LDC received extremely high marks by students and guests in end of course critiques and in post course surveys sent to graduates and their supervisors (Hinck & Davis, 2021).

2. Problem and Significance

From 2018-2020, the LDC was delivered synchronously, or in-residence, in a classroom environment using a range of pedagogical and andragogical methods. Due to the Covid-19 outbreak, military leaders increased health protection conditions and the LDC was halted for nearly two months while USAF developed guidance and procedures to return effectively and safely to delivering content to students.

The problem that faced the LDC Faculty and AU leadership was how to transition an in-residence course to a virtual environment under pandemic realities. Leaders wanted the new virtual course to capture similar experiences to the in-person course that had an interactive

and experiential learning environment that continued to achieve course outcomes and cognitive, affective, and behavioral learning objectives—all with high marks.

3. Literature and Research Questions

There is not enough scholarly work relating to developing a virtual course (Dunn, 2018; Tschimmel, 2012). There is a scholarly gap in how to design, test, and deliver a virtual course in the military environment. The Design Thinking Framework for Innovation (DTFI) does provide a way to design something new but has not been applied in reimagining how a course would operate virtually (Beckman, 2007; Liedtka, 2014). Figure 1 shows how a positive student experience is based on the interconnectedness between the human microsystem (interactions of instructors, peers, and self) and six overlapping elements - the exosystem - that brings the student experience to life (Hinck & Davis, 2021).

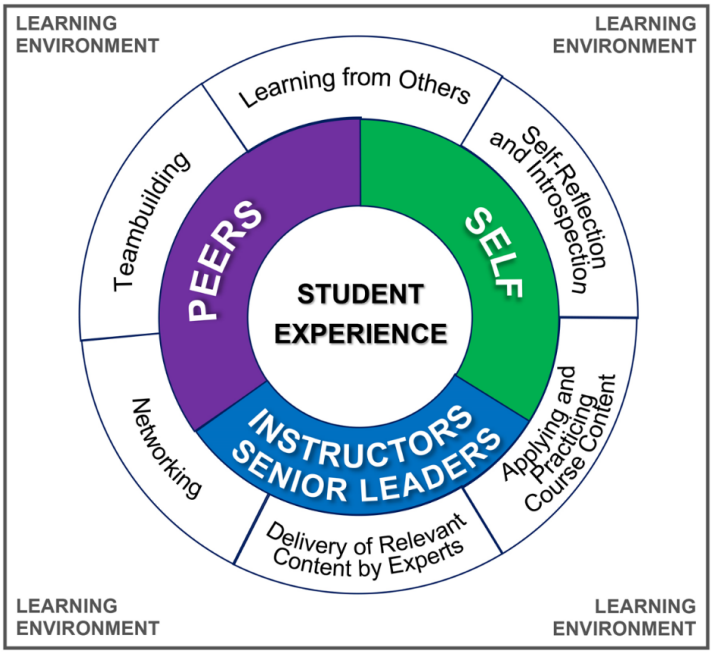

Figure 1. Student Experience Ecosystem

Action research is a philosophy and qualitative method that seeks transformative change via cycles of action, reflection, and change (Stringer, 2014; Torbert, 2004). There are five key features of action research for educators: actions matter, context-specific research, multiple cycles and phases, inclusion of people as research target, and reflections (Inoue, 2015).

Two research questions (RQ) guided this study:

RQ1. How can faculty adjust the in-residence program to a virtual version using the Design Thinking Framework for Innovation?

RQ2. To what extent do themes or lessons emerge during the research process that influence virtual course execution?

4. Research Design and Methods

The research design employed six cycles of action research of action-reflection-change that overlayed the five parts of the DTPI in each cycle: emphathise, define, ideate, prototype, and test, as depicted in Figure 2. Participants included 19 faculty/staff (N=19) and 102 students (N=701). Data collection included Zoomgov chats during course execution, staff emails, and notes captured during team meetings, student end-of-course surveys, and informal interviews to follow-up on data gathered in the collection process. Data analysis involved manual coding and NVivo Software to develop codes, categories, and themes.

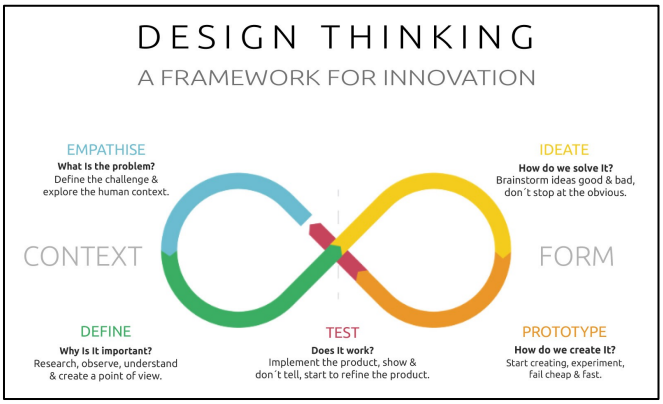

Figure 2. Design Thinking Framework for Innovation

5. Results

Using the DTPI, the results of the of the six cycles of action-reflection-change are shown in Table 1 and organized into duration to move from empathize-define-ideate-prototype, test phase, and over all time expressed in people hours.

Table 1. Organization of the Six Cycles of the DTPI.

Action – Reflection – Change			
Cycle	Empathize | Define | Ideate | Prototype	Test	Time
#1	7.5 days	Zoomgov discussion / 2 hours *Conceptual*	17K+ hours
#2	4 days	Alpha test / 3 hours *Technology platforms*	
#3	3 days	Beta test / 2.5 days *Days 0, 1, select content*	
#4	2 days	Faculty development / 6 days *Teaching Teams & Lesson Plans*	
#5	1.5 days	Virtual LDC #20M / 8 days *Days 0 thru 9 – IOC*	1.5K+ hours
#6	1 day	Virtual LDC #20N / 8 days *Days 0 thru 9 – FOC*	1.5K+ hours

From May 2020 to June 2020, a total of 121 participants were involved (voluntarily) with over 22,000 work hours in the six stages of the design process. The time spent on the first four stages decreased with each successive cycle (#1 thru #4) amid multiple failures. Time spent on the last stage of testing increased with each cycle (#5 and #6) to get to a successful version of the new virtual course. The coding process of four cycles (pre-codes, in vivo and descriptive coding, categorical coding, and thematic coding) produced 54 primary codes and 76 secondary codes that were organized into categories and themes in refining and re-imagining LDC for a virtual environment. NVivo coding supported manual coding between two researchers with 96% inter-rater reliability and two minor discrepancies that were resolved in the second coding cycle. The 22 categories are organized under the four themes that emerged during the coding process:

#1–General Course Design

- Be clear on the desired outcomes.
- Resources will determine your bounds of reality.
- Have a process to go from concept to test.
- Expand the concept of the virtual learning environment.
- Widening the learning continuum for before-during-after student contact time.
- How course design deepens the student experience.
- Identify conditions for success amid the pandemic.
- Using technology/schedule structure to aid in connections.
- The student experience ecosystem model needed to be updated for the virtual environment and new terms/definitions are needed.

#2–Student Experience

- Students want opportunities for pre-work and deepening understanding of concepts.
- Breakaways are needed to break away from main room, e.g., Zoomgov breakout rooms, use of telephone to chat, social media platforms, and self-reflection/journaling.
- Must tempo the type and duration of breakaways in seminar; type, number, duration of breakouts must be done with intent and focused on student experience.
- Students want more time to connect and have an experience with each other; they prefer to avoid rapid breakouts of pairs for a few minutes to being able to have longer conversations in small groups or with the entire seminar.

#3–Instructor Experience and Faculty Development (FAC-D)

- Need more instructors / people are needed to run vLDC as the learning environment requires more integral orchestration between actual and virtual environments.
- Optimum manning for seminar is three instructors with two instructors physically in the same seminar room and the third instructor either in the same room or from a remote location. There is a heavy reliance of collaboration in the moment to ensure learning environment is optimized and is adjusted/adapted to meet students' needs in achieving the learning objectives.
- Include the entire LDC team in FAC-D and mirror the student experience.
- Cover and delivery methods of content in morning; afternoons are instructor driven for "productive white space" of personalization of content and practice with teaching team.
- Need multiple reps using Zoomgov and "check-ride" to increase confidence of all.

#4–Technology Experience

- Expose students to all Zoomgov functions in week 1 as well as giving them co-host and host responsibilities over course duration.
- Need standard screen names – for *instructors/LDC team, students, and guests; on Day 0, recommending starting screen names during check-in and reinforcing on Day 1.
- Find ways to use and save student responses of chats, pictures, drawings/annotations, etc. and create a memory or moment, e.g., build a PowerPoint collage of students, words, pictures, and drawings as evidence of learning.

6. Discussion

Only parts of the overall discussion are presented in this paper. Based on the findings, the discussion is organized as five main lessons learned from the study. Discussions 1 and 2 are supported by existing literature. Discussions 3, 4 and 5 provide additions to the literature.

1. Moving from a traditional in-person course to a virtual version can be done, but it must be structured. As advocated for in research fields, the Design Thinking Process for Innovation (Beckman, 2007; Dunn, 2018; Liedtka, 2014; Tschimmel, 2012;) and action research methods (Inoue, 2012; 2015; Stringer, 2014; Torbert, 2004) provided such a framework. Of the five key features in action research (Inoue, 2015), participants reported that multiple cycles and reflections were most important in relation to the DTPI so that change could be enacted that reflected participant voices in the design process of the virtual course. A virtual in residence, remote (VIR-R) Leader Development Course can be executed that aligns with the Student Experience Ecosystem (Hinck & Davis, 2021). Students reported feeling connected, and a new student even commented: "I don't know how you did it, but you created a culture in two days... I feel more connected to you all than I do my own office, and I have a staff meeting with them every day". Another new student said, “this is the best mentoring I’ve received since I commissioned”.

2. Teaching teams found they actually have to collaborate more to successfully hold the environment for students in seminar, which is supported in some literature (Hinck & Davis, 2021; Liedtka, 2014; Matusov, 2001). To keep students engaged, students need to be actively participating by speaking, typing, calling another student, writing in their journal, etc. To facilitate all that interaction, instructors, are required to: remember to step in/out of the camera frame, mute their computer, coordinate breakout rooms, respond to chats, set up current and future activities, actively listen to students and watch the affective responses of students (body language, gestures, hand raises). That took 100% effort from our experienced teaching pairs.

3. Zoomgov is the right technology because of the quality of video frames, ability to see nonverbals, and platform capabilities. We asked students to keep their videos on full-time in seminar and during lecture. Paired with our big 72” Microsoft Hubs, we were able to show 12” x18” video feeds of all students, which allowed instructors to observe body language and level of engagement. Knowing they were on video made students feel they were “in a classroom”, especially when gestures such as raising a hand, laughing, clapping, or shaking their head proved to be effective communication tools. We used multiple Zoomgov rooms (LDC Main, Seminar 1, Seminar 2, and Student Management) and pushed students from one room to the next. Each room requires a separate paid account.

4. Specific to LDC (highly interactive, human-domain focused course): To keep the students’ attention for a VIR-R LDC, the content delivery must be synchronous during the times they are on Zoomgov. Interaction among students and instructors is what keeps their attention! Pushing a video lecture “live” via Zoomgov was our only failed delivery method. Students disengaged and lost interest because it wasn’t live. They attribute this to the necessity for a “holding environment”. The students are NOT able to secure 100% quiet/uninterrupted environments in their homes or offices, so they rely on the LDC environment to keep them

engaged. When we pushed a video, LDC became "just another computer-based training they could walk away from and disengage" (student words).

5. Delivering a synchronous lecture/perspective/presentation in the auditorium is now a three-plus person job, like broadcasting a live TV show. What used to take one person on stage, now takes at least three dedicated personnel and four Zoomgov accounts. A "room manager" is required to manage, admit, mute, and respond to students' technical requests, while this or an additional person monitors student feedback. A producer focusing on muting/unmuting the presenter, switching between the cameras and "share screen" slide presentation/video clips, and managing the Hub display for the presenter. None of these duties can be done by the presenter, who has to focus on delivering content into the camera and staying on-script with the producer. Additional Zoomgov accounts are necessary to set up microphones and secondary cameras.

7. Conclusions and Implications

The four themes of 22 categories along with the discussion of five key lessons learned help fill a gap in the scholarly field, add new discoveries to the filed, and inform other institutions on the process, success, and failures of virtual course redesign. The application of the DTPI using action research methods produced results and lessons learned in the design process that contribute to the theory and practice on developing and teaching in a virtual learning environment. Multiple cycles and reflections that represented participant voices were keyways of informing the DTPI. The LDC has since delivered 10 versions of the new virtual course and students indicated the same high level of satisfaction and extremely impactful experience that was similarly reported in the in-person LDC.

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Collaborative mentoring to prepare doctoral students for college teaching

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Abstract

This project used psychosocial mentoring (Curtin et al., 2016) to create a collaborative mentoring experience to prepare doctoral students to become the instructors of record. In the collaborative mentoring experience, we paired doctoral students with a faculty member teaching a class that the doctoral student aspired to teach. The doctoral student observed the faculty member teaching, engaged in discussions with the faculty member, and reflected on the process. The following semester, the doctoral student became the instructor of record for the course. Following this experience, two doctoral students and one faculty member completed a retrospective self-study through journaling and discussions. After analyzing the results through discussions, we identified three themes: (1) understanding the course and our learners, (2) underlying goals and processes involved in college teaching, and (3) stretching the scope of practice for instructors of record. This paper describes the theme of stretching the scope of practice for instructors of record. Implications for teaching and learning in higher education are discussed.

Keywords: *Psychosocial mentoring; doctoral students; higher education; college teaching; instructor of record.*

1. Introduction

In this project, our goal was to prepare special education doctoral students in a university program for higher education faculty positions. Although each doctoral student in our program had K-12 teaching experience, we found that students were not prepared for teaching in the college classroom. Guided by the concept of psychosocial mentoring (Curtin *et al*., 2016), our program developed a process we called collaborative mentoring, where a doctoral student was paired with a faculty member teaching a class that the doctoral student aspired to teach. Each doctoral student participated with and observed the faculty member teaching the course for one semester. The doctoral student and paired faculty member engaged in frequent discussions and the doctoral student reflected on the process. The following semester, the doctoral student assumed responsibility for the course as the instructor of record. The purpose of this project was to examine the learning experiences of two doctoral students and one faculty member who engaged in this collaborative mentoring experience. This study examines how psychosocial mentoring through our collaborative mentoring process prepared doctoral students to become the instructor of record for the first time and provided a faculty member with an opportunity to stretch the scope of her instructional practice.

Curtin *et al*. (2016) discussed three conceptualizations of mentoring in graduate education: (1) psychosocial mentoring, a process by which the faculty member allows their doctoral student to see firsthand the activities and experiences of the faculty member; (2) instrumental mentoring, where a faculty member offers explicit instruction through mentoring; and (3) sponsorship mentoring, where a faculty member advocates or allows access to their network for their doctoral student. Psychosocial mentoring develops a learning community through the mentor's sharing of their practice, thoughts, plans, and reflections with the mentee (Curtin *et al*., 1996). Lin *et al*. (2018) elaborated on this notion of learning communities and suggested that the creation of mentor and mentee learning communities would lead to enhanced confidence and the development of self-efficacy, which is a person's belief in their ability to understand and complete necessary tasks (Lent *et al*., 1994). According to Curtin *et al*. (2016), psychosocial mentoring is much less common in graduate settings than instrumental and sponsorship mentoring. This is problematic because instrumental and sponsorship mentoring can build knowledge and refine practice, but these methods have little effect on self-efficacy and offer little help in adapting practice to a new setting. That is, instrumental and sponsorship mentoring can teach one how to complete a specific task, but not how to generalize to a new task.

Psychosocial mentoring is strongly influenced by aspects of Bandura's (2001) social cognitive theory and Lent's (1994) application of social cognitive theory into social cognitive career theory. In social cognitive theory, Bandura (2001) suggested that a person's situational agency, along with a person's ability to reflect on their practice, created a vehicle for the

person to enhance their situational self-efficacy. Lent *et al*. (1994) adapted social cognitive theory into social cognitive career theory, which focused on various types of mentoring and how mentoring can develop self-efficacy in a mentee's career. In our project, we anticipated that psychosocial mentoring would lead to enhanced doctoral student self-efficacy in their instructional role as they moved into positions in higher education (Curtin *et al*., 2016; National Academies of Sciences, Engineering, and Medicine, 2019). Because the doctoral student had access to the mentor's every plan, goal, practice, and outcome, the doctoral students could extend their experiences beyond the shared experience (Fletcher, 2018; Lent *et al*., 1994; National Academies of Sciences, Engineering, and Medicine, 2019).

This project connected aspects of psychosocial mentoring into a collaborative mentoring project designed to prepare doctoral students for college teaching. For this study, collaborative mentoring allowed the doctoral students and faculty member to learn through their shared experience.

2. Method

In this project, two doctoral students, Kenneth and Lindsey, and one faculty member, Tammy, retroactively examined the quality and impact of their separate collaborative mentoring experiences. Tammy, the faculty member participating in this project, is a professor with 30 years of experience in higher education. She has received several college teaching awards. Kenneth and Lindsey are both beyond the midpoint of their doctoral degrees and are transitioning to independent research and teaching. Both doctoral students specialize in high-incidence disabilities and teacher preparation. For Kenneth's collaborative mentoring experience with Tammy, he chose EDSP 444/644 Special Education Curricula: Secondary Students, a combined undergraduate and master's class required for special education teacher licensure in Nevada. Lindsey chose EDSP 411/611 Teaching Students with Disabilities in the General Education Classroom as her collaborative mentoring experience with Tammy. This course is an undergraduate and master's class geared toward students seeking secondary teaching licenses. Both courses are conducted in a three-hour, in-person, once per week format.

2.1. Procedure

This project used a retrospective self-study process as a methodology to study professional practice, settings, people, and assumptions (Loughran, 2004). Self-study is a recursive process that prioritizes questioning results, asking deeper questions, and responding to questions (Loughran, 2004). Figure 1 depicts a procedural diagram of our retrospective self-study.

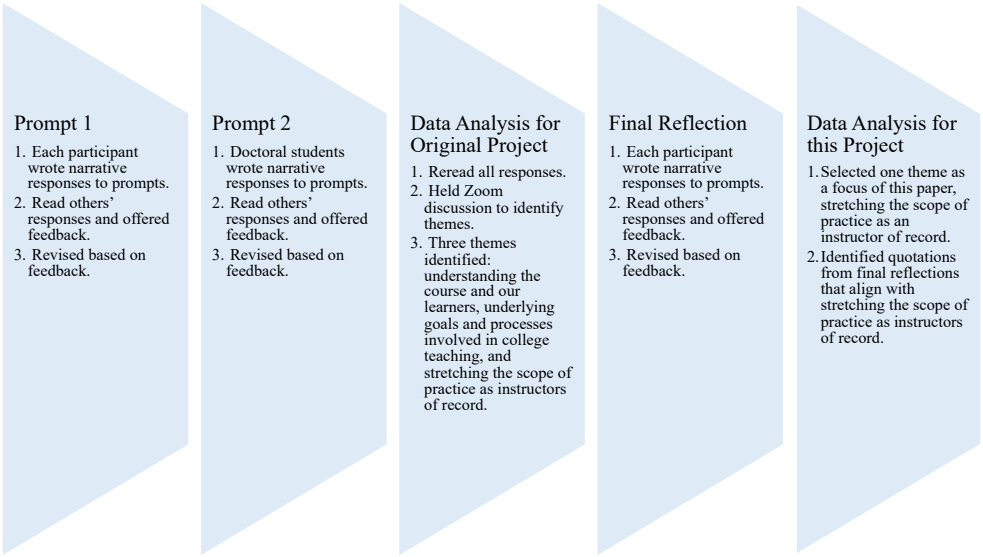

Figure 1. Procedural Diagram for the Project.

The data were collected through three prompts; each prompt had three rounds. For the first prompt, Tammy asked the doctoral students, Kenneth and Lindsey, to describe their expectations prior to the course and their overall experiences in the collaborative mentoring process. In turn, Kenneth and Lindsey asked Tammy to describe how having a doctoral student in the class influenced her instruction. For the second prompt, Tammy asked the doctoral students to describe their perspectives of Tammy's instructional decisions, including the syllabus, assignments, and instructional style.

After completing three rounds on the first and second prompts, we analyzed the narrative responses through rereading each response and discussing themes over a conference call. In this discussion, we identified three themes: understanding the course and our learners, underlying goals and processes involved in college teaching, and stretching the scope of practice for instructors of record. In this paper, we focus on the third theme, stretching the scope of practice for instructors of record.

Following data analysis, each participant wrote a final narrative response, which we called a final reflection. Kenneth and Lindsey had transitioned into the role of college instructor and described in their responses how the collaborative mentoring experience impacted their experience as instructor of record. Tammy added a narrative response describing her reflections on the collaborative mentoring experience as a whole. Each final reflection added new ideas to the theme of stretching the scope of practice for instructors of record. Quotations related to this theme were selected to add to this paper, which focuses solely on stretching the scope of practice for instructors of record.

3. Results

In our retrospective self-study, the data were organized into three themes: (1) understanding the course and our learners, (2) underlying goals and processes involved in college teaching, and (3) stretching the scope of practice for instructors of record. We are highlighting the theme of stretching the scope of practice for instructors of record for this paper because of the insights we gained about teaching and learning in higher education.

The collaborative mentoring process allowed Lindsey and Kenneth to stretch their practice by reducing their anxiety related to becoming the instructor of record for a college class. Kenneth's anxiety with being the instructor of record centered on how he would handle difficulties that might arise in class sessions. In his final reflection, Kenneth wrote that while observing Tammy, "I had witnessed how to respond to difficult questions and to overcome the challenges created by students as they struggle with difficult concepts and ideas." By learning how to overcome challenges in the classroom, Kenneth processed his anxiety and stretched himself an instructor who could address students' challenges and questions with confidence.

Lindsey also felt anxious before becoming the instructor of record. Lindsey explained that she benefited from frequent conversations with Tammy about college instruction, which helped her discard her idea of perfection in teaching. For example, Tammy told Lindsey to think about whether the ongoing writing assignment was necessary for students to achieve the course goals. This showed Lindsey that Tammy was willing to reflect on her instructional choices and make changes to her approach each time she taught the class. In her final reflection, Lindsey wrote that after each class as instructor of record, "I tried to reflect on the things that went well and the things I could do better after each class, because I wanted to be one of those professors who continually strived for growth." In conversations with Tammy during the collaborative mentoring experience, Lindsey observed Tammy reflecting on her instructional choices. Because of this, Lindsey realized that no class session was perfect, and what is perfect for one student is not perfect for another. Instead, Lindsey used the tools she gained from the collaborative mentoring experience with Tammy to reflect on her own teaching when she became the instructor of record. Time for reflection ultimately lessened her anxiety.

Through the collaborative mentoring experience, Kenneth and Lindsey gained the self-efficacy they needed to stretch into the role of instructor of record. Kenneth explained in his first journal response that because of the time he spent in Tammy's classroom, "I would never be walking into a class I need to teach without the memories of the content being taught. I have always relied heavily on my memory and it makes me more comfortable having had the experience." For Kenneth, the collaborative mentoring experience provided a level of comfort that he took with him into his own classes as the instructor of record, which increased

his confidence in his college teaching abilities. Lindsey added in her final reflection that Tammy explained how she made curriculum and instructional decisions, which helped Lindsey increase her confidence in her own curriculum and instructional decision-making. "I was able to make these decisions because I felt confident in my own judgment. I do not think I would have felt this confidence if I had been dropped into the course cold." For example, as instructor of record, Lindsey chose to repeat Tammy's learning disabilities simulation because she observed high levels of engagement in the students; Lindsey chose not to repeat Tammy's lecture on RTI because she did not have as much knowledge on the subject and there was a strong online learning module available.

While the collaborative mentoring experience increased the doctoral students' levels of self-efficacy, it disrupted Tammy's everyday practice as an established, well-regarded instructor. In her first journal, she reflected, "I felt like a novice teacher who needed to give a rationale for every topic, every reading, every activity and every interaction." Tammy explained that it made her nervous to bring doctoral students in to "watch me teach, to evaluate my teaching, to consider how they might do things differently." This experience compelled Tammy to analyze her teaching practices. Tammy added in her final reflection, "This experience forced me to boldly and baldly face my challenges, critique my own thinking, and face the notion that as I age, I may be losing my connections with my students and perhaps even my everchanging content." While the collaborative mentoring experience was challenging for Tammy, she explained that she felt it was important for established instructors to "face disequilibrium" in their teaching so that they may stretch the scope of their teaching practice.

Each participant stretched the scope of their teaching practice through the collaborative mentoring experience. Kenneth and Lindsey increased their sense of self-efficacy and learned strategies they would use in their own college classrooms. Tammy stretched her teaching practice by examining her instructional choices through conversations with the doctoral students.

4. Discussion

University professors are responsible for the education and mentorship of all students regardless of their academic level. Undergraduates should receive high quality instruction to prepare them for their chosen profession. Undergraduates may have graduate students as instructors, but that should not expose them to lesser quality instruction. Professors are also mentors invested in the futures of their graduate students. Additionally, professors are stewards of their profession and are responsible for preparing future faculty who are ready to excel in higher education from the first date of hire. This project met these responsibilities. Our goal of creating a collaborative mentoring model to prepare doctoral students and not expose undergraduates to substandard instruction was met in this project.

Prior efforts to mentor doctoral students in our program included static models of mentoring, such as instrumental or sponsorship models, where faculty met with students to check in or scheduled group meetings for discussion; these mentoring models were not effective in our program. Developing a psychosocial model of collaborative mentoring allowed our program to meet our goals of high-quality instruction for all. One feature of our collaborative mentoring model was the vulnerability of the participants. In this model, there was no room for faculty to hide as every instructional episode was observed, critiqued and discussed. These collaborative experiences impacted each participant. The doctoral students gained confidence and reduced their anxiety by watching Tammy deal with difficult situations and understanding why she made certain instructional choices. The doctoral students were able to take their ability to critique instruction and reflect upon the experience with Tammy to alter, improve, or celebrate their own success. The idea that the doctoral students and the mentor had shared experiences in the same environments to learn from made the psychosocial approach effective compared to more static, distal, and simple check-in type mentoring.

As Curtin *et al*. (2016) suggested, our collaborative mentoring model did not come without risk. In this project, the risk for doctoral students related to their anxiety around working with their mentors as equals in the collaborative process. The switch from student to colleague can be challenging, but it is important that students be given opportunities to share their point of view at the risk of disagreeing with mentors. While uncomfortable at first, doctoral students tactfully became thoughtful, expressive, and fully collaborative colleagues. This transition was a key part of their preparation for positions in higher education.

The faculty member, the mentor, should be willing to be vulnerable in front of doctoral students who hold the mentor in high esteem. The process was intrusive because the faculty mentor taught undergraduates and doctoral students at the same time with different objectives. This multitasking felt risky. It forced the person of status to be an equal member of a community with his or her students. This may not be comfortable for all professors.

Psychosocial mentoring, the shared experience of an authentic partnership in a collaborative classroom, made the difference for the doctoral students in our project because in this environment the students experienced every success and failure along with their mentor. Overall, the reward for this collaborative effort was the confidence doctoral students gained in teaching their courses. This experience was key to building and maintaining confidence for emerging academics as it allowed them to extend the experience into their future.

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Case Study in Project Management: A Vehicle for Business Curriculum Integration

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Abstract

This case can be team-taught to combine the different elements of business education taught by individual faculty within a course in Project Management, as a partial, half-credit module within a business curriculum. This case study is written to address the feedback from prospective employers that the fresh recruits are reticent and need a long period of "internship / training / mentoring" before they are ready to be a part of the company's internal team. The case depicting a real company undergoing substantial changes provides the students with opportunities to gain the analytical skills developed in the study of various business disciplines, while providing the opportunity for discussion and illustration of real-life scenarios, constraints, and roadblocks. Moreover, students practice team development and process efficiencies. Instructors will teach how marketing, sales, and procurement functions impact the accounting and finance components of the project so the project scope is managed within the resources, schedule, and budget.

Keywords: *Curriculum integration; competency-based learning; SCRUM; waterfall; project management; globalization of business education.*

1. Introduction

At the business school of a private Catholic university in the Upper Midwest, the job placement rate for undergraduate majors is averaging 80%. However, prospective employers give feedback saying that the fresh recruits are reticent and need a long period of "internship / training / mentoring" before they are ready to be a part of the company's internal team.

This case study is written to address this feedback. Following a real company undergoing substantial changes, this case provides students with opportunities to gain the analytical skills developed in various business disciplines, while providing the opportunity for discussion and illustration of real-life scenarios, constraints, and roadblocks.

As a part of the business curriculum, this case study's objective is to improve graduating students' confidence. The case proposes a short and meaningful way to use project management as a tool for curriculum integration and practical business education. While working on a real business project, students and company sponsors learn the skills of successful project management, a field where several business curriculums find a ready application of theory to practice.

Three authors—two instructors in Management and Finance, and a non-business graduate student—bring their individual perspectives to propose a short but effective way to coach students and faculty in the benefits of cross-functional integration via Project Management. This is the value added of the case.

2. The Case

Termadron (a pseudonym) is a 2.5 billion-dollar (USD) enterprise established in 1914. Their primary products are homeowner tools for maintenance and care. Termadron wanted to create a new lawn mower engine design that was lighter weight, was higher in power, and had better aesthetics than prior projects. One of the considerations was whether the new product should be outsourced or done in-house.

The CEO of this company was expecting to scale up in the next quarter in response to domestic and global market demand. The team under the CEO at Termadron had conducted extensive market research and defined the design parameters. The project needed to be completed in 9 months and could not exceed $750,000 (USD). The CEO named Mr. Noordgren as the project lead. The parameters of the project were defined as:

Key attributes:

- The engine must be less than 9 ft lbs. of torque
- The engine must have flexible storage and store in different positions

- The engine must be significantly lighter than its predecessor
- Cost reductions must be greater than 15 dollars per machine
- The engine will have newer, more attractive operating protection
- The product should be able to be produced domestically, internationally, and by select vendors
- Customers should find the product very pleasing

The Project Lead, Mr. Noordgren, and the Project Sponsor, Ms. Kindle, assembled a team composed of nine members with the following business operational functions:

- Commodities / Raw Material
- Design Engineering
- International Project Management
- Supply Chain
- Procurement
- Test Engineering
- Accounting
- Marketing
- Human Resources

The team came up with some observations and action items:

- Termadron leadership were faced with many of their projects not succeeding. In the past, the Engineering Department sent one of their members for training at the Project Management Institute (PMI). During PMI's 2010 research conference, their president stated that "70 percent of all projects do not come in on time, on budget, or within planned resources." Similar outcomes have been experienced by Termadron.
- The CEO, an alumnus of this Midwest university, suggested the project leader have students from this Midwest university undertake a mock session to test the modalities (Waterfall vs. Agile) for project deliverables within the attributes defined by the company's project management team.
- The project manager turned to the project training model at the Midwest university, which had the experience of working with employees of regional organizations. Hands-on project training was provided to these employees on projects within the employee's organization.
- Termadron's project management team wanted students to present the core elements of project outcomes (risk, cost, schedules, stakeholder needs, and a plan for attainment of outcomes) to the enterprise leadership.
- The student team was made up of nine members led by a student lead and a student sponsor.

The key benefit of the project training came from students learning to think and apply all business operational subjects in an interdisciplinary manner. They did this by using two tools of project management that they had been exposed to: Agile (SCRUM) and Waterfall. Establishing the distinction between Agile and Waterfall project management, students learned the phases of the Waterfall methodology—initiating, planning, executing, controlling, and closing the project—and the Agile project methodology, to complete a successful project. Students also assessed how different roles like marketing, operations, engineering, HR, procurement, accounting, and finance function within the project process. To achieve better project outcomes, instructions must be shared between all functions within an enterprise, whether the enterprise is for-profit, non-profit, governmental, international, etc.

2.1. Desired Outcome for Termadron

Given the modalities of the case, the key attributes, and the required action items, Termadron's CEO fully expected the implementation of this case at the university to produce one or more pathways helping the company to create a new engine design that is lighter weight, is higher in power, and has better aesthetics than prior projects.

3. Teaching Notes

3.1. Learning Objectives

The case serves as a repository of how different functions collaborate in Project Management, bringing various business disciplines together. Because the case is predicated on an actual project that was implemented, faculty can feel confident the outcomes are valid and useful. Figure 1 below is a diagram of the project management process, showing how faculty, sponsors, and students interact during the learning process. The arrows in Figure 1 below demonstrate PMI's tool of progressive elaboration, a tool that demonstrates the recursive nature of the conversation between the three stakeholders—faculty, sponsors, and students.

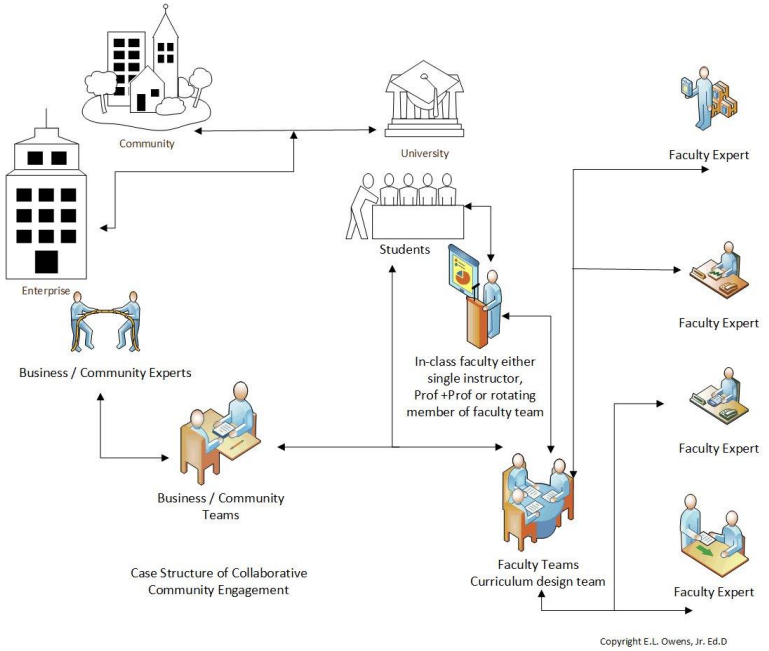

Figure 1. Case Structure.

3.2. Case Usage

The Project Management course, regardless of where it is housed, has an objective of providing a concrete deliverable that draws upon various disciplines of a business curriculum, similar to the team of nine functions assembled at Termadron.

The Termadron case is brought into the classroom in the second half of the undergraduate or graduate semester, after the students are exposed to the key methodologies of Waterfall and Agile. The Waterfall method would have students experience the methodical process of defining stakeholders. In addition, they would document their requirements, cost, risk, and schedule to achieve a well-defined outcome.

3.3. Discussion on Functional Areas: Theory, Analysis, and Practice

- Commodities / Raw Material

  Students will look for risk impacts to the project and work with industry sponsors and faculty to learn about issues with prior projects and issues that may affect the current project.
- Design Engineering

Because design specifications are constantly changing, students need to be incorporated into the organization's review cycle, and faculty may want to be included into the organization's review process for benchmarking.

- International Project Management

  It is important to shed light on practices in project planning that could have international implications, such as the EU and England procedures for project validation and signoffs.

- Supply Chain

  Scheduling materials into the production cycle poses significant risk. Students and faculty must make sure the supply chain issue does not create bottle necks with availability.

- Procurement

  Knowing the impacts of Economic Order Quantity and contracting strategies such as LIFO, FIFO, and all-the-time inventory will help the teams meet project schedules.

- Test Engineering

  Faculty and sponsors can help students do some research on prior projects and show that the cost of testing is usually a great down payment on good ROI, where less waste yields better returns.

- Accounting

  The team will walk through using all the resources to enact the product through an effective, budgeted plan that serves as a tool to control the project outcomes by making impacts on cost and schedule visible to the whole team.

- Marketing

  This part of the project team will elaborate the primary, secondary, tertiary, etc. stakeholders, as well as shine a spotlight on their needs and wants. Guidance from faculty about competing needs will teach students the process of balancing ambiguous project outcomes.

- Human Resources

  Faculty can drive home to sponsors and students that more diverse staffing by ethnicity, age, sexual identity, and capabilities (like financial perspective, design capabilities, and costing, to name a few) will reduce blinders to project design and mitigate catastrophic failures.

3.4. Teaching Tips

This case is a concurrent design project (Sharifi & Pawar, 2001) because it integrates the nine different functions, rather than creating a toss-it-over-the-wall-to-the-next-function process. This is concurrent engineering, a practical approach to business decisions that new recruits are yet to master.

Faculty can show through their research and consulting teams that working collaboratively on projects yields better results in less time than sequentially managed projects. A hybrid teaching style could successfully integrate Agile with the Waterfall method (Wyss, 2014), thereby teaching students that both methods may help with project outcomes. With many of the functions doing similar activities (such as engineering, test engineering, and commodities), the classroom experience could be crafted with three sub-teams focused on quantitative, qualitative, and graphical or symbolic outcomes. Students in these smaller groups could enhance the cross-functional learning, and faculty could emphasize interdisciplinary learning. In this way, even with less in-classroom participation from all functional areas, faculty could create an effective learning experience.

Through Agile, whose core ability is a SCRUM team, students can take ownership of potential solutions to refine vague deliverables. The primary SCRUM tools make the Agile methodology extremely dynamic: stating a narrative of the project through an epic (a set of user stories), a timeline defined by story points within sprints, and a continuous redefinition of the requirements through daily scrums. The impact of a successful adoption of project management via Agile at companies is clearly demonstrated by Conforto et al. (2014).

Because Agile uses smaller teams to produce minimal viable features, the classroom can be broken into two to three sections working on the features of the product or process. The sponsor and faculty can work like product owner and SCRUM Master, respectively, bringing their respective disciplinary expertise to the project. This collaboration defines the epics, which are large chunks of deliverables from the vision of the project. The students, faculty, and sponsor can participate in a lecture about creating the backlog (refined epics). The sponsor and faculty teams should work to create a Release Plan (Dash, 2018) for the semester work.

- Sub-teams and with their faculty member can use tools like Post-It Notes to define the epic and user stories to show the overall flow of the project and feature releases.
- The whole class can review user stories, gaining confidence that they are all on the correct path. Teams will now go back to their subgroup and define story points (time estimates) for their user stories and release levels along with their sponsor as the basis of their daily classroom standups.
- Students will act as the primary SCRUM team to define solutions and plans to achieve the features along with their sponsor. During the semester, the sponsor (product owner) and faculty (SCRUM Master) will meet separately to make sure the sprints are producing the right outcomes.
- The deliverables will be put into sprints, usually two to four weeks in duration. This will serve to timebox the work into iterative outcomes.

- With the daily standups, the students, sponsors, and faculty can work on the changing requirements and fold in the new updates to the user stories, dynamically showing the students the nature of the SCRUM methodology.
- The sponsor can now have the teams present their Sprint Retrospectives, or lessons learned, to the organization's leadership and release the effort into production. In this model, students can see the different impact the faculty have on the SCRUMs, sprints, and feature outcomes.

3.5. Teaching Activities

Faculty should be aware that the most predictive factor of the team outcome will be how well the team shares a common goal (Flahiff, 2014). The class size determines two or more teams of nine or fewer members, each team having its own project lead and sponsor. The student teams expand on the case and its attributes to produce the deliverable for Termadron. The project lead and the project sponsor can be two or more instructors teaching project management and another area in business.

Students, relying on various courses in the business curriculum,1 will role play with people in the professions and set schedules in both methods. They will gain a sense of time and expectations that both methods set. Students will engage the human interaction framed in the two approaches through cross-functional teams or intensive dedicated teams. Students will be able to tackle different styles of project risk, whether the risk is systemic or immediate. Students will also learn the concepts and rationale of Corporate Social Responsibility (Tharp & Chadhury, 2008), which introduces them to the notion that firms have a both social and fiduciary obligation to their clients and communities.

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Global Competency Through Collaborative Online International Learning (COIL)

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Abstract

There is a need for college students to develop global perspectives and gain cultural awareness to become responsible global citizens. Innovative ways to create such experiences are known as Collaborative Online International Learning (COIL experiences). COIL is a voluntary partnership between professors in different countries collaborating on jointly constructed learning experiences to enhance international and intercultural understanding. The purpose of this article is to highlight a successful COIL partnership between students from SUNY Oswego in New York and The Hague University of Applied Sciences in the Netherlands during the COVID-19 pandemic. 35 students participated in the experience that served as a platform to educate students through a health educator's unique cultural lens. Benefits from the experiences regarding global outcomes showed that both US students (n=70.6%) and Holland students (n=61.1%) felt they gained the appropriate skills and knowledge to use in their future careers. 70.6% of US and 61.2% of Holland students reported that the COIL experience introduced them to a new outlook and new ways of thinking about how they relate to the world. The current COVID-19 pandemic has created an opportunity to rethink education pathways and integrate global learning in our classrooms.

Keywords: *Global learning; COIL; partnerships, collaboration.*

1. Introduction

1.1. Importance of Global Perspectives in Higher Education

Today college students need to develop global perspectives, where they think and act in terms of living in a world where they collaborate, work, and live with individuals from various cultures, backgrounds, perspectives, values, and beliefs (Braskamp, Braskamp, & Merrill, 2009). Higher education leaders acknowledge that their graduates will face challenges with growing urgency, resulting in the vital development of intercultural competence and global learning for effective participation and leadership in an increasingly complex and diverse global environment (Earnest, 2003). Many institutions increasingly internationalize their curricular and co-curricular efforts on campuses (Soria & Troisi, 2014) to deepen students' connections as responsible citizens in a global context. For example, the State University of New York (SUNY) system created such experiences as Collaborative Online International Learning (COIL). It was made a formal educational priority by establishing the SUNY COIL program center in 2006 (SUNY COIL Center, 2017).

1.2. Collaborative Online International learning

At its core, COIL is the concept of voluntary partnership between professors in different countries collaborating on jointly-constructed learning experiences to make their individual courses stronger through enhanced international and intercultural understanding. Rather than being only based on institutional contracts or agreements, enacted by permanent bureaucracies and vetted by legal counsels, the essence of COIL is a reliance on willing and like-minded faculty colleagues worldwide who are eager to bring classrooms, projects, and performances together through technology. This nodal network of global academics has become indispensable during the COVID-19 pandemic, during which nearly all traditional academic and student mobility has halted worldwide; indeed, COIL may have found its moment to realize its long-imagined potential to transform globalization in education. A successful COIL partnership can be formal or informal; it need not require a written agreement or memorandum of understanding (MOU). The student-to-student interaction can occur through any reliable communication platform, and travel by faculty or students is not required. Perhaps most importantly, there need not be any additional cost to operate a COIL course. These aspects make COIL a compelling program model, especially for students unable to travel internationally for whatever reason on traditional study abroad programs. The following presentation of a successful design and implementation model will be of interest to Senior International Officers (SIOs) of universities and others responsible for curricular integration in fulfilling their existing institutional goals in this new format (Leask & Green, 2021; Pinder, 2019).

1.3. The Current Research

This article highlights the successful COIL partnership between SUNY Oswego and The Hague University of Applied Sciences, a carefully constructed and rigorously assessed partnership example that can serve as a potential model for enhanced global education. Building on established principles for international program planning (McKeown, 2014) and partnership-building (Gorlewski, 2014) modified and implemented for the COIL environment, this partnership embodies what makes a successful COIL relationship unique. It is especially important during the time of the COVID-19 global pandemic when so much of virtual and remote instruction worldwide was transitioned to rapidly and done so out of necessity (Altbach & de Wit, 2020); this course was purposefully planned and designed to facilitate online learning and community-building across borders based on a willing relationship, not travel. Even the disruption of COVID-19 during the course was not a deterrent to this approach, indeed learning flourished in this COIL context where it often suffered in others.

1.4. Globalization in Education and Education Reform

As a model to enhance globalization in education, COIL's potential has received renewed emphasis during COVID-19. International education thought leaders and practitioners have noted that COIL and other virtual global learning forms are likely here to stay (Kahn, 2020). Indeed, the virtual educational world that emerged through technology more broadly during the pandemic was an inescapable and pervasive new facet of life required to support the continuation of academic activities, which previously relied primarily on face-to-face interactions (Chan, 2020), including international mobility through traditional study abroad and exchange programs. Technology-mediated educational delivery can also be seen as an attempt to build communities and foster a sense of awareness and belonging in people that typically would take place through intense in-person experiences that became a real alternative during the pandemic (Reed & Dunn, 2022). Despite the urgent concerns about inequities in access to and literacy in technology worldwide (Chan, Bista, & Allen, 2022), COIL can also be seen as a way to help address access issues and inequities in international education, travel restrictions, and enhance global learning for all in the curriculum.

However, at this moment, it is recognized that little data exist showing the efficacy of this form of international education and the extent to which COIL experiences differ from traditional in situ experiences (Whalen, 2020). Also, it has been noted that faculty particularly need guidance on how to construct and deliver such experiences (Duke, 2020). This article seeks to contribute to this growing and vital conversation on how best to identify effective COIL practices post-pandemic in order to bring accessible and equitable global learning for all.

2. International Teaching and Learning From New York to the Netherlands

2.1. Purpose

The underlying motivation for creating an international learning experience was to help students from two countries gain cultural competence and offer a global perspective in their field of health promotion and wellness. Specifically, health educators have a duty and responsibility within their code of ethics to deliver health education that considers all individuals' cultural backgrounds and practices, thus creating an opportunity for a collaborative online international learning experience to foster and grow.

2.2. Approach

Through networking at a COIL conference held in New York City in 2018, two professors from the Netherlands and the US met to create and design a COIL experience in health promotion. The experience joined SUNY Oswego students from the Department of Health Promotion and Wellness and students from The Hague University of Applied Science from the Nutrition and Dietetics program. The professors designed this course around three primary elements of pedagogy, intercultural learning, and technology (The SUNY Center for Collaborative Online International Learning, 2019). Emphasis was placed on the collaborative process between the students to create shared experiences and understanding around health promotion standards. The professors developed a collaborative project where students would utilize technology to communicate and exchange cultural and experiential lenses while they process and move through learning material together.

The course established student collaboration to understand how health educators in different countries contribute to global health processes and communicate their ideas and values clearly and effectively with diverse audiences. A total of (N=35) undergraduate students from both institutions participated during the Spring of 2020. Of these participants, 17 were US students, and 18 were Holland students. The learning objectives of the COIL experience were to: (1) Facilitate an understanding and appreciation of cultural differences between the United States, and Holland, (2) Learn about lifestyle and health promotion from a diverse perspective, (3) Build intercultural communication skills by practicing interviewing techniques, (4) Acquire digital communication skills, (5) Connect with students from another country and form new relationships, (6) Develop cultural sensitivity to understand individuals from another culture better, and (7) Build skills to attain cultural competence. Students were paired with a student from the opposite country by random to ensure cross-cultural collaborations. Students then collaborated for six weeks on various health promotion assignments through virtual modalities.

2.3. Curriculum

The focal point of this COIL experience consisted of a cross-border collaborative project that was broken into various tasks and small assignments. Each of these tasks and assignments created a cumulative PowerPoint showcasing the students' global work concerning their discipline of health promotion. This project was designed to compare and contrast physical activity, behavior, and nutrition issues through an international lens. The first step in the process was introducing the two classes from across borders virtually in the classroom via Skype. Students then initiated contact through various technological modes setting up their first one-on-one virtual meeting. Before the first meeting, each student was required to bring pictures and videos of the target population they were studying to share. Students discussed the photos and videos analyzing similarities and differences regarding lifestyle issues in each other's country. The next virtual meeting, students discussed predisposing, reinforcing, and enabling factors of behavior, focusing specifically on nutrition and physical activity in the two cultures. Students analyzed differences regarding diet patterns and physical activity between the two countries. Another virtual exchanged, helped students critically analyze governmental health guidelines within both countries and environmental factors that contributed to the health behaviors they had been discussing. In the final meeting students shared their goals and objectives for the evidence-based health promotion program they have been planning that would aid in behavior change for their target populations. Outcomes showed that students had a better understanding of global governance systems and proper knowledge to solve societal health problems in ethical ways. At the end of the 6-week experience, students created a 10- slide PowerPoint Presentation that highlighted the commonalities and differences among people and cultures and how these factors influenced their cultural perspectives on health.

2.4. Technologies Used

This technology-rich learning environment that housed the COIL experience for students from both countries enhanced student performance and fostered deeper understanding because of their ability to communicate effectively and efficiently with their international partners. A proprietary learning management system (LMS), such as Blackboard, was a cost-effective solution to developing our global partnership. The learning management system (LMS) Blackboard was utilized and hosted by SUNY Oswego, allowing for secure access for The Hague University of Applied Science Students to use, communicate, and submit assignments. This system was already existing and available for free. Campus Instructional Designers were able to assist in setting up the course shell, making it accessible to both institutions, and solving any technical issues encountered. There are various open access third-party technologies available to use for a COIL course. Still, there has not been significant evidence or research explaining the possible security risks to student data or other private information when using these technological tools (Zhang & Pearlman, 2018). Thus, making

blackboard the most appropriate platform that had no restrictions for our partner institution and was equitable and seamless in the integration.

Another technological tool introduced by the Holland instructor was Padlet. This free online tool is consistent with a 'notice board.' Students shared images of their favorite foods and interests to build community and facilitate engagement. A variety of online collaboration tools can be used, but it is important to keep in mind how equitable the tool may be for students from both institutions. Using free applications or tools can help keep things simple and feasible for all students. This is why many of our students communicated virtually with their partners through applications such as Facetime, Skype, Zoom, WhatsApp, Google Voice, Rebtel, and Vonage, which offer either free or low-cost video chat and communication methods. Other technologies aided in creating the collaborative project, such as Google Drive, PowerPoint, and Microsoft Software Systems. These systems were also available to both institutions, and students were able to navigate through their tasks and assignments with their international partners.

Overall, 57.1% of the students agreed and stated that they felt prepared to meet the technology demands of the COIL component in the course, while 17.1% strongly agreed with that statement. Students also agreed and thought that the technology chosen for this COIL component was appropriate for the needs of the experience, and 28.3% strongly agreed with this statement.

3. Lessons Learned

This COIL experience served as a platform to educate students through a health educator's unique cultural lens. Students built on knowledge and developed diverse personal relationships by negotiating meaning when working in virtual teams (Fowler, Pearlman, LeSavoy, & Hemphill, 2014). There were many benefits from this experience regarding student global learning outcomes. For example, 58.8% of US students reported that they made such significant connections with their international partners to maintain that relationship and friendship beyond the course. Holland students reciprocated this feeling, with 44.5% stating the same. Students reported that the COIL experience provided them with the skills and knowledge they will use in the future and within their careers (US students n= 70.6%; Holland students n=61.1%). 76.5% of US students and 61.2% of Holland students reported that the COIL experience introduced them to a new outlook and new ways of thinking about how they related to the world. COIL experiences increase intercultural awareness and online intercultural communicative competence. These experiences also better prepare students for careers and civic engagement in the global context (Zhang & Pearlman, 2018). Students participated in this experience during the very beginning of the COVID-19 pandemic. They were able to create close bonds and conversations with their partners and discuss the state of the pandemic in

each country. The circumstances surrounding COVID-19 presented a unique opportunity for virtual exchanges that resulted in international shared experiences and socialization without worrying about safety or financial barriers due to travel.

3.1. Limitations

A limitation of this COIL course that also turned out to be an opportunity in many ways was the COVID-19 pandemic. There were some challenges associated with Wi-Fi interconnectivity once students transitioned to remote learning at home. However, the pandemic offered students a valuable opportunity to discuss in real-time the impacts COVID-19 was having on different parts of the world. English was the preferred and common language; however, students had mentioned varying proficiency levels when working with their partners. Students also reflected upon the time difference between New York and The Netherlands, where there was a six-hour time difference.

3.2. Moving Forward: The COVID Re-Invention

Amidst a current public health crisis, Colleges and Universities are navigating remote learning and creatively bringing back some sense of normalcy for their students. Many have been forced to work from home shifting our conceptions, resulting in the possibility of new avenues for our future generations where virtual global collaborations are day-to-day job commitments. Educators are creating health promotion programs through a computer lens, and students are acquiring new transferable skills that prepare them for co-workers they never meet in person. These situations create opportunities to rethink educational pathways by using global learning initiatives as an integrative theme (Hovland & Schneider, 2011).

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Measuring the Internet Skills of Gen Z Students in Higher Education: Validation of the Internet Skills Scale in University Settings

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Abstract

Internet technologies have infiltrated higher education institutions around the world. At the same time, the latest generation of students, the so-called Generation Z (Gen Z), are entering higher education. Gen Z is the first generation born in an Internet-connected world, and digital devices are a seamless part of its life. As a result, Gen Z students have already been engaged with informal digital learning via internet-based technologies outside of formalized education settings. However, previous research has shown that their engagement with these technologies is limited and might not sufficiently cover the knowledge and skills needed to perform internet activities effectively in higher education. Additionally, their familiarity with digital devices and tools varies. Consequently, there is a need for higher education institutions to close the skills gap by applying assessment processes that will assist them in forming policies and training resources for undergraduate students. To achieve the above, research efforts need to focus on developing theoretically informed and valid instruments that measure internet skills. This study has contributed to the validation of a self-assessment questionnaire, the Internet Skills Scale, that can be used in university settings. The questionnaire measures five types of internet skills: operational, information-navigation, social, creative, and critical. The results presented herein provide directions for future research in the field.

Keywords: *Internet skills; Internet skills scale; validation; generation Z; higher education.*

1.Introduction

Today's university students belong to the so-called Generation Z. This generation was born in the 1990s and has experienced a globally connected world where the Internet has always been available (Seemiller, & Grace, 2016). As a result, this generation, who is also reffered to as "digital natives", has already used various digital technologies from a very young age, and the Internet is a seamless part of its life (Seemiller & Grace, 2016; Mohr & Mohr, 2017). Although young people's use of digital technologies takes place outside formal education settings, such technologies are also an essential part of their academic lives (Bullen, Morgan, & Qayyum, 2011; Ng, 2012; Ting, 2015; Brooks, 2016; Alexander, Becker, Cummins, & Giesinger, 2017). Despite that, research indicates that informal experiences with digital technologies do not necessarily suggest that undergraduate students can use such technologies for academic purposes (Kennedy & Fox, 2013; Šorgo, Bartol, Dolničar, & Boh Podgornik, 2017). One explanation for this may be that such learning experiences might not sufficiently cover all the skills an individual must acquire to exploit the full potential of digital technologies (van Laar, van Deursen, van Dijk & de Haan 2017). Concequently, many students enter higher education institutions with limited digital skills (Sewlyn, 2009; Ng, 2012; Ståhl, 2017). Additionally, the level of students' digital skills and their familiarity with digital devices and tools varies (Helsper & Eynon, 2010; Hagittai, 2010; Corrin, Bennett, & Lockyer, 2010).

It is widely recognized by higher education institutions and organizations that digital skills are considered an essential component of the human capital, and highly competent users are thus in a better position to be benefited (van Laar, van Deursen, van Dijk, & de Haan 2017). According to forecasts of the European Commission, the future workforce is expected to possess a basic level of digital skills for at least 90% of the professions in the future (European Commission, 2017). In this regard, there is a need for universities to ensure that graduates possess the skills that will enable them to leverage digital technologies and prepare them for the labour market (Jørgensen, 2019).

Hence, research efforts need to provide valid and reliable measures that assess students' needs in advance (Litt, 2013; Ting, 2015). The identification of student's needs will allow higher education institutions to enhance their responsiveness and adaptability and promote programmes for the effective and productive use of digital technologies in the academic environment (Brooks, 2016).

2. Theoretical Background

At an academic level, the effective use of the Internet is essential because it is the primary medium that students regularly use to access course materials and other information resources, communicate with their peers and professors and conduct course work (Kennedy

& Fox, 2013; Gosper, Malfroy & McKenzie, 2013; Shopova, 2014). Research has shown that young people easily adapt to the use of the Internet at a technical level (e.g. accessing services, connecting to a WiFi network) (Kennedy & Fox, 2013; Ng, 2012). In addition, they are very familiar with the use of internet technologies for communication purposes (Bullen, Morgan, & Qayyum, 2011; Gosper, Malfroy & McKenzie, 2013; Shopova, 2014). However, they seem to experience difficulties using tools and services for online information search and evaluation (Hargittai, Fullerton, Menchen-Trevino, & Thomas 2010; Head, 2013; Neumann, 2016) and content creation (Ng, 2012; Kennedy & Fox, 2013). In this regard, there is a need for higher education institutions to close the internet skills gap (Helsper & Eynon, 2010; Hargittai, 2010) by applying assessment processes that will assist them in forming policies and training resources for undergraduate students (Litt, 2013).

One of the most comprehensive and updated measures for assessing the above skills areas is the Internet Skills Scale (ISS) which is proposed by Van Deursen, Helsper and Eynon (2014.2016). The development of ISS is based on a theoretical framework which includes four types of skills: Operational, Information Navigation, Social and Creative. Operational skills refer to the most basic technical skills required to use the Internet, such as using browsers to access web applications. The Information Navigation skills refer to navigating through various websites with different layouts and searching, selecting and evaluating the information on the Internet. Social skills relate to using online communication services, interacting with others and exchanging meaning. Lastly, Creative skills are the skills someone needs to create different types of acceptable quality content (e.g. text, audio, video) and publish it or share it with others on the Internet (Van Deursen, Helsper, & Eynon, 2014. 2016).

The ISS was developed to measure the general population's internet skills, including young people. The study herein aims to theoretically inform the ISS and provide a reliable and updated measure that can assess nationally representative samples and other subpopulations, namely undergraduate students. In this regard, it will allow for better comparisons between demographics that help future researchers to determine how different aspects of internet skills vary among groups (Litt, 2013).

3. Research Methodology

The study sample included 180 undergraduate students who were attending courses at the University of Cyprus during the academic year 2017-2018. Approximately 30% of the students were males, and 70% were females. Additionally, 58.3% belonged to the 18-20 age group, 33.4% to the 21-23 age group, while a small percentage of 8.3% belonged to the 24-25 age group. Finally, 23.9% were first-year students, 31.1% were in the second year, 26.7%

were in the third year, 14.4% were in the fourth year, and the remaining 3.9% were in the firth year of study and above.

3.1. Description of the Internet Skills Scale

The original Scale includes 35 proposed Likert-scale items on five skills categories: Operational, Information Navigation, Social, Creative and Mobile. The category "mobile skills" (three items) was excluded because the importance of and distribution of skills in using mobile devices was not in this study's scope. Additionally, Van Deursen, Helsper and Eynon (2014) proposed future studies to include new items, such as "critical skills" which refer to the process of evaluation. For this reason, two "critical skills" items were included which were suited for the study's context (I am confident in selecting search results, I carefully consider the information I find online).

Table 1. Proposed Items for the Internet Skills Scale

Skills	Items
Operational	1. I know how to open a new tab in my browser. 2. I know where to click to go to a different webpage. 3. I know how to bookmark a website. 4. I know how to use shortcut keys (e.g. CTRL-C for copy, CTRL-S for save) 5. I know how to download/save a photo I found online. 6. I know how to open downloaded files. 7. I know how to complete online forms. 8. I know how to upload files. 9. I know how to connect to a WIFI network. 10. I know how to adjust privacy settings.
Information Navigation	11. Sometimes I end up on websites without knowing how I got there. 12. I find it hard to find a website I visited before. 13. I find the way in which many websites are designed confusing. 14. All the different website layouts make working with the internet difficult for me. 15. I get tired when looking for information online. 16. I should take a course on finding information online. 17. I find it hard to decide what the best keywords are to use for online searches. 18. Sometimes I find it hard to verify information I have retrieved.
Social	19. I know which information I should and shouldn't share online. 20.I know when I should and shouldn't share information online. 21. I am careful to make my comments and behaviours appropriate to the situation I find myself in online. 22. I know how to change who I share content with (e.g. friends, friends of friends or public). 23.I know how to remove friends from my contact lists. 24. I feel comfortable deciding who to follow online (e.g. on services like Twitter or Tumblr).
Creative	25. I would feel confident writing and commenting online. 26. I am confident about writing a comment on a blog, website or forum. 27. I know how to create something new from existing online images, music or video. 28. I know how to make basic changes to the content that others have produced. 29.I would feel confident putting video content I have created online. 30. I know how to design a website. 31. I know which different types of licences apply to online content. 32. I know which apps/software are safe to download.
Critical	33. I am confident in selecting search results. 34. I carefully consider the information I find online.

Adapted from: Van Deursen, Helsper, & Eynon (2014).

3.2. Preparation for the validation process

For validation purposes, the original items of the Scale were translated into Greek from two experts in Technology, who then discussed and resolved the discrepancies. A back-ward translation was followed, and the final version of the translated questionnaire was pilot tested on a small sample.

Prior to analysis, descriptive statistics were performed for each questionnaire items to determine whether there were any floor or ceiling effects in the questionnaire. While most of the items performed well, some of the items had very strong ceiling effects. In particular, ceiling effects were evident in six questions of the operational skills set (I know how to open a new tab in my browser (1), I know where to click to go to a different webpage (2), I know how to open downloaded files (6), I know how to download/save a photo I fould online (5), I know how to connect to a WIFI network (9), I know how to upload files (8)). Additionally, the same effects were evident in one question of the social skills set (I know how to remove friends from my contact lists (23)). This finding is consistent with literature that suggests that younger generations, due to their familiarity and frequent use of the Internet, have already acquired basic technical knowledge (Ng, 2012; Kennedy & Fox, 2013; Ting, 2015; Ståhl, 2017). Because of these ceiling effects, it was considered more appropriate for these items to be removed from the scale.

4. Results

In order to validate the construct validity of the constructs measured in the Internet Skills Scale, we performed an Exploratory Factor Analysis (EFA) in the remaining 27 items of the Scale with SPSS 24.

Initially, we examined the suitability of the data for factor analysis. The correlation matrix indicated that there were many correlations with a coefficient greater than 0.30 (and no correlation with a coefficient greater than 0.90). The KMO had an initial value of 0.87 and the Bartlett's test suggested rejecting the null hypothesis at the level of $\alpha = .01$. Factor analysis resulted in a 27-item scale with five subscales: Information-Navigation, Social, Creative, Operational and Critical. Results from the reliability analysis showed that all five factors had high internal reliability (Cronbach's alpha is 0.90 for the first factor, 0.89 for the second factor, 0.91 for the third factor, 0.84 for the fourth factor and 0.87 for the fifth factor).

Table 2. Mean, Standard Deviation and Reliability Values for each Construct (N=180).

Factors	Items*,**	$\bar{x}$	SD	alpha
Information Navigation	11,12,13,14,15,16,17	15.39	6.11	0.90
Social	19,20,21,22,24,25,26	27.41	5.50	0.89
Creative	27,28,29,30,31	11.80	5.66	0.91
Operational	3,4,10,7	16.21	3.31	0.84
Critical	18,32,33,34	14.53	3.64	0.87

**The number of each item, as it appears in Table 1.*
***The Information Navigation items were reversed since they were negatively worded.*

The use of principal component analysis for factor extraction suggested the presence of five factors with eigenvalues > 1, which together accounted for 70.3% of the variance (38.9%, 13.8%, 7.4%, 6.2% and 4%, respectively). For the best interpretation of the factors, the initial pattern matrix was rotated orthogonally using varimax rotation.

The first factor, Information-Navigation skills, explained 38.9% of the variance and was composed of seven items with factor loadings .536 to .904. It is important to note that most of the highest loading items refer to navigation. The second factor, Social skills, explained 13.8% of the variance and loaded clearly with seven items with factor loadings .648 to .810. Although in the original Scale, the items 25 and 26 loaded higher on the Creative skills factor, in this study they loaded higher on the Social skills factor. The third factor, Creative skills, explained 7.4% of the variance and was composed of five items with factor loadings .766 to .879. The fourth factor, Operational skills, explained 6.2% of the variance and was composed of four items with factor loadings .527 to .849. Lastly, the fifth factor, Critical skills, explained 4% of the variance and was composed of four items with factor loadings .565 to .664. The Critical skills set has formed a fifth factor, although the framework refers to the processes of evaluation as part of the Information Navigation skills. However, it is worth noting that two of the items, 18 and 33 in the Critical skills factor load (more than 0.5) to the Information Navigation skills factor.

5. Discussion

Internet skills research could benefit from developing measures that show reliability and validity. This study performed an Exploratory Factor Analysis to adapt and validate the Internet Skills Scale to the context of higher education in Cyprus. The results produced four factors that remained relatively consistent with the original Scale. The addition of the "critical skills" items resulted in the composition of a new factor and a new set of skills, as the authors of the original Scale suggested. The results from the descriptive analysis showed that the highest ratings were given to items from the Operational and Social skills sets, all of them

referring to technical skills. Some items from the Information-Navigation skills set referring to navigation were rated high, while one item referring to information search was among the ones that were given very low ratings. Similarly, low ratings were given to items from the Creative and Critical skills sets. However, similar percentages in a range of responses showed that individual differences exist in different skills sets. The fact above confirms the heterogeneity of skills possessed by younger generations, and it is essential to be considered by higher education institutions. Future work needs to analyse the Scale's robustness with different academic groups, to improve the available instrument. Also, further research should examine the relationship between Critical and Information-Navigation skills. Moreover, other Operational skills could be explored, such as safe browsing, or Information-Navigation skills, such as avoiding plagiarism when using online information resources, which are essential for academic environments.

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Applying Physical Education Methods to Skills Teaching of Law Students

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Abstract
We study to what extent the "constraints-led approach" (CLA) in physical education can also be applied to skills teaching for law students. In the CLA athletes are challenged to finding their own movement solutions in a dynamic setting rather than responding to verbal cues in a fixed environment. Similarly, we experimented with the implicit acquisition of policy analysis skills in law students in preparation for pro bono client work in so-called law clinics. Although the project was cut short due to Covid-19 circumstances, preliminary outcomes suggest students feel better equipped to working with clients. We provisionally conclude that CLA skills teaching has the potential to improve skill acquisition in clinical legal education.

Keywords: *Skills teaching; law clinics; constraints-led approach.*

1. Introduction

Clinical education is a staple of law school curricula. Law clinics allow students to do pro bono legal work with actual clients. As law students typically are unexperienced in pro bono work, we wanted to create a safe learning environment, with room for experimentation and mistakes, while optimizing learning potential. To this end we taught students professional lawyering skills before working with clients, based on insights from the constraints-led approach (CLA) in physical education.

The CLA is a relatively novel methodology in skill acquisition, in which athletes are incentivized to find their own solutions to motor problems by means of manipulation (constraints) in the environment, task or individual. This type of implicit skill acquisition is reported to transfer to improved performance in competition. Similarly, rather than lecturing clinical students about practical skills, we developed a CLA-inspired methodology in which clinical students independently acquired policy analysis skills before commencing a clinic in which they assisted local municipalities in developing or implementing climate adaptation policies.

This paper chronicles our experiences developing and executing a CLA-inspired training program for law students in the "Water & Climate Law" clinic, and our preliminary findings. To this end, we will first outline how our research project is grounded in clinical legal education and the CLA. We will then explore our aims for this research project, and the methodology by which we have executed and evaluated it. This will lead into an analysis of our findings and suggestions for follow-up research.

2. Context

Law clinics allow students to do pro bono work for real clients as part of their law school curriculum. This pro bono work, however, requires practical lawyering skills. The CLA is a novel skills acquisition method coming from the field of physical education and motor learning.

2.1. Clinical Legal Education

A law degree is a professional degree, and qualifies graduates to apply for bar membership and eventually practice as an attorney. Like with any professional in a regulated profession, rights come with responsibilities for the practicing lawyer. It is therefore that a purely academic legal education may not be the most optimal preparation for practice. The ambition to better prepare law students for practice led to the development of law clinics in US law schools from the 1930 onwards (Carey, 2002), for fear law students become "like future horticulturalists confining their studies to cut flowers, like architects who study pictures of

buildings and nothing else, [or] prospective dog breeders who never see anything but stuffed dogs." (Frank, 1933)

Since, a tradition of law clinics has emerged across the world, in which students undertake pro bono lawyering work for real clients under the tutelage of professors with experience in practice. Typically law clinics have a social justice component, by offering legal work to disenfranchised people or institutions (Barry et al., 2011). Moreover, clinics tend to take place in the vicinity of the law school, allowing for community-based pro bono lawyering (Tokarz et al., 2008).

While law clinics offers students learning by experience (Wizner, 2001), the responsibility towards clients also calls for skills training in students—think of communication, time management, presentation and professional writing skills. While this type of skills training has broadly been regarded as crucial for the success of clinical education for law students, no common methodology has emerged (Kruse, 2013). We propose to experiment with a relatively novel method for skill acquisition in physical education.

2.2. The Constraints-Led Approach

The CLA stems from pedagogical science as a means to study motor learning in children (Wade & Whiting, 1986). As a theorem, the CLA has traveled to physical education and motor development since, and has offered a new approach to skills acquisition in sports.

The traditional approach to skills acquisition in sports prescribes that coaches should encourage athletes towards perfect technical execution in isolation, which will then transfer to optimal performance in competition (Fitts & Posner, 1979). This typically involves repetitive drills—dribbeling a basketball between cones leading up to a jump-shot—coupled with explicit verbal feedback: "tuck your elbow, and again."

The CLA poses that the supposed transfer from practice to competition in this traditional approach to skills acquisition does not materialize. Therefore there is little use for striving towards perfect technical execution in isolation (Renshaw, Chow, et al., 2010). In the CLA, rather, athletes are challenged to find their own movement solutions in a dynamic setting, through manipulation of tasks, environment and individual conditions. This involves non-specific drills closely resembling competition, with few verbal cues by coaches (Davids et al., 2008; Renshaw, Davids, et al., 2010). For example: a basketball drill with defenders instead of cones that *incentivizes* rather than *tells* the athlete to take a jump-shot, by limiting the playing field to the perimeter. Randomized controlled trials show better performance in athletes following CLA training over traditional skill acquisition methods (Gray, 2020).

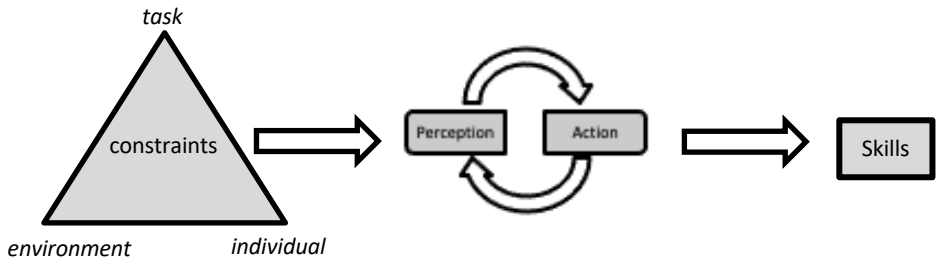

Figure 1: the CLA fosters skill acquisition by manipulation of task, environment and individual conditions, leading to sensory perception in action

3. Aims and Approach of the Research

We have set up a project to apply insights from the CLA to clinical legal education. The starting point for this project was our experience that law students weren't properly prepared for working with real clients in law clinics. This manifested itself on two levels. First, students themselves reported feeling insecure and ill-equipped to dealing with 'real' cases and clients, mainly due to inexperience and a fear of making mistakes. Second, as professors we found students to be hard-wired to treat clinical cases like abstract exam questions to be solved in isolation, rather than real problems of real people that need to be involved in the project. Moreover, a unlike an exam a clinical project does not necessarily lead to one correct 'answer.'

Similar to the traditional approach to motor learning in sports mentioned above, academic legal skills teaching often pre-supposes transfer from verbal instruction to practical execution (Binder & Bergman, 2003). Better preparing graduates for practice by skills teaching and the optimal methodology to teach skills has become a hotly debated topic in legal academia (Kruse, 2013). At our law school, this has led to the establishment of a so-called "Legal Skills Academy," organizing lectures and descriptive 1-pagers about professional and academic skills. As part of this ongoing debate on skill teaching for law students, we have experimented with professional skill acquisition in a law clinic, modeled on the CLA methodology.

3.1. Aims: Effective Analytical Skills Acquisition

Of the many skills that students need to excel in a law clinic, we decided to focus on the analytical skills required for client work. Similarly to law practice, clients in law clinics often have a hard time explaining the issue they face—they are not trained lawyers, after all. Acquiring the analytical skill to abstract a client's situation, in our view, would better prepare students for a law clinic.

Instead of lecturing students on analytical skills, we set out to incentivize students to themselves develop a method to analyze a client's policy program, and to abstract this into a coherent and tractable project. This was done in preparation for our "Water & Climate Law" clinic, in which students would advise 5 participating municipalities on developing and/or implementing local climate adaptation policies. This clinic is the final compulsory course in our 1-year LLM-program in Environmental Law. After having finished this course and having written their LLM thesis, most students start applying for jobs.

3.2. Methods

We developed a day-long training session culminating into the students' first meeting with representatives of the municipalities. In this training session we led students through a series of scenarios to be discussed in groups, with little ex ante instruction.

First, students were given documents on an existing municipal policy program to prevent flooding by excessive rain in low-lying neighborhoods. Given the complexity of this program, students were divided into small groups and asked to figure out:

- Question 1:
    - Group 1: **what** does this program do?
    - Group 2: **why** has this program been instantiated?
    - Group 3: **where** is the program situated, and what are the particularities of this location?
    - Group 4: **when** will this program take place?
    - Group 5: **who** (which stakeholders) are involved in this program?
    - Group 6: **how** (using what instruments) will this program be executed?
- Question 2: what other questions would you wish to ask to figure out the key elements of this program?

Students would prepare for 15 minutes, and present their findings plenarily. The aim of this exercise was for the students to collectively answer question 2, incentivizing them to jointly develop a set of standard questions that can be asked to analyze any given policy program: what, why, where, when, who and how—or 5W1H in short (Bromell, 2017).

Second, students were again divided into small groups and given a separate (fictional) scenario in which a problem occurred during the implementation of the previously introduced policy program. Students were asked to abstract this problem to the level of tensions between the previously developed basic questions, for instance:

> *When the city council intends to de-fund the flooding prevention program after a prolonged drought period, this points out a tension between the "**what**" and "**why**" question.*

Students were asked to present their scenario plenarily, and reflect on how they abstracted it into a basic tension. The aim of this exercise was to make students realize that most policy implementation problems can be translated into tensions between the basic components of a policy proposal.

In both of these exercises we manipulated the task and environment to incentivize the students to develop their own solutions in policy analysis and implementation, rather than lecturing them on the 5W1H method in policy analysis and the basic tensions between 5W1H components (Bromell, 2017). Our hypothesis was that this CLA preparation would lead to positive outcomes in students' self-perceived level of preparedness for the environmental law clinic. We would test this hypothesis by means of a perceived efficacy survey immediately following the training session and a perceived effectiveness survey after completion of the clinic.

4. Results

The Water & Climate Law clinic was a 5 EC course that took place at Utrecht University School of Law (the Netherlands) from February until May of 2020. 14 Master's level students participated, and divided in groups assisted 5 municipalities in the Utrecht province in the development and implementation of climate adaptation policies. The students' involvement was part of a larger project about climate resilience in residential areas in the Utrecht region funded by the Dutch National Delta Program (Kennisportaal Klimaatadaptatie, 2016).

Based on the qualitative perceived efficacy survey immediately following the training session (N=14), we find that students felt well prepared for working with the municipalities after the training sessions. Students reported:

- Being able to systematically analyze a policy program at the start of a project
- Being able to identify common problems that clients have run into when approaching outside counsel
- Being able to depart from pure legal analysis and consider the broader, non-legal context in which clients operate

This latter finding was not envisioned, but at the same time not entirely unforeseen. This outcome partially mitigates the situation described in section 3 above of students being "hard-wired to treat clinical cases like abstract exam questions."

As so often in 2020, the Covid-19 epidemic led to unforeseen circumstances for the Water & Climate Law clinic. Lockdown and quarantine requirements complicated the clinical projects significantly, leading us to terminate the formal evaluation of the clinic—including the ex post effectiveness survey. Notwithstanding the encouraging outcome of the initial qualitative

survey, therefore, we do not have the data to definitively report on the effectiveness of our CLA methodology.

5. Conclusions

The findings of our experiment are limited but promising: as hypothesized, participating students report being able to better analyze a policy program and the typical problems a policy program may run into. Moreover, students report being able to better relate to the not purely legal context in which a client operates. Lastly, students report to feel less insecure about working with 'real' clients.

Given these qualitative results we preliminarily conclude that CLA skills teaching has the potential to improve skill acquisition in clinical legal education. We feel encouraged to iterate on our initial findings and develop a more quantitative study on the effectiveness of constraints-based teaching in law clinics. We therefore intend to run follow-up surveys with a new group of students in the clinic once on-campus teaching resumes.

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Professional development of in-training museum educators: an experience of curriculum improvement in time of a pandemic

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Abstract

The present paper aims to illustrate the reorganization of two post-graduate courses, "Museum Education. Theoretical aspects" and "Advanced Studies in Museum Education" promoted by CDM (Center for Museum Studies) - Dept. of Education at Roma Tre University, carried out during the Covid-19 pandemic, and to analyze the education strategies adopted in terms of museum professionals development to face the Covid-19 museum and universities 2020 Italian lockdown.

The results emerging from the quantitative evaluation of the module "Museum and Social Networks", taking into consideration the activities and digital tools proposed, show the efficacy of the courses reorganization, in terms of transverse and professional skills development in university students, critical thinking and collaboration in particular. Moreover, the data analysis give useful indications in term of university online lectures, laboratory activities and practices in e-learning mode, evaluation tools and methodologies aimed at solliciting professional development of in-training museum educators in university learning context.

Keywords: *Museum education; e-learning; evaluation; transverse skills, professional skills, emergency remote education.*

1. Introduction

The Creative Industries Education context, meant as museums, galleries and libraries, presents a low emphasis on the use of new digital technologies, entrepreneurship promotion, digital abilities and transverse skills development (Poce, 2019; European Commission, 2017). Both newly graduates and existing employees, especially adult professionals, in fact, lack relevant skills (OECD, 2018) for their future careers, thus having less opportunities to improve their development and to add new forms of digital expression to their work (European Commission, 2018). However, the use of web, mobile, social and analytical tools are becoming more and more popular in the field of Cultural and Creative industries, especially during the last year (NEMO, 2020). These communication channels proved to be essential for cultural institutions in general and museums in particular to face the challenges posed by the current world-wide health emergency. In a report published on the EUR LEX website the need for stronger partnerships between the cultural and creative sectors, social partners and education and training providers, both through initial training and continuing professional development was highlighted. Such closer connection should provide sectors with the mix of skills needed for creative entrepreneurship in a rapidly changing environment.

2. The research context

In the light of the above assumptions, CDM (Center for Museum Studies) – Dept. of Education at Roma Tre University has designed and offered a revised version of two postgraduate courses devoted to professional development of future Museum Educators named 1. Museum Education. Theoretical aspects (since 1994) 2. Advanced Studies in Museum Education [1] (since 2012) offered in a blended mode (face to face – f2f - and on line) on a devoted platform.

The annual II level course in "Museum Education Theoretical aspects", mostly online, allows the acquisition of the annual post-graduate course certificate. Participants learn the theoretical foundations and the practical tools for analysing museum visitors' characteristics and needs. Online activities are offered and organized into theoretical and multimedia learning units, self-assessment and educational support from tutors.

The biennial course "Advanced Studies in Museum Education" is addressed to those interested in deepening museum education theoretical framework and wish to employ educational research methods in such a context: analysing various categories of visitors' needs, training on museum standards in education, according to the latest world research results in the field. The course guarantees an international dimension to all its initiatives.

[1] http://centrodidatticamuseale.it/en/post-graduate-courses-2/

Lecturers expert in museum education teach f2f classrooms (UCL, Loughborough Univ., National Gallery – UK; Sorbonne – Fr; Universidade Abierta – P; Smithsonian – USA). An academic year involved about 294 classroom hours, 217 distance-learning hours to carry out within a Learning Management System (LMS) named *orbisdictus*, 206 internship and project work hours, 33 hours of guided visits and 750 hours of study. For distance learning, online activities were divided into theoretical and multimedia learning units, with assessments and educational support from teachers. Internship activities took place at the partner companies (e.g. CoopCulture) or at public or private museums in Italy and abroad (Poce & Iovine, 2015).

2.1. Re-designing post-graduate courses at the beginning of the pandemic

From the beginning of March 2020, the spread of COVID-19 imposed an immediate reorganization of the CDM post graduate courses. Even before the emergency, the post-graduate courses were intended to promote students' digital, transverse and entrepreneurship skills. The mobilization of the world of culture – in particular of the world of cultural heritage – further encouraged the post graduate courses' managing staff to create specific online teaching units aimed at understanding the current state of heritage institutions and at figuring out which could have been effective online educational activities for heritage institutions going massively online. The implementation and adaptation of the course contents were carried out together with the readjustment of the LMS activites normally employed for distance learning.

The LMS was re-arranged to host a new section entirely devoted to "extra" activities planned to deal with the emergency.

Materials shared in the Orbis Dictus LMS are Open Educational Resources (OERs), wich includes PDF file, streaming videos, apps, podcasts, assessment tests, quiz, etc. available to students and periodically updated in the e-learning platform.

A section of the e-learning platform has been reserved to the video-updates where students are periodically informed about the development of the activities and how to proceed in the course accomplishment. As far as f2f teaching and learning is concerned, national and international experts and teachers involved in the post-graduate courses training activities agreed in redesigning conventional lectures and adapt them to the new digital educational context, meeting the challenge and collaborating to the outline renovated online programs.

Students interested in attending one of the modules proposed by the experts were involved according to the following model: introduction of the activity, presentation of the issue, description of the task, live sessions where the topic is discussed and elaborated. Students were in fact invited to join a virtual classroom on Microsoft Teams©, participating in live

sessions where group discussions, performing tasks, group activities and presentations were delivered.

2.2. The educational activity: Museum and Social Networks

Within the new educational proposal offered to students, a particular attention has been paid to the analysis of the strategies adopted by museum institutions from all over the world to face the COVID-19 lockdown. Students were invited to devise project hypotheses and solutions starting from a number of case studies identified by the tutors. This can be realised through the ideation of original activities designed by considering the specific target needs and the most suitable mediation tool. Although currently visitors cannot access to the museum buildings, our students, as future museum educators, are invited to reflect upon creative opportunities to keep visitors exploring the museums' exhibition, also university ones, living an authentic experience and learning through the works of art.

The educational activity was named "Museums and Social Networks" and it wasstructured to achieve two main goals:

1. Developing *analytical skills* (Facione, 1990): Analysing the online presence of one or more museum institutions; Analysing its or their presence on social media; Analysing engagement strategies for facing the COVID-19 emergency carried out by the selected museum/s.
2. Developing the ability to find *new solutions* for the identified problems (Poce, 2017);

The second goal will be achieved by asking students to design an online educational activity, by considering the potential of specific museum's collections and resources. Students are invited to contextualise the activity at the light of the current cultural-historical context.

These activities are thought to be relevant not only to develop technical skills and abilities for future museum educators but also transverse and digital skills. Furthermore, an improvement of students' critical thinking ability on the proposed topics is expected (as identified by Facione, 1990 and Poce 2017), as well as individual and group communication, collaboration and problem solving, in order to solve those questions in a creative way.

3. Research questions, data collection and data analysis

Our research is aimed at understanding how the above mentioned activities could encourage the 4C skills development, including teamwork and cooperation, creativity, critical thinking, and communication among students.

The post-graduate managing staff of the courses and the lecturers involved in the learning activities have designed an evaluation plan of the objectives achieved by the participating students, as follows:

- Formative assessment activities: during the course, two evaluation tools are used to monitor the level of knowledge acquisition and transversal skills development: a self-assessment survey (Poce, Agrusti & Re, 2015) of the skills developed, filled in by the students at the end of the teaching module, and a closed-ended assessment test to assess the levels of knowledge acquired.
- Summative assessment / academic performance: students are asked to produce an empirical research project in the field of museum mediation, education and cultural heritage fruition. The empirical product was assessed by a group of lecturers and tutors of the course through the use of a critical thinking evaluation rubric, already used and validated in previous research in the field (Poce, 2017).
- Course assessment:final evaluation survey of the course will be filled in by the students in order to evaluate the general course progress, the specific educational activities, the tools and teaching methodologies used.

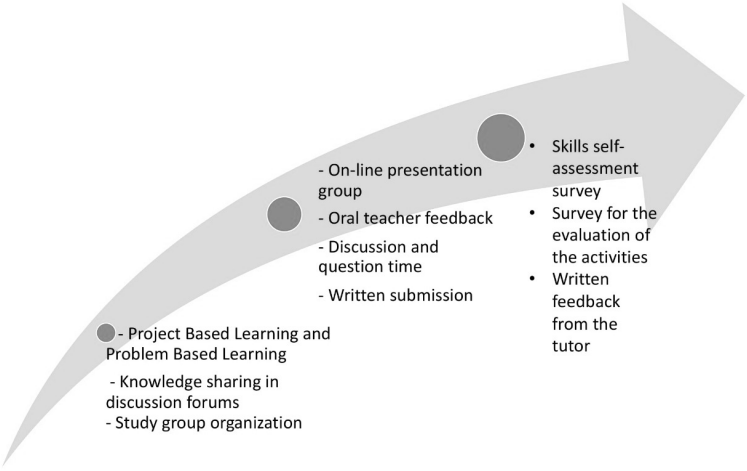

Figure 1. Monitoring, formative and summative assessment activities within the post-graduate courses.

4. Results from "Museum and Social Network" educational activity

The students who took part in Museum and Social Network (M&SN) module were 12, attending both Post-graduate courses. As regards the evaluation data, the average scores expressed, considering a score scale from 1 to 5, are well over 4 out of 5, both with regard to the qualitative aspects inherent to the contents of the activity and to the self-assessment of

the acquired knowledge. With regard to the skills encouraged and in particular focusing attention on the 4C skills, the one that showed the greatest increase, according to the students, was the communication skills, probably due to the primary purpose for which the activity was designed, i.e. to be able to "communicate" the activity they designed taking as a reference the museum if selected, in times of pandemic, in an innovative, impactful and above all attractive way using social networks as a medium, in order to reach immediately the target chosen for the proposal

Relevant scores were also attributed to the development of critical thinking skills and creativity. Among the four competences the one that received a lower score than the others, but still sufficient (3.4 out of 5), was the collaboration competence. This result can be associated with the fact that, compared to the other activities proposed, the latter was the one that preferred individual rather than collaborative work.

Concerning the course assessment, the average score was 4.7 out of 5. This result is particularly relevant if we consider the historical-cultural period of great social, political, psychological and intimate upheavals that each of us had to face.

Concerning the assessment of digital technologies, students provided the highest scores in the following areas:1) supporting for their motivation and involvement, 2) acquiring higher confidence with the use of digital technologies 3) using new e-learning platforms for the activity.

Concerning the assessment of academic learning outcomes, the students' projects have been evaluated using the CT grid (Poce, 2017) which gives scores on a scale from 1 to 5 taking into consideration the following macro-indicators: use of language, justification/argument, relevance, critical evaluation, innovation (Figure 2).

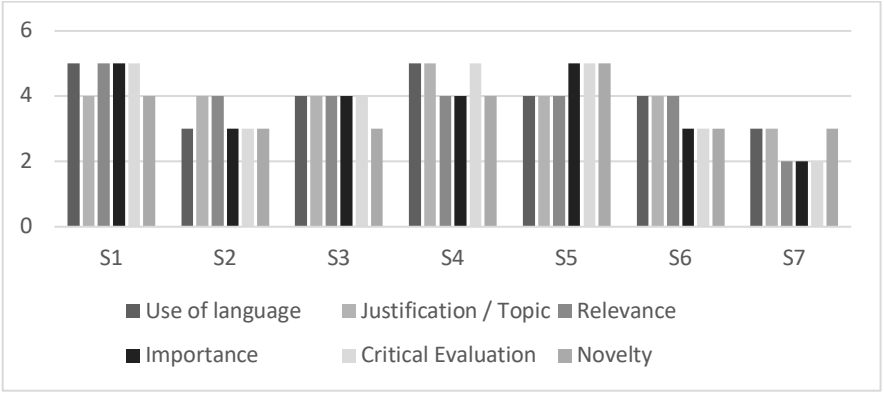

Figure 2. Evaluation of Critical Thinking in the works produced by students for the activity Museums and social networks.

Starting from the analysis of the average results that emerged from the works, in particular from the "use of language" in which the appropriate use of punctuation, spelling, morphosyntax, lexical property is evaluated, with particular reference to the use of the technical-scientific language adopted in the empirical research in the pedagogical field, a score of 4 out of 5 was recorded. As regards the second macro-indicator "justification/argument", the average score of the papers was again 4 out of 5, since most of the arguments turned out to be very clear and consistent. Regarding the third macro-indicator "relevance", the average scores showed a development of the projects in most cases correct and complete. Only in one case the development was assessed as partial. The average results for this indicator were 3.9 out of 5 points in total. As far as the fourth macro-indicator "importance", only one paper showed a superficial treatment. The average result was 3.7 pt out of 5.

The fifth macro-indicator "critical assessment" evaluates the critical re-elaboration of documents and sources (study texts, other sources mentioned) used by students to complete the assigned task. In this case the re-elaborations were mostly extensive and adequate, recording an average score of 3.9 out of 5.

The last macro-indicator "novelty" assesses the possible presence of additional information, new ideas or solutions that students have reached after the first phase of theoretical study, in-depth study and practical proposals for implementation. For the most part, correct ideas have been provided and in some cases the proposals have turned out to be original and perfectly in line with recent research in the field. The average results are 3.6 out of a total of 5.

5. Discussion and conclusive remarks

The present research has shown how, thanks to the critical use of technological and digital supports, an effective way to reorganize entirely the activities of 2 post-graduate courses, which normally included f2f lectures, laboratory activities and workshops at the museum. This was possible by exploiting the huge amount of digital resources offered by museums and, in the specific case, by university museums.

In the projects submitted at the end of the *Museums and Social Networks* activity, students often referred to digital sources and resources belonging to university museums. Given the very encouraging overall results, especially if we take into consideration the evaluations given by the students themselves, it is possible to rethink in an almost definitive way a reorganization that foresees at the same time a double possibility of using the courses, in presence and at a distance, a modality that we plan to experiment concretely next autumn. Surely, it is necessary to review in a timely manner the possibility of increasing the number of laboratory activities in e-learning mode, which has proved to be the most requested by the students and at the same time to encourage critical reflection activities with project proposals

that refer to concrete and current scenarios to be submitted periodically to the students, preferring group research, so as to further stimulate the skills of collaboration, entrepreneurial spirit and problem solving that are among those that, in the opinion of the students themselves, should be strengthened.

Authors' contributions

A. Poce coordinated the research presented in this paper. The research group is composed by the authors of the edited contribution, in the following order: A. Poce (1, 2, 5), M. Valente (2.1) M. R. Re (4), F. Amenduni (3), C. De Medio (2.2).

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Combining experimentation and reflection techniques in behavioral competency development programs: A learning approach based on journaling and peer coaching

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Abstract

Behiavioral competencies are key determinants of individual performance and literature has recently started to devote attention on those methodological approaches that can effectively promote their development. According to Dewey, individuals do not learn from experience, but they learn from reflecting on experience. In this paper, we draw on the Dewey's idea and we investigate if reflective practices through journaling and peer coaching can improve the learning experience of individuals engaged in a competency development program. After introducing the prior research that emphasized the positive impact of these two reflective techniques, the paper illustrates how journaling and peer coaching has been introduced as a part of a competency development program. Preliminary insights from the empirical case show that self-directed learning requires a reflection process that helps individuals to better understand their current behavior, their progresses, and opportunities for change. Journaling was found especially useful to increase one's self-awareness and self-confidence, whereas peer coaching allowed students create a social bond, share their experiences and receive a direct feedback from a peer. The paper also illustrates the limits of these reflective practices, discussing the interventions that can be implemented to maximize their learning benefits.

Keywords: *emotional and social competencies; reflective journaling; peer coaching; experiential leaderning.*

1. Introduction

The current economic environment, characterized by increasing competition, flexibility, and continuous rapid change, has led organizations to look for employees with personal characteristics that go beyond their mere technical ability. Nowadays, people who want to enter the labor market are required to show a set of emotional and social competencies (Azevedo et al. 2012; LinkedIn, 2019) that enable them to pursue effectiveness (Brown, et al., 2003; Emmerling and Cherniss, 2013). Adopting a behaviorist approach to emotional intelligence (Boyatzis, 2016), we define emotional and social competencies as "related but different sets of behavior organized around an underlying construct, which we call the 'intent" (Boyatzis, 2009: 750).

Scholars maintain that the development of these competencies requires an approach that is different from traditional methods based on passive accumulation of knowledge that have traditionally been offered by higher education institutions (Garcia-Aracil and Van der Velden, 2008). The development of emotional and social competencies should be based on active learning, stimulation of relationships and cooperation (Garcia-Aracil and Van der Velden, 2008), in which experience plays a critical role (Kolb, 1984).

By involving participants in a process of reflection, interactive engagement, and practice, experiential learning techniques stimulate the cognitive, behavioral, and emotional dimensions of learning and behavioral change that are necessary to acquire emotional and social competencies (Hoover et al., 2010). Experiential learning conceives learning as a holistic process in which the person is called upon to think, feel, perceive and behave in the interaction with the environment (Kolb, 1984). According to experiential learning theory, the ideal learning cycle is a recursive process in which concrete experiences represent the basis for reflection and observation (Kolb and Kolb, 2005). Reflection allows individuals attach meanings to their experiences, creating frameworks of knowledge, which in turn transforms the action patterns (Yeo and Marquardt, 2015).

Although practitioners have often translated the principles of experiential learning theory simply in the provision of contexts in which students can try out new things, the literature clarifies that experiences alone do not promote the development of the person as much as the meaning that individuals derive from such events (Ligon and Hunter, 2010). According to Kolb (1984), taking experience seriously means honoring and valuing people's subjective sense-making and reflection, which represent a substantial feature of learning (Dewey, 1933).

The ability to reflect refers to how effectively individuals can learn from their personal experiences (Boud et al., 1985). It facilitates the process of analyzing the various components of the experience and convert it into learning, through the construction of a meaning.

In this paper, we thus overcome the idea that the experience alone is enough to drive the acquisition of emotional and social competencies, and explore the role that personal reflection may have in this process. We will focus on two instruments adopted to enhance personal reflection and convey behavioral change, namely journaling and peer coaching, and we will present a case study that illustrates the benefits and challenges of the application of the two instruments for emotional and social competency development.

2. Theoretical background

2.1. Journaling

Journaling is one of the most common tools used to foster individuals' practice of reflection due to its ease of implementation and the potential depth of the outcome (Roberts, 2008). It consists of the daily, or weekly, report of experiences from which thoughts, feelings, ideas, reactions arise (Montagna et al., 2013). Reflective writing is the expression on paper, or on the screen, of some mental processes of reflection. Writing things down allows the individual to distance him/herself from what he/she has experienced and examine the situation from an external point of view (Jefferson et al., 2014). This facilitates the individual in giving a structure to the experience, linking facts together and searching for the deeper meanings of the events taken into consideration. Moreover, it allows for a meta-analysis of experiences, by giving the individual the opportunity to integrate behavioral and emotional patterns that follow one another in the daily experiece (Jefferson et al., 2014).

2.2. Peer coaching

Peer coaching is a confidential process by which two peers work together to reflect on current practices, expand, refine and build new skills, share ideas, and teaching each other (Robbins, 1991). Jackson (2004) proposes that coaching is intrinsically a reflection effort, as coaches are able to ask questions that spur the coachee critical reflection (Robertson, 2005). Experiential learning advocates the value of consulting with knowledgeable peers (Schön, 1983), as it allows peers to assist each other in learning and drawing insights into personal behavior (Parker et al. 2008). Peer coaching is a type of developmental relationship that needs to be characterized by positive inclination, authenticity and mutual trust to be effective (Rogers, 1973). Compared to other developmental relationships, peer coaching differs for being characterized by the mutuality and reciprocity of the process.

Previous studies showed that peer coaching had a positive influence on students' personal development. For instance Parker et al. (2008), found a positive relationship between peer coching and leadership development in a group of MBA students.

3. The adoption of journaling and peer coaching for competency development

To better understand the effectiveness of journaling and peer-coaching for the development of emotional and social competencies, and highlight the advantages and limitations of the two tools, we conducted an analysis on a group of Master students participating to the elective course "Emotional competencies and personal development". The aim of this course is to encourage students' development of emotional and social competencies through a self-directed learning methodology. During the course, student learn what emotional and social competencies are, reflect on their ideal future self, undertake a multi-rater assessment of their emotional and social competencies and finally define which are the two or three competencies they would like to improve with priority.

During the four months that follow the end of the course, students were asked to engage in the experimentation of new behaviors in real-life contexts aimed at improving the competencies defined as learning objectives. They were asked to complement their learning process using the tools of journaling and peer coaching. Specifically, they were asked to write a journal at least twice a week and perform peer coaching sessions at least once a month. They were provided with one form to fill in per each activity to facilitate their reflection process. In the journaling form they were asked to reflect upon: i) the situation in which they practiced the emotional or social competency; ii) the specific behaviors adopted; iii) the positive and negative outcomes of their behaviors they perceived or other people expressed as a feedback; iv) emotions felt, difficulties encountered, and areas of improvement. The peer coaching form consisted of a first reflection on the main topics discussed during the session, followed by a question on the perceived benefits of the session, and on the questions that helped the individual carry out a more in depth reflection on his/her learning experiences.

Both the journaling and peer coaching forms were analyzed through a thematic analysis in order to explore the evolution of the development path students were undertaking.

After the four months, a survey has been carried out in which we asked students to what extent the activities of journaling and peer coaching contributed to become aware of the progresses made in the improvement of the emotional or social competency, to what extent they helped the student identify the behaviors that lead to positive outcomes, the behaviors that generate negative outcomes, and the way to change in order to achieve more positive results in the following learning experience. The scale used ranged from 1 (totally disagree) to 7 (totally agree). Open questions were included to investigate the students' perception on the effectiveness of journaling and peer coaching as instruments to pursue competency development, and the difficulties students encountered during their use.

3.1. Results

The initial sample participating to the course was composed by 51 Master students, of which 70% females and 30% males. Seventy-one percent of the initial sample engaged in the journaling and peer coaching actitvities.

The majority of the sample completed the journaling activity on average once a week, 37% percent completed the activity on average twice a week, and the 4% engaged in the activity more than twice a week. From a qualitative analysis of the content of students' writings, it emerges that journal reflection enhanced an increasing self-awareness troughout time. Three main phases can be identified. In the initial phase, the writings brings together a contraposition between hesitation and fears and a great desire to improve. For instance, students reported: "I hate myself when I am under stress, I am the worst, I am not empathic, I am selfish and grumpy", but also "I felt I was ready to react, to start changing as soon as possible". The intermediate phase is characterized by greater awareness and willingness to achieve improvement. Comments mainly describe situations in which despite the small difficulties, students feel they can achieve results, they valorize their own stregths and believe in themselves. The third phase describes a consolidation of the awareness. They become aware of their progresses and continue to challenge themselves. Ideed, in the final survey, students identified benefits of the journaling activity that include: developing higher awareness of their learning path; higher concentration; higher intrinsic motivation to development; improvement of well-being. The main difficulties encountered regard the need for perseverance to maintain a certain frequency of writing, shyness in writing down some negative experiences, and describing the emotions felt. From a methodological point of view, some students felt the scheme provided was too rigid, and they perceived a sense of obligation that devalued the activity and the desire to complete it.

As for the peer coaching activity, students grouped in couples performed a coaching session on average once a month. Students appreciated both elements related to their role as a coach and as a coachee. As a coach, students perceived an improvement in their active listening, empathy, and in their being supportive. As a coachee, they acquired new stimuli thanks to the sharing of different development methods for the same competency and the discussion of different points of view. They felt the effective exchange of experiences, of progreses and failures enhanced the awareness on their development. Students unanimously declared they created a good feeling with their peer, which consistently with theory, leads to a trusting relationship in which people express their thoughts and feelings without fear of judgment. The main obstacles encountered concerned the fit of agendas to find a moment to talk. Secondly, being constant both in the frequency of appoinments and in the level of enthusiasm was found challenging. Some students also felt not good enough in asking the right questions.

Concerning the quantitative assessment of the efficacy of the journaling and peer coaching instruments for competency development, 78% of the sample agreed (rates from 5 to 7) that journaling helped them become more aware of their progresses, a slightly higher percentage was found for peer coaching (81%). The influence of journaling on the understanding of effective and non effective behaviors was rated as positive by 71% and 50% of the sample respectively. As for peer coaching, 83% and 74% of the sample agreed with the helpfulness of peer coaching in identifying effective and non effective behaviors. 75% of the students agreed journaling helped them identify ways to modify their behaviors to improve their competencies, a slightly lower percentage was found for peer caching (70%).

4. Discussion

This case analysis advances the understanding of how journaling and peer coaching can be adopted in an emotional and social competency development program in order to enhance the students' engagement in an experiencial learning cycle. To improve emotional and social competenecies, experiencial learning techniques are required. However, beside undertaking the experience itself, we argue that in order to maximize the learning from experience, students should be accompanied in their reflection process. To do it, journaling and peer coaching were found to be positively valued by students, who perceived the two tools helped them better understand their current behavior, their progresses, and opportunitites for change.

Journaling was found especially useful to increase one's self-awareness and self confidence. However, the number of journals to write in a week was considered too demanding and led to a higher dropping rate. From a methodological point of view, the tradeoff between need for regularity in writing and level of commitment need to be found. Moreover, someone considered the predefined schema to fill in too rigid to freely express the sense-making of their experiences.

Peer coaching resulted to be generally more appreciated, as besides the benefits in terms of self-reflection, it allowed students create a social bond, share their experiences and receive a direct feedback from a peer.

The case provides also evidence of the effective integration between classroom activities and self-directed learning. The first provides the theoretical bases to understand how to direct one's improvement. Afterwards, students need to be provided tools that can be used in their everyday life that can ease the process of continuous learning.

5. Limitations and future directions

The present study presents some limitations that can be addressed by future research. First, the study is limited in terms of sample size. Future developments of this research will overcome this issue by addressing different cohorts involved in the process of emotional and social competency development. Second, the method adopted is coherent with the explorative nature of this study, but limited in the ability to empirically test the influence of the journaling and peer coaching tools on competency development. Thus, future directions for research include the adoption of a quasi-experimental design that could provide further insight on the effects of journaling and peer coaching in the improvement of emotional and social competencies.

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My course is a series, and what is yours?

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Abstract

Everybody is talking about the newest episodes on Netflix, Amazon Prime or other channels. While the cultural phenomen of a "series" is nothing new, it has never been so popular as today. The "lockdown" era brought more streaming, more time at home and more online teaching. Starting with the idea that our students (and many of our teachers) are now part of the "Netflix generation", we have been integrating serial elements in education and training. This contribution describes the first experiments of using the elements of a series in teaching. Regardless of whether online and offline teaching, teachers and trainers can use some classical methods of series, such as recaps and cliffhangers, teasers and mysteries to make the courses not only more interesting but also more consistent. Encouraged by the positive results of our experiments, we will be taking the series a step further in the upcoming semester and include elements of an interactive series in our teaching. Together with the students, we will be developing a storyboard outlining the series' episodes throughout the semester.

Keywords: *Learning; series; online; interactive; training; teaching.*

1. Introduction

In today´s entertainment industry, the series plays an important part. The subscription numbers of the streaming service Netflix are rising, and Amazon, Apple and others are becoming more involved in the entertainment business. But the idea of series is much older - and its basic principles are by no means only usable for the entertainment industry.

Many students and adult learners belong to the "Netflix generation". Regardless of whether young or old, people enjoy watching and discussing their favorite series. The streaming platform Netflix reported almost a quarter more revenue in the first quarter of 2020, thanks to an increase in paying subscribers and had more than 203 million subscribers in the forth quarter of 2020.

When people talk about series in teaching, they usually integrate existing (TV) series into their course, as scenes from Dr. House in medical studies or telenovelas in language classes. In this paper, we focus at implementing serial elements in training and teaching. After briefly discussing the background and existing research on series, we describe our first experiments of how elements of a series can be used in teaching and training.

Figure 1. background picture: unsplash.com / Chester Wade, text by the authors

2.1. Background and research

Christian Blümelhuber (2011), lecturer on strategic corporate communication at the Berlin University of the Arts, defines a series as the variation of the same thing over and over again. Like a brand which offers security and orientation to consumers, a series helps the audience to find their way through the jungle of entertainment products. From Episode 1 of a series onwards, the audience is meeting familiar people and is recognising patterns in the plot as storytelling is inherent in films and series.

Many teachers and trainers, too, are increasingly relying on stories to foster learning as our memory stores a story faster and more efficiently than facts. A story triggers emotions, which

in turn stimulate deeper learning processes (Masemann, 2009). Research refers to this as episodic memory (Radvansky, 2015). We deduce that, in teaching and training, the learners are better in remembering content placed along a clearly outlined story arc than classically presented learning material. Lugmayr et al (2017) use the name "serious storytelling" in this context.

Additionally, a historical model for series in the classroom exists. From the 1960s until the end of the 1990s school television offered for example mathematics and Russian in Germany and Austria (Barth, 1978). Print media, too, uses elements of series as the media repeat certain formats in regular intervals (Knellessen, Schiesser and Strassberg, 2015).

To find out more about the phenomenon of a series, we have conducted four interviews, namely with Wolfgang Temmel (2020), Florian Born (2020), Jana Burbach (2020) as well as Stefan Zinke (2020), and have received recommendations from the training institution Serial Eyes in Berlin (2019). Wolfgang Temmel is a multimedia artist from Austria. The Austrian Florian Born works in Agile Management and Software Development (Born, 2020) and is an avid recipient of podcasts. These comparatively new digital formats often have a fixed protagonist, a given topic and guests. Jana Burbach (2020) and Stefan Zinke (2020) are series authors from Germany.

2. What defines a series?

A series has several episodes arranged in seasons. There is a clear dramaturgy with acting characters as well as a clear "branding" with name, graphics, sound, tonality and more. A series has fixed elements that are repeated in each episode and on the other hand there are new aspects of the story in each episode. Series are not new. On the contrary, Umberto Eco has identified serial thinking in the work of Shakespeare and in Star Wars and refers to 1980s as the "age of repetition". (Eco, 1987, p. 50)

2.1. Elements of a series and a connection to teaching and training

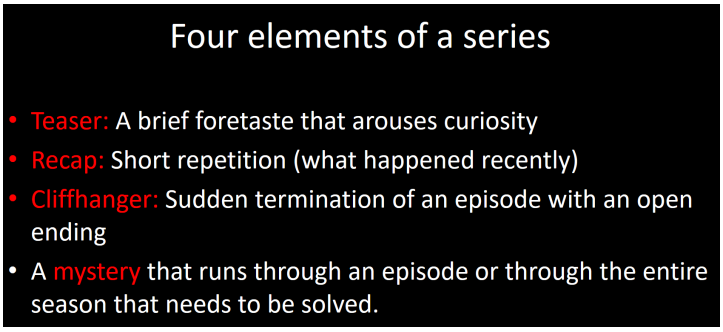

Figure 2. Elements of a series - own illustration

The four elements of a series – teaser, recap, cliffhanger and mystery - can be applied to teaching and training. As shown in Fig. 2, the teaser invites the audience to watch the episode or listen to the podcast. In teaching or training, the teaser refers to the syllabus or the workshop description functions as the teaser. The recap of a series can be easily applied to the start of a class. Instructors as well as students can recap on what happened in the last class – or episode. While it might be difficult to imagine a cliffhanger in the classroom, it is possible to include this element. Mysteries, on the other hand, are easy to incorporate because learning is all about solving mysteries. The learning experience can be enhanced with multimedia products, such as videos, blogs, and podcasts.

2.2. What is the benefit of a series in the classroom?

Teaching and training can benefit from the series as the series provides orientation. It ensures continuity for teachers/trainers and students/learners as it offers a relatively fixed setting and a story arc over a longer period of time. Ideally, the classroom series also creates tension with its elements of cliffhangers and mysteries as it makes students wonder what will happen next.

3. Case studies

The integration of serial elements into our teaching started in March 2020. In the two semesters of 2020 and 2020/21, we applied the approach of a series to different areas, in online training and online teaching for example with videos and podcasts.

3.1. Elements of series in the master's programme

In the master's programme "Media Competence and Digital Literacy", video interviews were incorporated as a series. Four video interviews were created on the topic of "Social Media in the Cultural Sector". To illustrate the series character, the video interviews were provided with a specific graphic line. The videos were made available to the master's students on an online platform to be used in the asynchronous part of the course.

3.2. A series for train the trainer/teacher

The online women's network #dienetzwerkerinnen has been created for women to empower and support each other in their everyday professional lives and explore ways to help shape the digital transformation. In the network, women work on their current projects in a moderated exchange process, whereby creative and visual approaches to solutions are an essential part of the process. Due to the COVID pandemic, there was an urgent need to learn not only how to deal with technology to set up a found pedagogical framework but also how to deal with learners exclusively in an online way.

To help with pedagogy and technology, two seasons with nine episodes were created between March and August 2020 for a broad target group of trainers, teachers, and everybody else

who was in need of learning. Season 3 started on February 26, 2021. The series with the name #didaktischekleinigkeiten – #didactictrivia – comprised topics such as video reflection, visual online collaboration, moderation of the online group, concepts for online trainings, the quality of online training/teaching and others (dienetzwerkerinnen, 2020).

In the first season, two episodes were created each week. After an evaluation among the online readers, the episodes of the second season were created weekly. The episodes were posted on a website. Photos, self-drawn comics, audio podcasts with a length of three to five minutes, and sometimes videos were included.

Figure 3. Episode 9, season 2, series #didaktischekleinigkeiten - screenshot

Each episode has the same structure, starting with a short teaser and answering the questions of what the topic is and how we solve the dilemma. Each episode finished with a checklist for teachers and trainers and offered additional material.

3.3. Workshops

In two workshops with teachers and trainers in 2020 and 2021, we discussed the possibilities, risks and chances of using serial elements in teaching.

3.4 A series in the bachelor's programme Journalism and Public Relations (PR)

In the course "Web competences in communication-related professions" during the winter semester of 2020/21, the students translate theory into practise by using the social media platform Twitter. The semester is divided into four phases where the students tweet in

continuity and acquire deeper skills. Accrodingly, the series #twitterpraxis consists of four episodes guiding the students through the semester.

Figure 4. Twitter-Series by jupidu - screenshot

The first episode was implemented as a video, which was already used in the year before and only had to be adapted to the idea of a series. The other three episodes were created as audio podcasts of about three to four minutes and shared with the students in Twitter (Pauschenwein, 2020). The content focused on the new tasks and on increasing the competence of the students.

4. Discussion and Outlook

By moderately inserting elements of the series, we give the audience in our teaching events, workshops and trainings a better orientation about the planned activities and increase the excitement for all participants including teachers and trainers.

To evaluate the use of series in learning scenarios, it is necessary to analyze the results obtained and reflect on the process. Starting with a series, developing multimedial materials for the episodes and making it available for learners on a continuous basis takes a lot of work. While we did not systematically analyze how learning happened in classes and in the network, we established some spaces for reflection and feedback. The potential and challenge of series in class were discussed several times with university teachers during workshops and

at conferences. In developing the series for the use in the classroom, we reflected upon what worked, what was difficult and what should be changed. Additionally, we discussed possible future developments.

The first season of the series #didaktischekleinigkeiten – #didactictrivia – was evaluated in an online questionnaire and two interviews. We also asked the students about the series in class as well. The students seem to like it and stayed engaged during the difficult COVID-semesters. Yet, we did not see better grades with this pedagogical approach. We are planning on collecting quantitative data to validate our approach, possibly in an international cooperation.

Our next step is to develop an interactive series with the students or training participants. At the beginning of a new semester, we are planning to construct a storyboard together that will guide us through the following months. This interaction will increase the intrinsic motivation for the students to follow the course and to play a more active role.

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Proposal for an intelligent digital teacher's textbook solution adapted to the Bachelor-Master-Doctorate system

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Abstract

This paper proposes an intelligent solution for course monitoring based on the use of a digital textbook coupled with an algorithm for verifying the conformity of the teaching content. The proposed solution allows to follow in real time the evolution of the courses and to alert the pedagogical managers in case of non-compliance with the syllabus.

In most sub-Saharan African countries engaged in the Bachelor-Master-Doctorate (BMD) reform, incessant strikes prevent teachers from completing the program. Also, there is no way for the teacher to know whether students have the necessary prerequisites. In addition, constraints related to agendas sometimes prevent the holding of pedagogical animation meetings.

To solve these problems, we propose the implementation of an intelligent digital teacher's textbook. The tool helps in the follow-up and the respect of the pedagogical objectives. It implements an algorithm to evaluate in real time the concordance between the courses given and the requirements of the syllabus. An SMS and e-mail alert system has also been set up to inform training actors in case of non-compliance with the syllabus.

The proposed solution contributes to the overall improvement of the quality of higher education in Saharan Africa.

Keywords: *BMD reform; course monitoring; pedagogical animation; quality of education.*

1. Introduction

Since 2011, most French-speaking African states have undertaken reforms in higher education to better adapt their training to international standards. The focal point of these reforms has been the adoption of the BMD (Bachelor-Master-Doctorate) as an education system.

One of the principles of the BMD system requires that there be a set of Teaching Units (UE) to be validated in order to obtain a degree. Each UE is made up of a set of coherent course, called by EC, belonging to the same disciplinary field. Because of the complementary links between UEs and ECs, it is essential to have a good pedagogical animation.

In sub-Saharan Africa in general and in Senegal in particular, incessant strikes in primary, secondary and higher education prevent teachers from completing the program. This has a negative impact on the quality of education as demonstrated by authors (Sy, 2008) and (Sall, 2014). In addition, there is no quick and reliable way for the teacher to know whether students have the necessary prerequisites.

In its traditional paper form, the textbook that should play this role has some shortcomings: loss or damage, infrequent consultation by the students, almost non-existent use by teachers outside their own classes and non-participation in the reduction of paper consumption to minimize the negative impact of paper production on the environment.

The authors (General Direction Of School Education - France [DGESCO], 2010) and (Costa et al., 2015) make proposals on the digital textbook. This new approach has a positive impact on the internal organization of the institution, pedagogical engineering and on the organization of teachers. However, the proposed solutions do not allow pedagogical managers to automatically check in real time the conformity between the course given and the syllabus.

This paper aims to propose an intelligent solution for monitoring courses based on the use of a digital textbook coupled with an algorithm for automatic monitoring of lessons. The proposed solution allows to follow in real time the evolution of the courses and to alert the pedagogical managers in case of non-compliance with the syllabus.

The rest of this paper is organized as follows: Section 2 describes the state of the art, Section 3 describes our methodology of research, Section 4 presents our solution, Section 5 outlines the results obtained, Section 6 is reserved for discussion and Section 7 for conclusion.

2. Related works

2.1. The BMD System

The BMD is a training system that includes an architecture of studies in 3 grades (Bachelor, Master, Doctorate), organization of training courses in semesters and in the UE, contents structured in pluri and transdisciplinary fields with diversified career paths.

The BMD system aims to allow the learner to build a path adapted to his possibilities and needs. In order to do so, the BMD requires that training courses be flexible and organized around capitalizable units.

The adoption of the BMD when it is well understood constitutes a real change of mentality, another vision of university education: it then provokes a profound renovation of the whole system, of the whole university life.

2.2. The BMD in Sub-Saharan Africa

The BMD reform in Europe is the result of a long process, which was not the case for most African Universities (Diarra, 2009). A study (Mignanwande & Hounmenou, 2016) conducted among 690 people selected by a random and intentional method shows that the fundamental principles of the BMD system are not yet mastered and applied by the different actors of the University of Abomey-Calavi.

Another difficulty in the implementation of the BMD system is the pedagogical scenario that this reform requires. Indeed, the respect of the order of succession of the EC and the UE according to the prerequisites remains very problematic in university training as demonstrated by the authors of this study conducted at the University of Burundi (Hajayandi, 2020).

The pedagogical methods (essentially theoretical courses) and the massification in African higher education institutions generally constitute obstacles to any idea of professionalization. The author (Diarra, 2009) proposes the creation of institutional support mechanisms to conduct the reform with the mission of sensitizing, informing and training all university actors involved in the implementation of the BMD system.

Also, mastering the university calendar, another requirement of the BMD is not easy because of strikes and other recurring social movements. Authors (Diop, 2016) and (Lauwerier, 2016) have shown that poor working conditions, low salaries and the expectation of subsidies lead teachers to take union actions that have a negative impact on learning and program completeness.

2.3. Digitization of the teacher's textbook

According to (DGESCO, 2010), the digital teacher's textbook is a valuable tool for teachers, educators, administrators, and teaching staff. Accessible via the Internet, the digital textbook is intended to help support teaching and learning activities. (DGESCO, 2010) reminds us that the class textbook, even if dematerialized, is an official document with legal value. It allows, in the event of a teacher's absence or transfer, to ensure a close continuity between the teacher's teaching and that of his substitute or successor. In practice, the class textbook must be easy to use, reflect the course of instruction and allow the progression of learning to be accurately monitored. However, the proposed solutions (DGESCO, 2010), (Costa et al., 2015) and (Maugard, 2013) do not fully address the challenges of BMD in sub-Saharan Africa. Also, they do not allow educational managers to automatically check in real time the conformity between the course and the syllabus.

3. Methodology

To prove the relevance of our approach, we conducted a survey among 13 teachers from 11 public and private universities in West, East and Central Africa (Senegal, Benin, Central African Republic, Gabon, Djibouti). All the interviewees are involved in Science, Technology, Engineering, and Mathematics (STEM) fields. Of the 13 who responded, 5 have less than 5 years of experience and 8 have been teaching for more than 5 years.

The data was collected using the Google Form tool. The results reveal that only 7.7% systematically organise a meeting between teachers from the same UE, compared to 76,2% who say they do not find the time to meet to discuss the objectives of the UE. Finally, 16,1% participate in pedagogical animation sessions but only for a few UEs.

The results of this study confirm the hypothesis that the constraints related to agendas prevent the actors of the BMD system from holding sessions that are essential for a good pedagogical animation. These results have led us to make a proposal for an intelligent digital textbook to improve the quality of education in sub-Saharan Africa.

4. Smart Digital Teacher's Textbook

To facilitate the pedagogical follow-up and to solve the problem of lack of time in the organization of animation meetings, we propose Smart Digital Teacher's Textbook.

Smart Digital Teacher's Textbook is a 100% digital solution that not only allows you to follow in real time the evolution of each EC but also to ensure that the pedagogical objectives are respected and achieved.

The proposed system includes an application developed from the Spring and Angular frameworks, coupled with a MySql database for data persistence.

4.1. Architecture of the proposed solution

The proposed solution as shown in Figure 1 is a web application based on a monolithic architecture. The choice of this architecture was motivated by the fact that we would like to have a solution that is simple to build, test and deploy. In terms of performance, the monolithic architecture offers better performance than modular approaches such as MicroService Architecture (MSA).

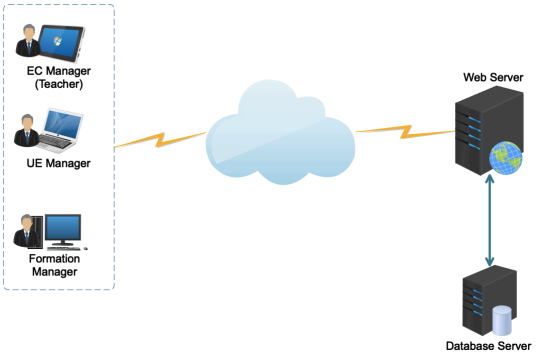

Figure 1. Architecture of the solution.

4.2. Test environment

The tests were carried out with the temporary teachers of the Bachelor 3, Master 1 and Master 2 classes of the Central School of Free Software and Telecommunications (EC2LT) in Dakar, Senegal. It should be noted that the teachers were not informed of the automatic conformity check carried out by the platform. To facilitate access to Smart Digital Teacher's Textbook, a link has been added to EC2LT's e-learning platform.

5. Results

We present here the use cases that allow the real-time monitoring of the evolution of each UE as well as the achievement of the pedagogical objectives.

5.1. Case 1: The teacher (Head of EC) or the Student adds a new class session

At the end of each class session, the teacher (responsible for the EC) or a student in the class has the possibility to add a new class session. To do so, he has the menu " My Courses " and a form for adding sessions. This form contains the fields " Date ", " Duration " and " Session content ".

After adding or modifying a course session, a program is automatically launched to verify that the pedagogical objectives have been respected. This program performs a keyword analysis to determine if the content of the session is consistent with the EC objectives. Figure 2 summarizes the implemented algorithm.

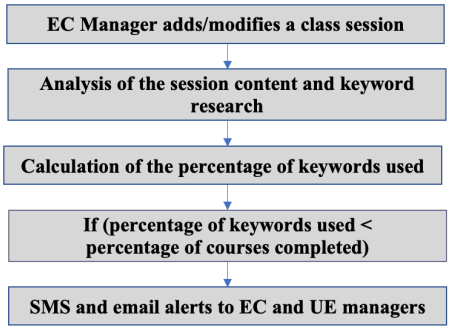

Figure 2. Algorithm of the solution.

5.2. Case 2: The teacher (Head of EC) visualizes the ECs in his field of study

The proposed solution allows the head of an EC to consult (read access only) the details of the sessions of all the ECs in the same disciplinary field. To do this, each EC manager has access to the "Global View" menu. This menu lists all the training courses and all the UEs in which the logged-in user intervenes. By choosing an EC, the user can then view the details (date, time and course content) of each session as shown in Figure 3.

Figure 3. Detailed view of the EC for the teacher

5.3. Case 3: The head of a teaching unit (UE) visualizes the progress of the ECs

The head of a UE has full access to all the ECs in the Teaching Unit for which he is responsible. With the help of graphs, he has the possibility of following in real time the evolution of the ECs as well as the respect of the educational objectives. If necessary, can view the details (Title, Total hourly volume, percentage of courses completed, keywords and percentage of matching) of each EC. Note that keywords already used appear with a green tag as shown in Figure 4.

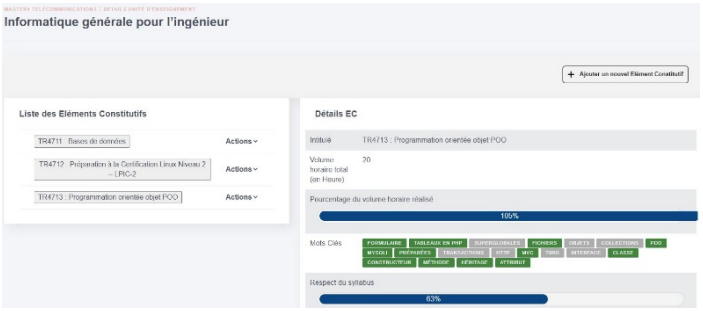

Figure 4. Detailed view of the EC for the head of the UE

6. Discussions

After having used the textbook for a full semester, we can affirm that Smart Digital TextBook brings a real added value to the pedagogical follow-up.

Unlike existing digital textbook solutions (DGESCO, 2010), (Costa et al., 2015) and (Maugard, 2013), Smart Digital Teacher's Textbook integrates an algorithm for automatic verification of course content and an alert system in case of non-compliance with the syllabus. It thus appears as a complete tool at the service of all the actors of the BMD system.

4 out of 10 EC managers have received alerts by sms and email to encourage them to comply with the recommendations of the syllabus. These alerts made it possible to immediately review the content of the next sessions with a view to achieving the pedagogical objectives. In addition, the pedagogical manager and the tuition department made use of the platform to ensure that the online courses were actually completed at the scheduled times. These training actors were also pleased to have a reliable tool for remote and real-time monitoring of the courses. However, it should be noted that despite the initial training of all teachers in the use of Smart Digital TextBook, the results show that those belonging to the "communication and general culture" disciplinary field have difficulty in appropriating this new tool. These difficulties are mainly related to the lack of mastery of the computer tool. This could constitute a brake on the generalization of the solution proposed in this article if no action is taken. Moreover, in the context of Covid19, Smart Digital TextBook limits the sharing of physical resources.

7. Conclusion

The results of this work show that digital can be used to contribute to the BMD maturation process in Sub-Saharan African countries. Smart Digital TextBook solves, among other things, the problems of pedagogical animation and course monitoring within universities. It also provides a solution to the problem of information sharing between teachers of the same

disciplinary field and thus contributes to the overall improvement of the quality of teaching. The tests carried out reveal that initial training of teachers in the use of the solution is an essential prerequisite for its adoption. In perspective, we plan to integrate a synchronous communication space into the tool and improve the algorithm for keyword detection by introducing artificial intelligence.

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Charting the competency-based eportfolio implementation journey

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Abstract

As health professionals, nurses are responsible not only for staying abreast of current professional knowledge to provide effective care but also for managing their own career, professional growth and development. Nurse educators have acknowledged that eportfolios provide a means through which nurses can record and provide evidence of skills, achievements, experience, professional development and on-going learning, not only for themselves, but for the information and scrutiny of registration boards, employers, managers and peers. Recognising that practices to support these activities that foster 21st century learning should ideally start during their student years, the authors explored eportfolios as a valuable learning device for on-going personal and professional development for fostering students' lifelong learning and enhancing continuous personal and professional development. This paper describes the critical success factors for successful implementation of the Google Sites Practice eportfolio embedded in the three-year BSc(Hons) Nursing Programme in Malta. Evidence-based practice of successful eportfolio implementors was examined and their methods adapted to ensure the initiative had a sound foundation and fit for purpose. The authors argue that to be successful, eportfolio implementation must primarily be strategic, holistic, supported and have senior management buy-in and secondarily, have a robust tool, good pedagogy, and skilled and enthusiastic staff.

Keywords: *Nursing; competency; implementation; eportfolio; Malta; nurse education.*

1. Introduction

Eportfolios are "digital presentations of a student's experiences, achievements and aspirations for a particular audience – the digital equivalent of a paper portfolio" (Joint Information Systems Committee, JISC 2019). In 2019, the Department of Nursing in the Faculty of Health Sciences at the University of Malta (UM) embarked on a two-phase project whereby the department developed and implemented a web-based Google Sites Practice eportfolio (GSPeP) in order to improve clinical competency assessment in the three-year Undergraduate Pre-registration Nursing Programme (UGNP).

GSPeP aims to support practice placement learning and is, therefore, embedded in the practice modules at each level in the nursing programme; it provides a cumulative evidence of practice placement learning and development. Hence, the GSPeP is an online representation of the student nurses' (SN) academic and professional accomplishments and achievements and enables the storage of their experiences and accomplishments in one place to highlight their nursing competencies. Essentially, competence is the capacity to carry out safe and effective practice on a developed basis of knowledge, skills, behaviours and attitudes. Attainment of competence is necessary in order to successfully complete the UGNP and be registered as a qualified nurse with the Council for Nurses and Midwives of Malta. The GSPeP is the SNs' evidence of working towards the required level of competence to enter a Professional Register of Nurses across the European Union.

It is clear that factors such as a robust tool, effective pedagogy and skilled and enthusiastic staff are all important, but, the authors believe success hinges on four critical factors: strategic, holistic, supported and senior management buy in. This paper aims to identify and act on the lessons learnt from implementing the GSPeP in Phase I in 2019-20 from the perspective of the project management team for a smoother delivery of Phase II.in 2020-21.

2. Overview

An average of 100 students register annually on the three-year BSc(Hons) UGNP programme which comprises an equal balance of theory and practice components. Attrition rate across the programme is consistently less than 8%. The theoretical component is designed and delivered by a group of Nurse Educators (NEd) while the practice component is steered by practising qualified nurses across the national Health and Social sector. Individual roles and responsibilities are discussed below.

2.1. Rationale for implementing GSPeP

Electronic portfolios (eportfolios) appear to have numerous advantages over paper based portfolios: they support a greater variety of artefacts and allow for increased learner expression; are dynamic and multimedia driven; accessible by a large audience; contain meta-

documentation; easy to store; and may serve to promote students academically and professionally (Buzzetto-More, 2006). Hence, in early 2019, following an evaluation of the then existing paper-based practice portfolio, the Department of Nursing joined other academic leaders (Jafari, 2004) in embracing the eportfolio for its fundamental benefits: sustainability, portability, versatility, feedback, transferability, shareability, to name a few. The curriculum team agreed that in line with the 21st century developments, it was imperative for their SNs not only to be clinically competent but also to be digitally literate and therefore, a shift towards an eportfolio would lend itself well towards the development of both expected realms of performance amongst students.

The eportfolio initiative aims to provide SNs with an online space (GSPeP) to curate evidence pertaining to their learning which is accessible 24/7 by all end users. It acts as both a guide and structure for the mapping of the SNs professional and personal journey. The eportfolio therefore, lends itself well towards the mission of Quality Assurance (QA) activities: internal and external quality audits required by the relevant QA authorities and the Council for Nurses and Midwives, the national professional regulatory body. Moreover, the eportfolio is an apt learning tool in itself because it helps students become reflective practitioners with a drive for lifelong learning complemented by a critical approach to self- assessment and self-improvement.

In summary, the GSPeP serves the following purposes of eportfolios in educational settings as identified by Barrett (2001):

- learning ePortfolio: focuses on personal development through the use of self-evaluation and reflection and are formative in nature
- assessment ePortfolio: requires students to show through dialogic reflection on selected experiences how skills and knowledge development have been demonstrated
- presentation ePortfolio: showcases skills and attributes in the professional context

2.2. Drivers for GSPeP

The GSPeP was set up in response to the growing demand for the submission of digital portfolios by applicants responding to calls for recruitment and career promotion opportunities from stakeholders the UM's wider strategy - further inclusion of technology in all its operations towards more sustainable processes and the GSPeP is a novel initiative which extends the current adoption of the MOODLE digital platform for the programme delivery.

3. The GSPeP implementation process

The implementation of GSPeP which followed the guide provided by the Joint Information Systems Committee (JISC, 2012) will be presented in this section.

3.1. Vision and Scoping

To avoid misunderstanding and ineffective implementation of the GSPeP due to the diverse uses of eportfolios, the vision was made clear in an easily communicable way to all the stakeholders at the conception of the idea.

"By implementing the GSPeP, the Department of Nursing, UM will empower students to become active participants in their own personalised education. Through use of reflection, technology and collaboration, SNs, link lecturers and mentors will develop knowledge, skills and attitudes that will lead them to achieve their lifelong goals".

The scope was that by the end of December 2020, the BSc(Hons) Nursing and the Higher Diploma in Nursing (2019 cohorts) would own and manage the GSPeP for the purpose of demonstrating achievement of the professional competencies. A clear timetable (Table 1) with milestones helped the Project Team to keep on track with the project schedule.

Table 1. GSPeP implementation schedule.

Phase I: Planning and Implementation	
Prepare Training digital packages: ep101, 102,103,104, 105,106, 107 video and pdf, Survival guide - ebook	06.01.2020 - 31.01.2020
UoM eportfolio (prototype) UM FoE shared, zipped Google drive: survival guide (staff) Google drive: survival guide	06.01.2020 - 31.01.2020
Staff Training	28/01/2020
Organise Orientation (Higher Diploma & BSc(Hons) Nursing students) via ZOOM video conferencing: Google Sites eportfolio development process Step I: Google drive as storage for evidence	03/02/2020 & 04/02/2020 (2hours/group)
Staff training - Create Google Sites eportfolio, populate with evidence, publish and share + eportfolio project team meeting	12/02/2020 & 18/02/2020
Prepare training packs eP106,107, 108, 109, 110- Google Sites compile all training materials in eBook	March 2020
Q& A session with staff (via google forms).	April 2020
Interim eportfolio development survey with students	April/May 2020
Interim eportfolio development survey with LL	May 2020
Zoom catch up with students : slides	May 2020
Review student progress via shared Google Drive.	May 2020
Year 1 students to submit formative reflections on an episode of online learning by 10 June 2020	10.06.2020
Review student reflections with LL and identify areas for improvement in reflective writing	Early June 2020
Collate findings from Initial students survey in preparation for LL meeting on 8 July	June 2020
Collate findings from Interim students survey in preparation for LL meeting on 8 July	June 2020
Collate findings from LLs survey in preparation for LL meeting on 8 July	June 2020
Zoom meeting with LL - wrap up	June 2020
Zoom meetings with students - reflective writing (3 groups)	9 July AM 9 July PM 10 July AM
Evaluation of project	September 2020
Write up and submit report	October 2020

3.2. Planning and Design

A critical success factor for GSPeP implementation is to have clear roles and responsibilities. JISC (2012) eportfolio implementation study found that the Implementation Manager role was critical for effective implementation. A UK-based eportfolio champion was headhunted through eportfolio research publications to lead the planning, executing, monitoring, controlling and evaluating the GSPeP initiative. The project manager (PM) delivered the project on time, within the budget and brief while keeping everyone in the know and happy. Additionally, two nursing academic/practitioners who worked closely with the SNs and the LLs acted as the local champions. The impacts and benefits of the GSPeP can be discussed in terms of its use in various aspects of the SNs'journey as a teaching, learning, assessment for and of learning tool in collaboration with diverse stakeholders who engage with the eportfolio for student growth and development (Ritzhaupt, et al. 2008) as shown in Figure 1.

Figure 1. GSPeP-stakeholder interaction model..

The literature has numerous research and case studies offering advice for successful implementations of eportfoliso including recommendations for diverse role holders. For example, according to Barrett (2007), the teacher's role is critical to success; high- performing teachers (as judged by student engagement) effectively used reflection, metacognition and other learning strategies to provide constructive feedback. In the context of GSPeP initiative, Nurse Mentors guide, monitor and assess SNs' learning and development in the practice area while the LLs are responsible for monitoring the continuous learning and development of their link students along a series of practice placements throughout the programme. Table 2 summarises the roles and responsibilities of the SNs, the Mentors and the LLs.

In addition to the scheduled GSPeP online training sessions designed and delivered by the PM on Zoom, she also prepared an eBook Survival Guide to cater for the needs of independent and autonomous learners. The two local champions were also key to communicating with the PM re need to respond to technical as well as non technical issues including privacy of content when GSPeP is published.

Table 2. Roles and Responsibilities.

Students	**Educators**
OWN the eportfolio development process	Clarify purpose of creating and developing Lifelong Learning Nursing eportfolio; if summatively assessed, clarify how
Create a Folder of Evidence (FoE) in Google Drive	Highlight role of eportfolio in the curriculum
Create files/folders in FoE to organise, curate evidence/artefacts for the purpose of the eportfolio	Create a sense of personal ownership over one's achievements: ownership engenders feelings of pride, responsibility, dedication (Paris and Ayres 1994:10)
Upload appropriately labelled evidence/ artefacts to demonstrate achievement of competencies	Make the eportfolio more Conversation than Presentation (or Checklist) as the former Transforms!
Reflect on learning (What? So what? Now what?)	Assist students create, recognise strengths and weaknesses in evidence/artefacts collected
Share FoE with selected audiences	Establish timelines for enabling eportfolio engagement
Seek feedback from Link Lecturers, Mentors, peers	Coach students to reflect on above
Engage with peer assessment	Facilitate peer collaboration and feedback on artefacts, reflections most probably across sites
	Monitor engagement emphasising the process of eportfolio development as a learning journey
	Model effective use by sharing own eportfolio

3.3. Implementing and Supporting

Another crucial factor for successfully implementing GSPeP is ensuring all end users feel supported and confident in using it. Appropriate training and support for students as well as for the LLs was scheduled and delivered in a timely manner as shown in Table 1.

"When and How to access Link Students' GSPeP" was an additional resource created for the LLs to provide feedback to students' work effectively and efficiently. This consolidated the schedule for the SNs (Table 3).

Table 3 Timelines for SNs.

File in FoE	How to tag/label your file/evidence	date to be available in FoE
Policies and Guidelines	As available	during each placement entity
Placement Planners	Clinical Placement Planner - Y1	11.03.2020
Student Contracts	Student Contract - Y1	05.02.2020
SWOT Analysis	SWOT analysis - Y1	26.02.2020
Learning Contracts	LC - Y1	18.03.2020
Clinical Placement Competencies Technical Skills Records	Domain 1 - Y1 Domain 2 - Y1 Domain 3 - Y1 Domain 4 - Y1 Domain 5 - Y1 TSR - Y1 TSR - Y2 TSR - Y3	work in progress
Placement hours	Placement hours Y1	
Link Lecturer and Mentor Feedback	LLandMentorFeedback - Y1	
Clinical Placements - Student Feedback	Student Feedback- Y1	end of each placement
Records of Evidence	Records of Evidence - Y1	
Placement Documents	Placement Documents - Y1	
Extracurricular Activities	Extracurricular Y1	

Table1 also illustrates a thoughtful plan of how the project leaders pursued a systematic, comprehensive plan for evaluating, gathering, analysing and presenting evidence of the ways the GSPeP shapes student learning resulting in a Project Phase 1 2019-2020 Report which will form the basis of Phase 2 2020-21.

4. Conclusion and Next Steps: Scaling and Sustaining

In summary, GSPeP is an example of e-learning practice that evidently addresses the Department of Nursing's current educational needs and "accommodates continuous adaptation to change, without depleting its resource base or receding in effectiveness" (Stepanyan, et al. 2013,p. 95). GSPeP is therefore, a sustainable development defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and

Development, 1987, p. 43). Future initiatives can be built upon this firm foundation for the sustainability of nurse education in practice that focuses on the implementation of sustainable forms of successful practice through educational development, leadership, and innovation. The Portfolios & Open Badges Maturity Matrix (Europortfolio, 2014) could be the tool not only for reflection but also for facilitating dialogue with practitioners, leaders in education and decision makers.

4.1. From Departmental to Institutional

In order that the GSPeP implementation and further developments are sustainable, the project team are taking steps to work at the institution level to build relationships and connect their work to institutional plans and systems.

4.2. Engagement with the wider community

The project team plan to share good practice within the UM and further afield through publications and conferences.

4.3. Periodic multifocal evaluation of the GSPeP

Use the Portfolios & Open Badges Maturity Matrix (Europortfolio, 2014) for reflection and transformation.

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Development of a learning pilot for the remote teaching of Smart Maintenance using open source tools

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Abstract

Technology has created a vast array of educational tools readily available to educators, but it also has created a shift in the skills and competences demanded from new graduates. As data science and machine learning are becoming commonplace across all industries, computer programming is emerging as one of the fundamental skills engineers will require to navigate the future and current workplace. It is, thus, the responsibility of educational institutions to rise to this challenge and to provide students with an appropriate training that facilitates the development of these skills. The purpose of this paper is to explore the potential of open source tools to introduce students to the more practical side of Smart Maintenance. By developing a learning pilot based mainly on computational notebooks, students without a programming background are walked through the relevant techniques and algorithms in an experiential format. The pilot highlights the superiority of Colab notebooks for the remote teaching of subjects that deal with data science and programming. The resulting insights from the experience will be used for the development of subsequent iterations during the current year.

Keywords: *Learning nugget; Jupyter notebook; open source tool; online learning; smart maintenance.*

1. Introduction

The 21st century is characterized as the era of digital transformation, as technology has permeated virtually every aspect of our lives and is fundamentally changing the way in which humans interact with their surroundings.

The increasing emergence and adoption of technological advancements has an impact on higher education in two distinctive manners: as an opportunity due to the potential for the development of sophisticated educational tools and approaches, but also as a challenge due to the educational needs created as a result of new expectations from the job market. Technologies such as the Internet of Things (IoT), Big Data, cloud computing, and others, are becoming commonplace in several industries as they are key enablers of what is known as *smart manufacturing* (Wang et al. 2016).

In recent years, a number of publications have discussed the effects caused by the introduction of these technologies into industrial spaces in terms of jobs and competences. These works mainly highlight the evolution of technical skills required from the workforce (Pinzone et al. 2017) as well as the need for a higher level of education among employees (Hecklau et al. 2016).One of the technical skills frequently appearing in these and similar studies is programming, as, due to the increasing digitalization of industrial shop floors, it is becoming ubiquitous in manufacturing and maintenance activities.

2. Computational notebooks: Jupyter and Google Colab

Computational notebooks are interactive environments for writing documents where users can insert regular text and software code that can be executed and which results are incorporated into the document. This combination of code, text, and visualization in a single document makes notebooks well suited for work in computation-intensive areas such as data science and machine learning (Rule et al. 2018). While notebooks have been around for quite some time, it is only recently that the emergence of open-source notebooks has caused a sharp increase in their adoption for research and data analytics.

Among the multiple alternatives currently available, Jupyter notebooks stand out as an excellent educational instrument for the instruction of a wide range of topics in science, engineering and programming. In the last years, there are several publications discussing their use in subjects related to artificial intelligence (O'Hara et al. 2015), manufacturing engineering (Suárez et al. 2018), cyber-security (Shahriar et al. 2019), and data analytics (Cardoso et al. 2019).

Colab (Figure 1) is a free Jupyter notebook environment offered by Google, which, in addition to the features included in regular Jupyter notebooks, also provide a number of extra features which can be summarized into the following advantages (Table 1):

Portability. Unlike Jupyter notebooks which are stored on the user local machine, Colab notebooks are stored in the cloud and are easily accessible from any device through a Google account.

Figure 1. Notebook interface highlighting the main elements.

Computational Power. In addition to cloud storage, Colab also provides their dedicated GPU and TPU computing resources and does not use the processing power of the user local machine.

Organized Interface. Colab includes a table of contents on the sidebar that facilitates the organization and exploration of the workspace, which is particularly significant for long notebooks.

Convenience. Colab does not require the installation of any software or package in the user local machine, and the process for sharing notebooks is quick and straightforward. Moreover, in addition to traditional data libraries included in Jupyter notebooks, Colab also provides pre-installed libraries for computationally-heavy machine learning projects that can run on any machine, as they use cloud computing resources.

Table 1. Comparison of features included in Jupyter and Colab notebooks.

Features	jupyter	colab
Running code	●	●
Note taking	●	●
Interactive	●	●
Cloud storage		●
Computing power		●
Organized interface		●

Source: (Kluyver et al. 2016) and (Google 2020)

These additional features and the resulting advantages are highly relevant in a scenario where lessons are delivered in a remote modality. For this reason, Colab notebooks are used as the primary instructional tool for the development of the learning pilot, as students can easily access, create and share notebooks without experiencing any technical hassles beyond the creation of a Google account.

3. Development of the learning pilot

The context for the design of the learning pilot was given by two main factors defined from the beginning: the learning modality and the learner's level of preparation. Due to the sudden change in the lecture delivery method caused by the onset of the COVID-19 emergency, the structure and contents of the Smart Maintenance course had to be redesigned to allow for an effective remote learning experience. While the main course contents were adapted for emergency remote teaching, the learning pilot was proposed as an accompaniment that could exploit the potential of the online format and include practical contents previously taught only in theory.

Furthermore, the distinct profile of the students expected to enroll in the course was well known from the previous iterations of the course. The large majority are industrial and mechanical engineers in senior positions at large companies belonging to mining and manufacturing industries who seek to pursue specialized postgraduate qualifications. Notably, a key shared characteristic is the possession of limited knowledge and experience in programming or the complete absence of a significant background.

3.1. Pilot Description and Objective

While the main course delivered in parallel focused on the theoretical foundation of Smart Maintenance, such as technologies and implementation frameworks, the learning pilot aims to present students a more practical experience involving the use of programming for the development and implementation of Smart Maintenance algorithms. Through the planned learning activities, students are able to visualize the underlying architecture while experiencing the steps involved in a typical solution.

3.2. Pilot Structure and Contents

The structure and contents of the pilot were defined and developed respectively based on the context provided at the beginning of this section (Table 2). The main learning activities chosen for the pilot are three: learning nuggets, demonstration exercises, and Q&A sessions (Figure 2).

The combination of these activities that involve instruction and guided discovery is expected to accomplish the creation of a deep learning experience for the students. The format of learning nuggets has been chosen due to its suitability for online teaching (Bailey et al. 2006). They are videos about 15 min in length that contain the necessary theory for the demonstration exercises.

The demonstration exercises were developed using computational notebooks through which students are walked through the process alternating between instructions and sections were code is meant to be written and executed. Both learning nuggets and demonstration exercises are delivered asynchronously, encouraging students to take an active role and to trace their learning path at their own pace.

Finally, live Q&A sessions were scheduled twice a week during which students are persuaded to ask questions as they go through the contents of the learning nuggets and the demonstration exercises.

Table 2. Specifications of the Smart Maintenance learning pilot based on moderating variables for online learning design (Means et al. 2014).

Duration	3 weeks
Modality	Online
Pacing	Self-paced
Synchrony	Blended (synchronous + asynchronous)
Instructor role	Passive responder: Answer students' questions when prompted
Student role	Active learner: Revise materials and solve exercises

4. Learning pilot notebooks

The notebooks are intended to aid students in the understanding of the role of programming in the development and implementation of an industrial Smart Maintenance solution. The notebooks follow a clear structure that ensures students are well aware of their position with respect to the process described in the exercises, which is as follows:

a) **Objective.** Explanation of the significance of the contents within the larger context and expectations from the execution of the code.
b) **Recap.** Recapitulation of the previous notebooks highlighting their relevance for the current one.
c) **Exercise.** Instructions alternated with code cells.
d) **Conclusions.** Exploration of the exercise results. Alternative variables are provided inviting students to modify the code written in the exercise.

The notebooks are designed to be explored sequentially so that the output of a particular notebook becomes the input for the following. The case study is intended to be solved through the successive application of the contents learned in the previous 6 learning modules.

The first two notebooks are intended as a quick introduction to programming in Python, presenting basic concepts and methods required for later exercises. Notebooks 4 to 6 walk students through the process of analyzing data extracted from a number of sensors installed on an industrial robot.

Students are walked through the process of preparing data for further analysis and the application of algorithms that will result in the extraction of meaningful information concerning the behavior of the machine, which can be used to identify undesired conditions that are relevant for the development of a Smart Maintenance solution.

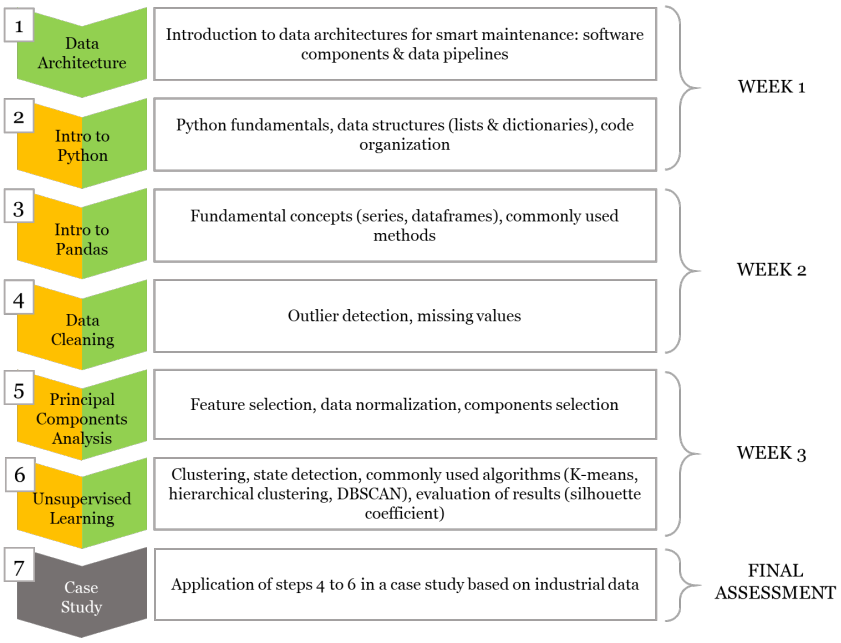

Figure 2. The learning pilot is structured into 6 learning modules and a case study. Learning modules are comprised of learning nuggets (green) and demonstration exercises (yellow).

5. Student feedback and lessons learned

After the conclusion of the learning pilot, students were asked to provide their feedback about the pilot by completing a survey with open-ended questions related to the development of the course. Their answers provided valuable insights that will serve as an input for designing subsequent iterations of the course.

Firstly, a significant number of students reported being confused about seemingly needless programming-based learning contents and hesitant about their practical value for their careers. Despite its inherent technological sophistication, at the university level Smart Maintenance is commonly taught as a topic within larger subjects concerned with the maintenance of industrial equipment or, if a standalone course, by covering theoretical aspects such as its origins, main concepts, standards and frameworks for implementation, etc.

The connection between Smart Maintenance, data science, and programming -as well as its practical implications- must be emphasized to students throughout the course. Most importantly, however, students should be able to understand the need for a shift in the contents usually covered in class in order to address skills gaps already identified in the workforce.

Furthermore, the large majority of students reported that the jump from introduction to the development of algorithms was abrupt. The pilot included only two notebooks dedicated to the introduction of Python where basic concepts are introduced. Difficulties in understanding algorithmic and programming concepts are well documented, and one of the methodologies implemented by educators to address these is Design-Based Research (Barab and Squire 2004). Through the subsequent implementations of the pilot the authors expect to adopt this student-centric approach that will allow for the identification of the shortcomings of each cycle and the subsequent redesign and reevaluation of the contents presented to students.

6. Discussion and Outlook

This article presents and discusses the use of computational notebooks as an apt environment for the teaching and learning of programming in the specific context of Smart Maintenance. While the learning pilot came into existence as a coping strategy during the COVID-19 emergency, it highlighted the potential of notebooks and open source tools to create lessons intended to be delivered online.

Programming in itself is a complex subject that is not easy to learn, and there is abundant literature that offers alternatives for a successful approach. The paper discusses the success of teaching programming starting from a very specific context (i.e. maintenance activities) with which students are already familiar. This contextualization represents an advantage to create a more effective learning experience, as students are able to place the contents learned within the larger scheme of concepts and experiences they already possess as a result of their work experience. While students showed some degree of reluctance when initially presented with the notebooks, they became more confident and eager to learn once they began to understand the importance of the contents visited.

The course is expected to undergo improvements based on the lessons learned and to be adapted for a 2nd and 3rd iterations by adopting a Design-Based Research approach. The respective audiences in these iterations will be high school students and university students following an Industrial Engineering program.

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