REMOTE TEACHING IN CONSTRUCTION ENGINEERING MANAGEMENT DURING COVID-19

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Abstract

This paper describes the impact of the change from face-to-face classes to non-face-to-face classes with students of a postgraduate course at the Universitat Politècnica de València. This study is carried out in the subjects of installation, organization and quality assurance in construction and construction procedures of both degree in public works engineering and civil engineering. This course develops the student's skills to integrate into the studies department of a construction company, as Site Manager or Production Director, from a journey through the different phases of the project-construction process. As part of this topic, the methods of scheduling activities on site are discussed. In the traditional face-to-face method, several problems are solved, requiring that students have previously learned programming techniques: arrow networks, precedence networks, and how to apply the PERT method to statistically obtain the probability of completion of a building or the completion of activities related. Due to the current situation of the pandemic caused by COVID-19, face-to-face teaching has changed virtual classes in a very short time. This has required a radical shift towards distance education. This paper explains how this change has been made, what new methods have been used to teach the contents corresponding to the scheduling of assignments, and what the students' perception has been. The quality of the education received and the difficulties encountered in obtaining the knowledge and skills attributed to this subject are analyzed.

Keywords: COVID-19, remote teaching, teaching alternatives, pandemic, teaching assessment.

1 INTRODUCTION

Traditional teaching in universities is based on the transmission of knowledge to students basically through the teaching of master classes complemented with other more practical ones in a face-to-face manner. At the Polytechnic University of Valencia (UPV) these classes are divided into classroom theory (CT), laboratory practice (LP), classroom practice (CP) and field practice (FP).

In March 2020 the state of alarm was decreed in Spain, as was the case in most European states, and the population was confined to their homes. This confinement was maintained until May when a gradual de-escalation took place. During these months, teaching had to move drastically to a non-attendance mode, since access to schools, institutes and universities was not allowed. This meant that, unexpectedly, all the contents of the subjects that were planned for face-to-face teaching had to be modified and adapted to the new conditions. In the UPV this new methods have been centered in teaching by masterclasses and practices carried out by Teams platform and some videos recorded explaining the contents of the subjects. This fast transition to remote teaching was produced independently of the preparation of the teachers for it [1]. At the UPV students began to receive classes, both theoretical and practical, from their homes through online platforms. Due to the fact that the state of alarm was prolonged in time, the evaluations were also carried out remotely.

Remote teaching have been available a couple of years ago e.g. in the study of Singh and Thurman [2], but their implementation depend on the institutions, grades and study programs [3]. In UPV engineering studies, the major part of subjects have not implemented remote teaching. As a consequence of this, students, teachers and infrastructure was not prepared to this fast change as state in some studies [4].

An important point of view of this topics is the students' perception of the management of the change from face-to-face to remote learning. Some studies state that students prefer or almost have a good acceptance to e-learning [5], [6].

Our research group teaches subjects related to the processes and types of constructions of civil engineering as well as their management and have done many research about this [7]–[12]. Our subjects have two main parts consisting of a theoretical part where the concepts of construction

procedures and management of civil engineering works are exposed by professors (CT), and a second part where practical problems are solved by students (CP, LP). Both theoretical and practical parts are evaluated in order to obtain the final grade of the course. Furthermore, our research group have another postgraduate subjects more related with optimization of structures where the same procedures have been applied. These subjects are closely related with research in optimization field [13]–[17] multi-criteria decision-making [18] and life cycle assessment [19], [20]. The aim of this study is to assess different topics related with Remote Teaching and Learning (RTL) in civil engineering construction management courses. To reach this, an anonymous survey has been made to the students of the related subjects of the degree in public works (GIOP) and civil engineering (GIC) degrees of the civil engineering school of the UPV.

2 METHOD

2.1 Sample and general description of the survey

To obtain the data about the perception of students about the change from face-to-face learning to RTL in management construction, we launched an online survey asking many questions about different topics related with different fields in order to receive their opinion. The survey is anonymous and classifies the sample including the following data to each answer: gender, age group, degree, employment, amount of subjects passed on the last course, number of credits ECTS enrolled in the current course (according to European Credit Transfer and Accumulation System) and if it is the first time in higher education. The target population were the students of construction management in civil engineering subjects from the civil engineering school of UPV.

The survey format consisted of statements to which students had to respond if they strongly agreed or strongly disagreed on a 5-level Likert scale. This survey was divided in five blocks according to five different fields which contains a different number of statements. The fields of the survey were as follows:

- Use of tools for remote teaching
- Remote evaluation tests
- Quality of remote teaching
- Practices (classroom, laboratory or computer) carried out during the confinement
- Group work carried out during confinement

2.2 Sample characterization

As said before, the sample have been classified according to: gender, age group, degree, employment, amount of subjects passed on the last course, number of credits ECTS enrolled in the current course (according to European Credit Transfer and Accumulation System) and if it is their first time in higher education.

The age grouping have been divided in year from 18 to 20, 21 to 22, 23 to 25, 26 to 28, 29 to 30 and higher than 30. The expected results according to age grouping is that the major part of the population is within 18 and 20 years. This is because two of the three subjects are in the second course and the major part of students starts their higher studies with 18 years in Spain.

According to the employment we have considered two groups. Those students that are studying and employed at the same time and those who not. This field is closely related with the number of ECTS enrolled. It is expected that student that are currently working and studying got less enrolled ECTS than those are only studying. The usual amount of ECTS per year is 60.

2.3 Fields description

2.3.1 Use of tools for remote teaching

This block is related with the statements concerning tools and infrastructure that student needed or had during the confinement. We asked if they noted big changes between the tool used from face-to-face learning and RTL. Furthermore, we asked students about the difficulty of changing to new tools for learning. The questions asked in this part of the survey where:

- I had sufficient tools to receive RTL.
- University had the necessary tools to be able to make the transition to RTL.
- Change to RTL has meant a big change according to the tools you used before.
- Need to use new tools has been an impediment to obtaining the expected knowledge.
- Transition to RTL has been simple from the point of view of the tools used.

2.3.2 Remote evaluation tests

This field tries to obtain information about the difficulties founded by students in changing to on-site test to remote ones. In this part we intended to know if the student think that is easier to plagiarize in a remote evaluations or if all the students have the same opportunities from their point of view. Furthermore, we asked about evaluation times and scores, asking them to compare between the previous years. The statements of this part of the survey where:

- Difficulty of the tests was higher than in previous courses.
- Time given by the teacher to take the exam was sufficient.
- Teacher's evaluation was less demanding than in previous face-to-face tests.
- Non-attendance evaluation encouraged peer plagiarism.
- Remote evaluation gave the same opportunities to all students.
- In general terms, the remote evaluation has been detrimental to me and my scores have been reduced.

2.3.3 Quality of remote teaching

In this part of the survey we have asked students about their feeling about the adaptation of the teachers and infrastructure to RTL. In addition, we have included in this block questions about the usefulness of the time in classes and after that. The statements of this part of the survey where:

- Professors have been able to adapt to RTL.
- RTL has been an impediment to obtaining knowledge of the subjects.
- Usefulness of the RTL has been greater than that of the face-to-face ones.
- Quality of the classes has not been influenced by the change to RTL
- I have spent more time studying the subjects in RTL than in the classroom
- While the classes were being taught, he could be doing other things not related to the subject

2.3.4 Practices (classroom, laboratory or computer) carried out during confinement

As said before, one important part of the course are the practices. In these part students have to solve real problems that are evaluated. Because of this, it is important to know if the methodology used in that part is tailored to their learning needs. The statements of this part of the survey where:

- Difficulty of practices was higher than in previous courses.
- Learning obtained in the remote practices has been less than in the on-site ones.
- Remote practices encouraged peer plagiarism.
- Remote practices gave the same opportunities to all students.
- I have perceived a greater difficulty in carrying out the practices due to the use of new tools.
- In general terms, the performance of remote practices has been detrimental to me and my scores have been reduced.
- Experience of remote practices has been satisfactory.

2.3.5 Group practices carried out during confinement

Some of the problems faced by students must be solved in a group. Group work has been separated from the rest of the practices as it is a part that not only favors the learning of concepts through the resolution of a practical case, but also encourages the development of transversal skills such as teamwork and leadership.

- Difficulty of the group work was higher than in previous courses.
- Learning obtained in the group works has been less than in the on-site ones
- Carrying out group work remotely favored plagiarism among colleagues
- Realization of group work remotely way gave the same opportunities to all students
- In general, doing group work without being present has been detrimental to me and my scores have been reduced
- I have noticed a greater difficulty when doing group work due to the use of new tools
- Experience of remote group work has been satisfactory

3 RESULTS

3.1 Sample characterization

The sample is composed by 60 participants being the males a 75% of the total. According to the degree taken by the students GIOP represents a 43.3% of the total while GIC is 56.7%. The highest percentage of participants are between the ages of 18 and 20, representing that range of ages the 48.3%. If we increment the range of ages to 18 to 25 years, then the percentage rises to 93.3%. The major part of the sample is studying as main employment representing that proportion the 86.7%. According to the percentage of subjects passes in the course before the 66.7% have passed between 90 and 100% of the total in the past course and the 95% of the participant have passed the 50% or more. The major part of the population (96.7%) have taken 40 ECTS or more this course.

3.2 Field results

3.2.1 Use of tools for remote teaching and learning

Results from the point of view of tools and infrastructures shows how students feel they do not have the sufficient resources to carry out in good conditions the RTL. This may be because students have used during confinement the same or similar resources than in face-to-face classes. 86.0% of students think that they have not had enough tool to receive RTL. With respect to resources and the infrastructure that the university have for RTL, students are neutral in a 35.0% while students that think university do not have enough infrastructure to RTL are 66.7%. Furthermore, they think that the transition to RTL have been complicated.

As average results, 58.7% of students are disagree with the management of tools for RTL done while students that shown neutral or agree are the 41.3%. Results of answer to statements with regard to tools for RTL have been shown in Figure 1.

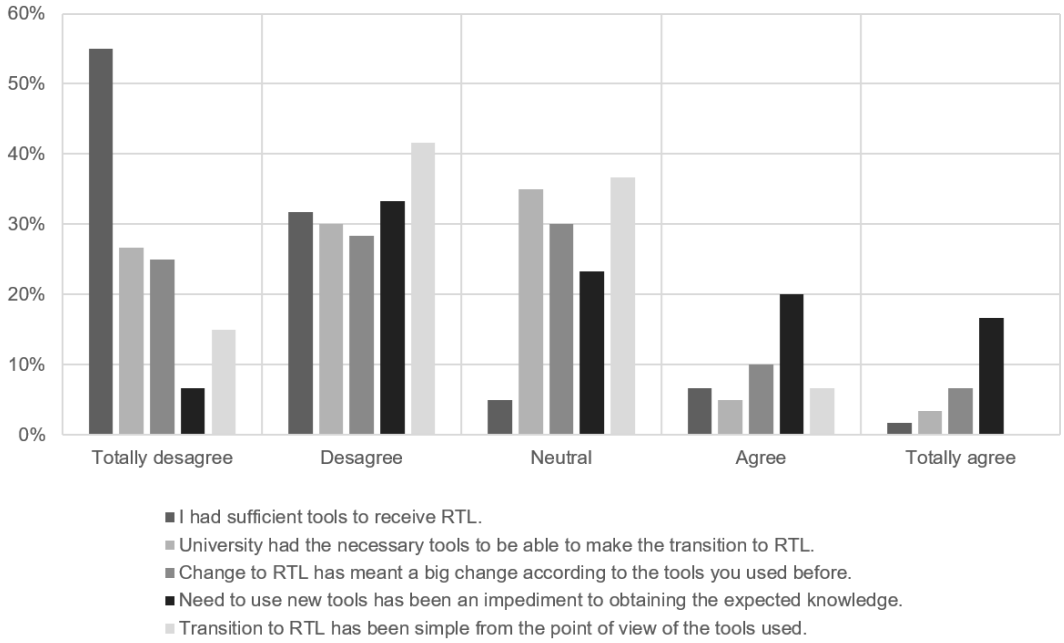

Figure 1. Summary of results about tools in RTL.

3.2.2 Remote evaluation tests

Results from the point of view of evaluation during confinement show how students think that the test, even if it is done online, have a difficulty similar than other year but, they think that teachers have demanded less level to pass the test (35.0%). From the point of view of time we can state that students think that they have had enough time to carry out their evaluations and according to plagiarism there is disparity on opinions 35.0% shown neutral to that statement while 35.0% affirm that is easier to copy. The same think occurs with the feeling concerning the opportunities that they have to pass the evaluations. However, considering the results before, students state that their scores have been lower than past years. Results of answer to statements with regard remote evaluations for RTL have been shown in Figure 2.

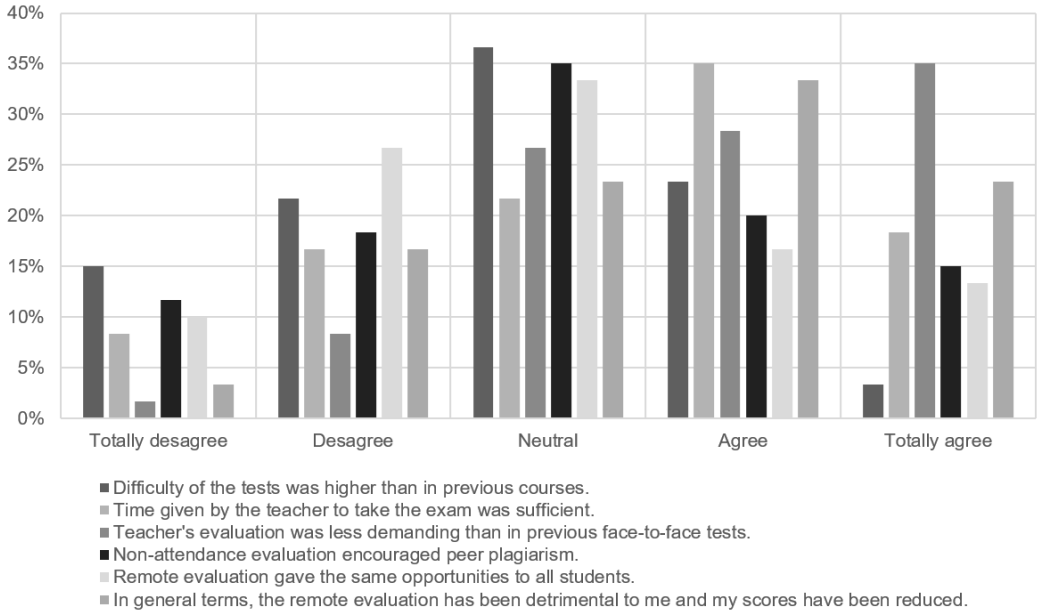

Figure 2. Summary of results evaluation in RTL.

3.2.3 Quality of remote teaching

As shown in Figure 3, results regarding the quality of remote teaching are good. The major part of students are agree or totally agree with the RTL adaptation of professors (46.7%). Also, have a good view of the usefulness of online classes, and in general they feel that the time spent is the same as regular face-to-face teaching. In general they are agree with the quality of RTL with a 63.3% considering students who are agree or totally agree with the quality RTL. One of the drawbacks of RTL could be that students spend their class time on other subjects, but as the results show some say yes (33.3%) while others say the opposite (40.0%), we can assume that than in regular classes there is a part of the students than do not profit the masterclass and spent this time in other subjects.

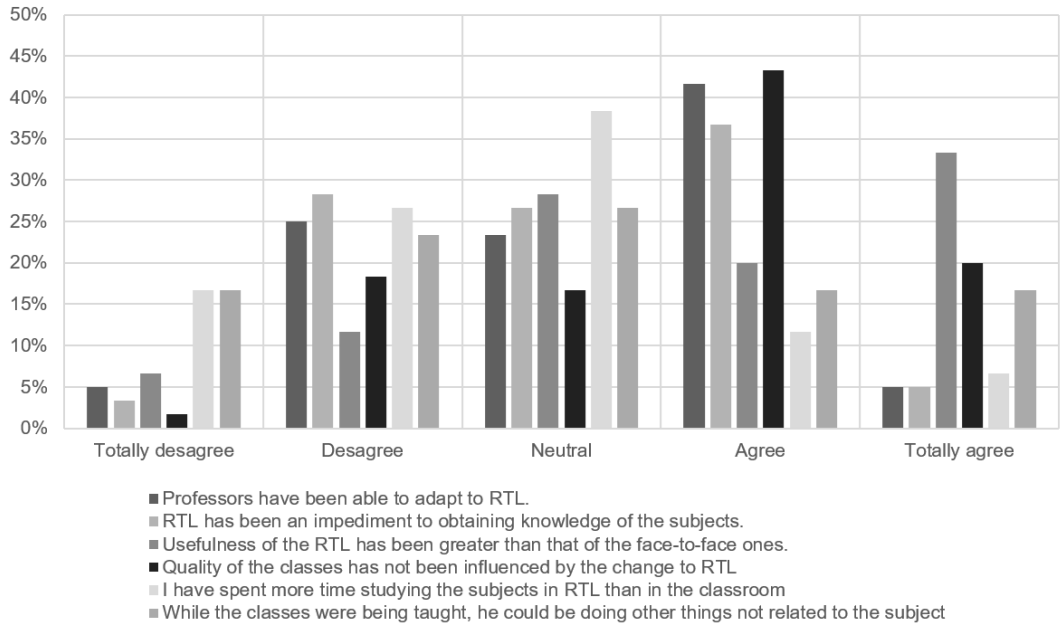

Figure 3. Summary of results about quality in RTL.

3.2.4 Practices (classroom, laboratory or computer) carried out during the confinement

Results about practices in RTL shows that students do not feel an increase of difficulty in online practices. 40.0% of students shown neutral respect this statement, so it can be state that the difficulty has been similar than in on-site classes. Furthermore, they think that the level of learning is slightly lower than in regular classes. Other aspect that it can be taken into account is the plagiarism. 45.0% of students feel like plagiarism is easier (considering which are agree or totally agree with the statement) in RTL. According to the difficulty of off-site practices they feel that the difficulty is the same. However, they claim that the grades they have obtained are lower than those of previous years. According to the level of general satisfaction 36.7% are satisfied while 33.3% are not.

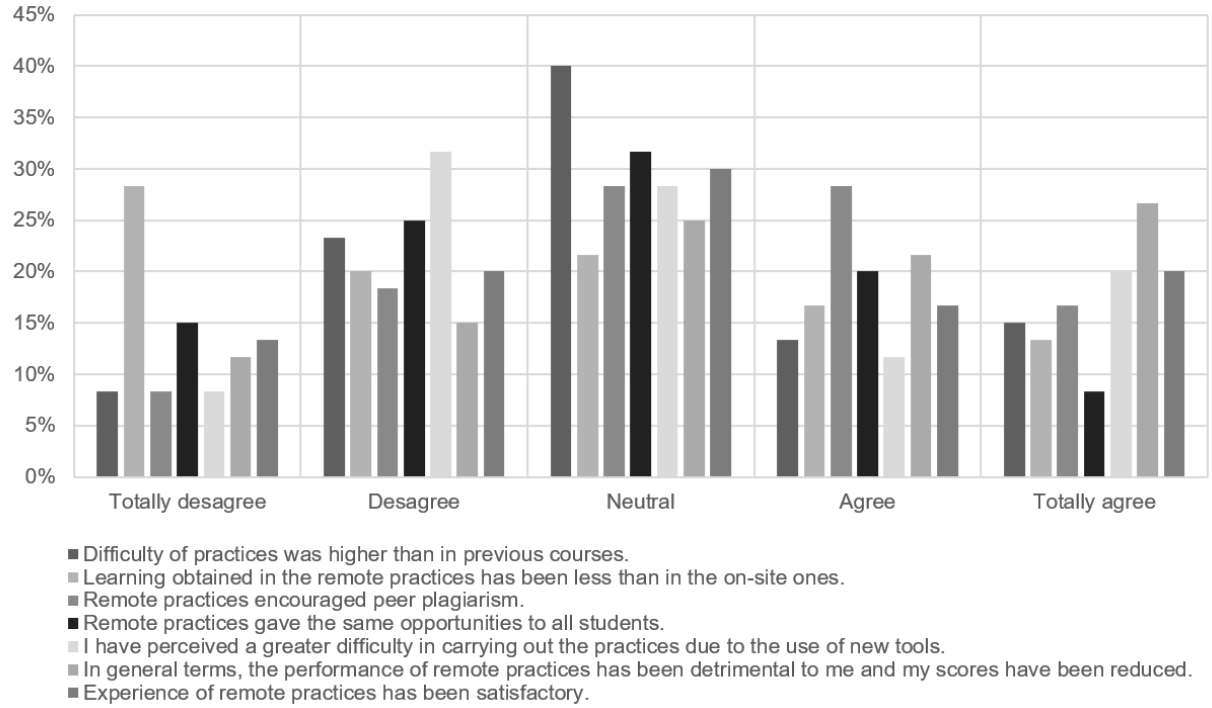

Figure 4. Summary of results practices in RTL.

3.2.5 Group practices carried out during confinement

The general feeling with group works considering whose are neutral and agree is the 66.7%, which means that this part of the RTL have been improved in order to give students a better workgroup experience. As in the general online practices they feel that the scores are lower, plagiarism is easier and the knowledge obtained is also lower. It is understandable that workgroup is difficult without contact, but under the confinement conditions that occurred during the pandemic, contact between people was impossible. Because of this, it is understood that there may be discontent on the part of students. This type of practice must be improved for confinement situations such as the one we experienced.

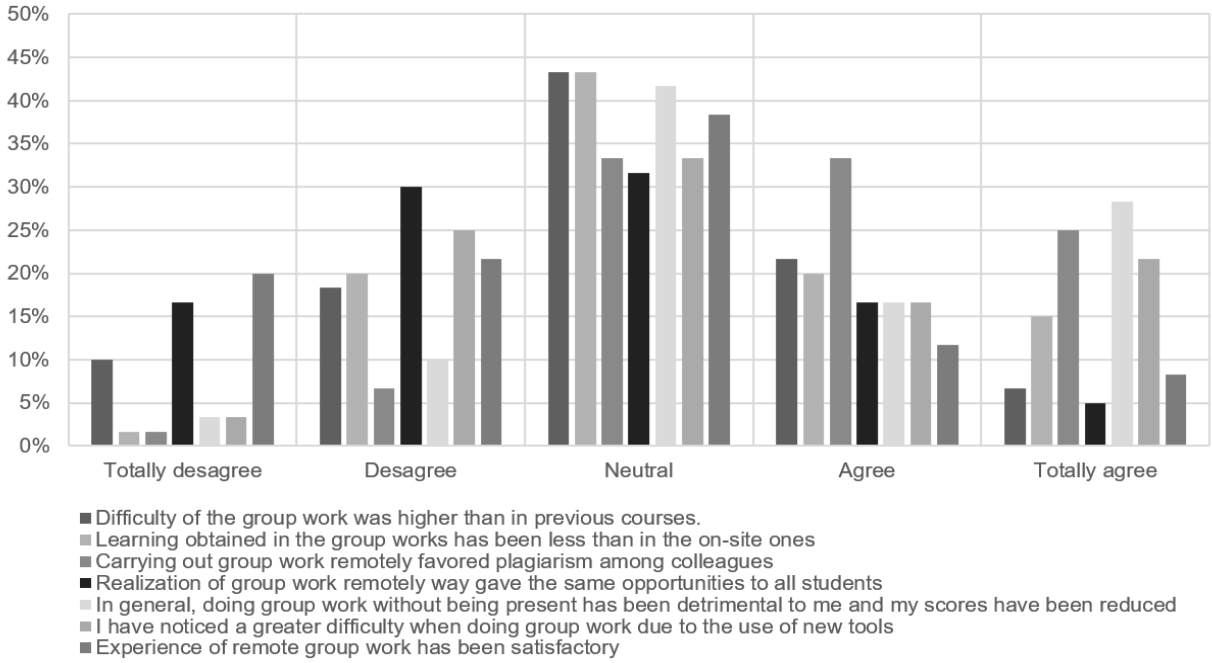

Figure 5. Summary of results group practices.

4 CONCLUSIONS

COVID-19 pandemic caused that during the months of March to May 2020 most of the European Union countries had to confine their population. This resulted in a drastic change from face-to-face to remote teaching and, as a consequence, an accelerated adaptation of traditional teaching methods to the use of new tools and methods that allow the transmission of knowledge from teachers to students through online platforms. This study has analyzed by conducting a survey of students from the school of civil engineering at the Polytechnic University of Valencia as was this transition. The objective of this work is to assess what was the situation in order to improve the methods used in a new possible situations of confinement in subjects related to construction management.

In general terms, students feel that the quality of Remote Teaching and Learning (RTL) have been good due to the fast adaptation of professors to online platforms. As an advantages of RTL student feel that they profit more time in online classes. The problems they have encountered have been due to the lack of infrastructure and tools available. General feeling with RTL is good, but there are lot of work to carry out in order to be capable to implement this methods these methods to make quality teaching and accessible to all students. The students have not perceived an increase in the difficulty of the tests or assessable practices, however the general feeling is that the grades obtained in the subjects have been lower than those obtained in previous years. Regarding the ease of plagiarism, students think that it has been easier to plagiarize while being confined, both in exams and in individual and group practice. This is something that should be controlled, since plagiarism should not be accepted and tools are available to check it. This study shows the experience.

This study shows the experience of students in construction management subjects for civil engineering during the period of pandemic containment. It also shows the weaknesses in this dramatic shift from face-to-face to remote teaching. It also opens the way to research in the field of remote teaching, which, although there are already some studies, has not been implemented in a conclusive way in universities.

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REFERENCES

[1] UNESCO IESALC, “COVID-19 and higher education: Today and tomorrow. Impact analysis, policy responses and recommendations,” *UNESCO IESALC*, 2020, [Online]. Available: http://www.iesalc.unesco.org/en/wp-content/uploads/2020/04/COVID-19-EN-090420-2.pdf

[2] V. Singh and A. Thurman, “How Many Ways Can We Define Online Learning? A Systematic Literature Review of Definitions of Online Learning (1988-2018),” *American Journal of Distance Education*, vol. 33, no. 4, pp. 289–306, Oct. 2019.

[3] M. Kebritchi, A. Lipschuetz, and L. Santiague, “Issues and Challenges for Teaching Successful Online Courses in Higher Education,” *Journal of Educational Technology Systems*, vol. 46, no. 1, pp. 4–29, Sep. 2017.

[4] S. Dhawan, “Online Learning: A Panacea in the Time of COVID-19 Crisis,” *Journal of Educational Technology Systems*, vol. 49, no. 1, pp. 5–22, Sep. 2020.

[5] D. A. Armstrong, “Students’ perceptions of online learning and instructional tools: A qualitative study of undergraduate students use of online tools,” *Turkish Online Journal of Educational Technology*, vol. 10, no. 3, pp. 222–226, 2011.

[6] B. Biswas, S. K. Roy, and F. Roy, “Students Perception of Mobile Learning during COVID-19 in Bangladesh: University Student Perspective,” *Aquademia*, vol. 4, no. 2, p. ep20023, Jul. 2020.

[7] V. Yepes, E. Pellicer, and A. J. Ortega, “Designing a Benchmark Indicator for Managerial Competences in Construction at the Graduate Level,” *Journal of Professional Issues in Engineering Education and Practice*, vol. 138, no. 1, pp. 48–54, 2012.

[8] C. Torres-Machí, A. Carrión, V. Yepes, and E. Pellicer, “Employability of Graduate Students in Construction Management,” *Journal of Professional Issues in Engineering Education and Practice*, vol. 139, no. 2, pp. 163–170, 2013.

[9] E. Pellicer, V. Yepes, C.L. Correa, L.F. Alarcón, “Model for Systematic Innovation in Construction Companies,” *Journal of Construction Engineering and Management*, vol. 140, no. 4, p. B4014001, 2014.

[10] C. Torres-Machí, A. Chamorro, C. Videla, E. Pellicer, and V. Yepes, “An iterative approach for the optimization of pavement maintenance management at the network level,” *The Scientific World Journal*, vol. 2014, 2014.

[11] L. A. Sierra, E. Pellicer, and V. Yepes, “Social Sustainability in the Lifecycle of Chilean Public Infrastructure,” *Journal of Construction Engineering and Management*, vol. 142, no. 5, p. 05015020, 2016.

[12] E. Pellicer, L. A. Sierra, and V. Yepes, “Appraisal of infrastructure sustainability by graduate students using an active-learning method,” *Journal of Cleaner Production*, vol. 113, pp. 884–896, 2016.

[13] J. R. Martí-Vargas, F. J. Ferri, and V. Yepes, “Prediction of the transfer length of prestressing strands with neural networks,” *Computers and Concrete* , vol. 12, no. 2, pp. 187–209, 2013.

[14] I. Paya-Zaforteza, V. Yepes, F. González-Vidosa, and A. Hospitaler, “On the Weibull cost estimation of building frames designed by simulated annealing,” *Meccanica*, vol. 45, no. 5, pp. 693–704, 2010.

[15] S. Kim and D. M. Frangopol, “Efficient multi-objective optimisation of probabilistic service life management,” *Structure and Infrastructure Engineering.*, vol. 13, no. 1, pp. 147–159, Jan. 2017.

[16] M. Liu, and D. M. Frangopol“Response of Nonstructural Components in Structures with Damping Systems Response of Nonstructural Components in Structures,” *Journal of Structural Engineering*, vol. 132, no. 11, pp. 1835–1845, 2006.

[17] D. Martínez-Muñoz, J. V. Martí, and V. Yepes, “Steel-Concrete Composite Bridges: Design, Life Cycle Assessment, Maintenance, and Decision-Making,” *Advances in Civil Engineering*, vol. 2020. Hindawi Limited, 2020.

[18] I. J. Navarro, V. Penadés-Plà, D. Martínez-Muñoz, R. Rempling, and V. Yepes, “Life cycle sustainability assessment for multi-criteria decision making in bridge design: A review,” *Journal of Civil Engineering and Management*, vol. 26, no. 7, pp. 690–704, Jul. 2020.

[19] V. Penadés-Plà, J. V. Martí, T. García-Segura, and V. Yepes, “Life-cycle assessment: A comparison between two optimal post-tensioned concrete box-girder road bridges,” *Sustainability*, vol. 9, no. 10, p. 1864, Oct. 2017.

[20] V. Penadés-Plà, D. Martínez-Muñoz, T. García-Segura, I. J. Navarro, and V. Yepes, “Environmental and Social Impact Assessment of Optimized Post-Tensioned Concrete Road Bridges,” *Sustainability*, vol. 12, no. 10, p. 4265, May 2020.