

ENTREPRENEURSHIP AND PEDAGOGICAL INNOVATION IN THE CLASSROOM THROUGH A SCRUM-BASED EDUCATIONAL METHODOLOGY: A PRACTICAL LEARNING EXPERIENCE IN AN UNDERGRADUATE COURSE IN SPAIN

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Abstract

Entrepreneurship at school represents a major challenge of today's education at different educational levels. Seemingly more conceived for studies at older ages, several contributions have identified its benefits not only in later grades, but also as early as primary school.

However, turning this specific objective into reality is not an easy task, as motivating students and facilitating learning in this field require appropriate tools and methodologies. The literature and experience on entrepreneurship promotion in education have provided a wealth of tools that have brought this knowledge to the youngest students. However, much work remains to be done as student engagement is often difficult to achieve and labour market requirements are constantly evolving.

This work attempts to contribute to this topic by explaining the practical learning experience achieved in the subject "Fundamentals of Business Administration" in the bachelor's degree in Computer Engineering at Universitat Politècnica de València in Spain during the 2021/2022 academic year through the application of a combined Scrum and Design Thinking based educational methodology. Scrum is a well-known Agile framework, traditionally used in managing software development although it has been adopted in other business sectors. It is designed for teams who break their work into actions that can be completed within fixed duration cycles called "sprints". Each sprint has a main topic and a challenge attached to it.

Nevertheless, in this practical experiment, the Scrum basic fundamentals along with the Design Thinking five phases, i.e. Empathise, Define, Ideate, Prototype and Test, are used to develop the different stages of the product/business design process. More concretely, we apply an educational framework called Scrum Educational Experience to a group of 57 students of the aforementioned course with the aim of managing the whole process that leads them from scratch to develop a business idea and put it into practice in the market.

After the application of the methodology, the results obtained have been very positive as the students have felt motivated throughout the course, the final results of the product/company have been more suitable for the market and the final grades have improved compared to previous courses.

Keywords: Scrum educational experience, Design Thinking, Entrepreneurship, Pedagogical innovation, Bachelor's degree in Computer Engineering.

1 INTRODUCTION

The development of entrepreneurial competencies during the students' educational stage has received increasing attention from both the educational and academic communities. The current alarming levels of unemployment among young Europeans, especially in countries such as Greece (28.6%), Spain (26.9%), Italy (24%), Slovakia (19.5%) or Sweden (18%) [1], together with their lack of knowledge and skills in entrepreneurship have prompted the design of educational policies in the European Union aimed at the promotion and development of youth entrepreneurship skills at all the educational levels. In this sense, different activities and events have been developed in recent years throughout the different European countries aimed at awakening interest in innovation and entrepreneurship among young people [2].

In the university sphere, it has been common for some years now to find in the curricula of the different degree courses in the area of engineering or business management, among others, training content directly linked to the area of entrepreneurship and innovation with the aim of developing students' skills,

knowledge and attitudes to promote entrepreneurial mindsets and encourage self-employment. At the same time, universities around the world have also developed infrastructures and promoted funding and recruitment of specific staff to stimulate interest and help students develop their own entrepreneurial ideas during their time at university [3].

At the purely teaching level, classrooms have been filled with lectures and experiences to promote this area among students. However, transferring this knowledge effectively is not straightforward, as motivating and facilitating student learning requires the right methodologies and tools. The literature on entrepreneurship promotion in education has provided a wealth of tools that have brought this knowledge to the youngest students. However, much work remains to be done as student engagement is often difficult to achieve and labour market requirements are constantly evolving.

Due to the difficulties and challenges of entrepreneurship, traditional pedagogical approaches are not appropriate in this area. Rather, entrepreneurship learning requires current and novel approaches that prepare learners for multidisciplinary and uncertain environments. Universities, policymakers and educators have devoted enormous efforts in recent years to the development of new learning approaches and pedagogies in entrepreneurship education to enable learners to become autonomous and to exploit opportunities in complex situations [4].

In this work, we focus our attention on two recent methodologies that, although emerging from the business world, have begun to be successfully applied in the teaching and academic environment.

First, we have turned our interest to Scrum [5]. This methodology is a well-known Agile framework, usually used in managing software development although later adopted in other business sectors. It is designed for teams who break their work into actions that can be completed within fixed duration cycles called "sprints". Each sprint has a main topic and a challenge attached to it. Different adaptations have tried to apply this methodology in the teaching realm. In this paper we have considered the application of the Scrum Educational Experience (SEE) [6] which has proven to be effective in introducing technology and entrepreneurship into learning environments. In this case, the sprint structure is organised in 3 stages: 1) the challenge introduction in which the facilitator presents the task and outlines the list of deliverables; 2) the sprint itself, in which the task is developed, usually for 30/40 minutes; and 3) the retrospective with feedback and discussion led by the facilitator.

On the other hand, we also have complementarily considered the principles and contents of Design Thinking [7]. It is a recognised method for generating innovative ideas that focuses its effectiveness on understanding and providing solutions to the real needs of users. According to [7], it uses the sensibilities and methods of designers to match people's needs with what is technologically feasible and with what a viable business strategy can convert into value for the customer. From a more operational point of view, it is implemented following a process that emphasises the generation of empathy, teamwork, the generation of prototypes, the generation of an optimistic atmosphere conducive to creativity and the use of great visual content.

Under these premises, this work attempts to contribute to this topic by explaining the practical learning experience achieved in the subject "Fundamentals of Business Administration" in the bachelor's degree in Informatics Engineering at Universitat Politècnica de València (UPV) in Spain during the 2021/2022 academic year through the application of a combined Scrum and Design Thinking based educational methodology. The combination of these techniques is appropriate, as they complement different organisational and operational considerations to create an approach that is contemporary and adapted to today's dynamic learning needs. Specifically, in this practical case study, the Scrum basic fundamentals along with the Design Thinking five phases, i.e. Empathise, Define, Ideate, Prototype and Test, are applied to develop the different stages of the product/business design process in a group of 57 students of the aforementioned course with the aim of managing the whole process that leads them from scratch to develop a business idea and put it into practice in the market.

After the application of the methodology, the results obtained have been very positive as the students have felt motivated throughout the course for the contents related to entrepreneurship, the final results of the product/company have been more suitable for the market and the final grades have improved compared to previous courses.

This document is structured in four sections. After the introduction, the second section presents the methodological considerations and the research setting on which the work is based. This is followed by a description of the proposal developed to meet the objectives. Finally, the conclusions of the work and recommendations for future developments are presented.

2 METHODOLOGY

This section details the context of the study where the concepts and combination of methodologies described above have been applied.

The study has focused on the subject of "Fundamentals of Business Management of the bachelor's degree in Computer Engineering at the Alcoy Campus of the UPV during the 2021/2022 academic year in which a total of 57 students participated. This first-year subject has six ECTS credits distributed in 4,5 credits of theory (45 classroom hours and 63 non-classroom hours) and 1,5 of practical or experimental nature (15 classroom hours and 21 non-classroom hours). The different topics covered in the course are intended to train students and bring them closer to the business management process. In this paper, we will focus our attention on the practical part of the subject. Here, the enrolled freshmen students are divided into two classroom groups (for the academic year analysed, 30 students in Group 1 and 27 students in Group 2) and are required to manage the whole process that leads them from scratch to develop an innovative business idea that solves a current problem for a specific end user. Given the linkage of the studies with computer science and technology, the students are requested that the type of novel product/service to be devised and developed is linked to ICT. The tasks corresponding to the practical part of the subject have a weight of 40% in the final mark of the subject.

3 RESULTS

Having described the scope of the research study, this section will deal with the proposal developed within the subject "Fundamentals of business organisation" in order to meet the objectives set out.

3.1 Proposal

The proposal addressed in the practical part of the course is based on the idea or concept of Hackathon. The main objective of this is to carry out the entire development process of a new product, service, app or website, from the idea to its materialisation. Following the SEE methodology [3] introduced above, attention should be paid to the following dimensions: 1) Problem research and user persona; 2) Solution research; 3) Prototyping, coding and testing; 4) Business Model; and 5) Pitch.

Many students, when they finish their studies, must face the development of projects in teams with ever shorter deadlines and work in increasingly complex and changing environments. These competitive scenarios are forcing companies to adopt agile frameworks to be able to respond to customer needs by being flexible with their demands and adaptive to change. The most widely used framework in project development is Scrum.

Using the Scrum Hack for the development of the contents of the business idea, students simulate the way of working through the Scrum framework, which allows them to develop the contents as if they were developing a project in a company, improving their skills and competences in terms of communication and collaboration for teamwork, as well as critical thinking and creativity to solve challenges. The aim is to make students feel comfortable in product development and to foster their entrepreneurial spirit. Most importantly, students prepare for the world of work almost without being aware of it.

3.1.1 *A sprint-based course structure*

The organisation of the practical part of the course has been set up and structured in two stages. Firstly, during the practical sessions of the course (five sprints of two hours each, one per week), which are compulsory for all students, they are guided in making decisions linked to the new business idea, which is preliminarily developed in work teams of a maximum of five students. Subsequently, and after each practical session, the working groups meet outside of class hours to develop and expand on what was seen during each previous practical session to reach a greater depth of analysis in each of the decisions addressed, thus forming what would be a complete project for the development of a business idea (five sprints of seven days each, one per week). From this structure based on practical session sprints in the classroom and sprints outside the classroom, work teams receive a different grade for each of the two parts based on their performance.

As seen above, the course inherits the sprint-based structure of Scrum for its temporal organisation in each of these two parts. The five sprints proposed for the practical sessions part and the five sprints for the development of the complete project are sequentially related according to Fig. 1.

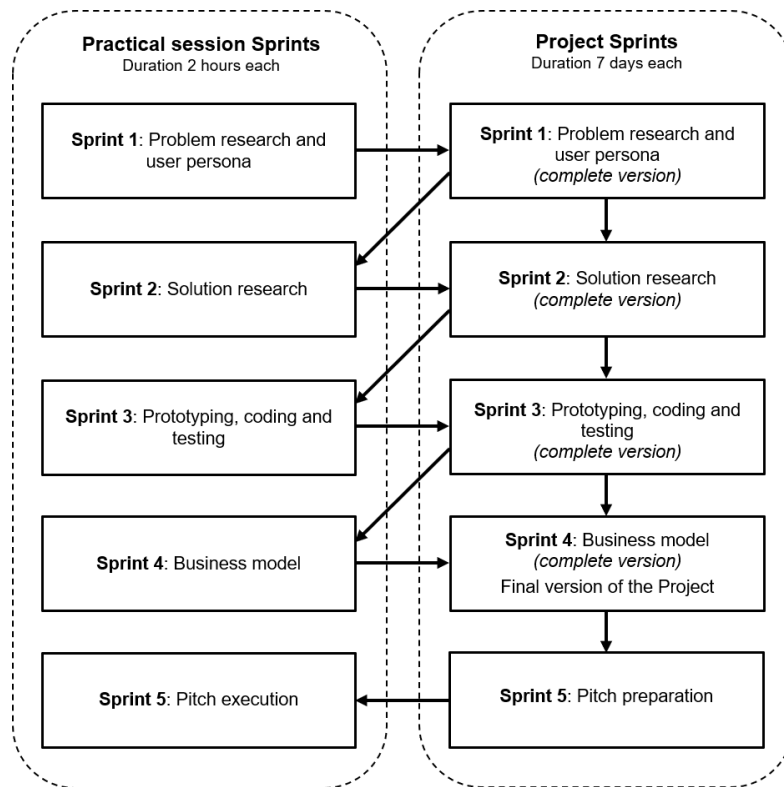


Figure 1. Sprints' structure and sequencing. Source: Own elaboration.

Furthermore, each practical session sprint is composed of a sequential series of activities, as shown in Fig. 2.

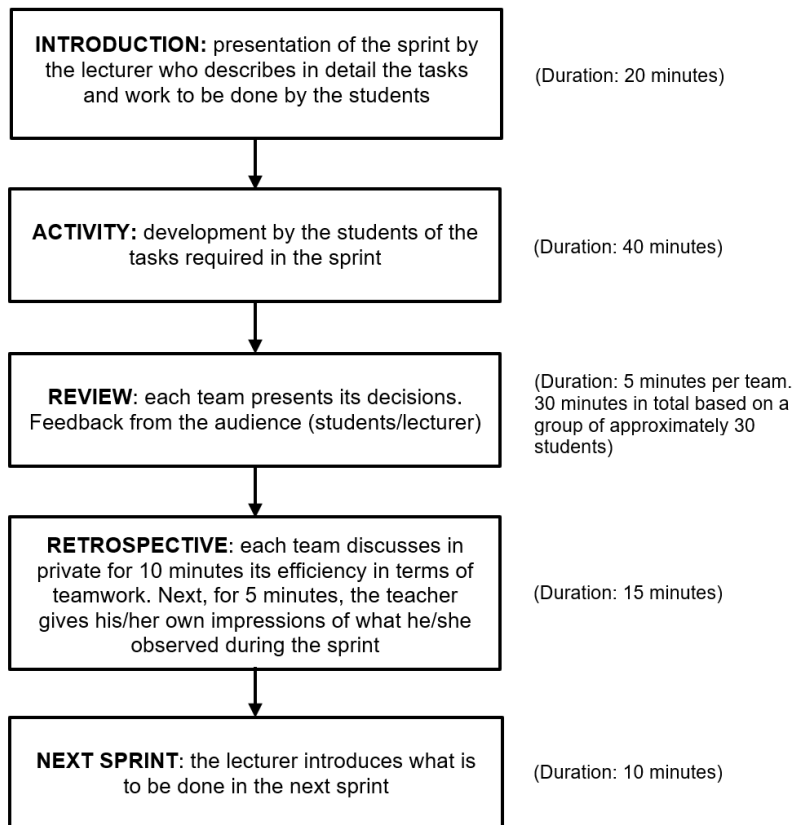


Figure 2. Activities developed in the practical session sprints. Source: Own elaboration.

On the other hand, and as stated in the introduction section of this work, the particular schemes and procedures that are addressed for the development of the business idea in each sprint follow the precepts of the Design Thinking methodology. Under this approach, students grouped in work teams are encouraged to learn from their peers, both from their teams and from other teams. In this sense, students are allowed during the practical sprint sessions to move around the class to exchange knowledge and promote inter-team collaboration. Complementarily, students are provided with a work environment in the cloud based on a Kanban Trello board [8] to support all the activities they develop and the management of their workflow, as if they were in a real company.

The specific contents covered in each of the scheduled sprints are described below.

✦ *Sprint 1: Problem resolution and user persona*

In this first stage, the work teams focus on detecting an existing problem in society, as well as on identifying and describing the profiles of potential users facing this problem. The main aspects of the problem detected are written down in the *Problem Research* template, along with the estimated number of people facing it and the next steps of the project. Regarding the specification of the user profiles or *User Persona*, both the aspects related to the name, personal image and relevant characteristics and behaviours are taken into account, including demographic data such as age, gender, occupation and income, psychographic data such as lifestyle, social class, personality and behavioural attributes such as usage patterns, attitudes and brand loyalty. Likewise, the work teams prepare an *Empathy Map* for each *User Persona* with the aim of obtaining a deeper understanding of the potential user's current behaviour in relation to the problem detected, so that a solution as tailored as possible to their needs and desires can be proposed.

✦ *Sprint 2: Solution*

In this stage, students analyse the different solutions available on the market for the problem detected and propose options for improving them. In addition, they provide a novel solution assuming that they have all the necessary resources to put it into practice. Next, they complete the *Value Proposition Canvas* template for each of the *User Persona* from the previous stage, so that at the centre of the analysis are both the needs and concerns of the potential user and the value proposition of the novel solution provided by the working group. This sprint ends with the creation of a *Product Draft* indicating the product typology, its functions and an outline of its basic general appearance. For the sprint 2 of the project this *Product Draft* is developed to an advanced version of the *Minimum Viable Product* (MVP). The MVP is the basic version of the product or service offered by the work teams as a solution to the detected problem.

✦ *Sprint 3: Prototyping, coding and testing*

In this stage, the work teams focus on materialising the solution proposed in the previous steps, so that students design, code and test their app or website to meet the needs and desires of potential users. They create a *Customer Journey Map* to indicate all the actions that the user performs as a result of their interaction with the proposed solution, always from the user's perspective. In addition, in the *User Story* template they capture the user's actions for specific cases such as consulting information, subscribing to a service, purchasing a product, etc. within the app or website that they have prototyped. The working groups also reach the final version of the MVP which is tested by a group of potential users so that their opinions, suggestions for improvement and criticisms are summarised in a *Solution Test* template.

✦ *Sprint 4: Business model*

In the sprint of the practical session students use the *Lean Canvas* tool to identify all the possible actions related to their app or website that may provide an income. Likewise, they identify the cost structure differentiating between initial, fixed and variable costs. For the project sprint, the groups complete the rest of the areas of the *Lean Canvas* with the information generated in the previous sessions and finish the final version of the project.

✦ *Sprint 5: Pitch preparation and execution*

This stage involves the preparation of a 5-slide PowerPoint presentation to introduce the problem detected, the proposed solution (app or website), the business model addressed and the marketing actions to be carried out, the team members and the next steps to be taken with the project. Furthermore, each team has five minutes to present orally the project and the prototype. The first three minutes are

used to present the work done during the previous stages and the last two minutes are used to present the prototype to the audience. It should be noted that, unlike in previous sprints, the students first attend the project sprint and then the practical session sprint. This is because the project sprint is to prepare the documents that will serve as support for the oral presentation that the students make in the practical session sprint.

★ *Practical sprints and project assessment*

The work carried out by the work teams has been evaluated mainly by considering aspects such as the quality of the content presented in each of the sprints, the adjustment of the proposed solution to the detected problem, as well as to the needs and wishes of the potential users, the adjustment to the time available to work and the adjustment of the documents delivered to the established format and deadline. However, the working dynamics that the students followed in the classroom were also valued, both within the team and among the other working groups, as the students were able to collaborate with each other and provide feedback after the oral presentations of the work carried out.

Table 1 shows the deliverable material for each of the sprints, both for the practical sessions and project.

Table 1. Deliverable material. Source: own elaboration.

Deliverable material	Sprint 1	Sprint 2	Sprint 3	Sprint 4	Sprint 5
Practical session Sprints	Problem research (1) User Persona* (2) Empathy Map* (1)	Solution research (1) Value Proposition Canvas (1) Product Draft (1)	Customer Journey Map* (1) Customer Story Map* (3) MVP* (1) (ready to be tested)	Lean Canvas* (Only Income and Costs Structures)	Pitch execution (5-minutes oral presentation)
Project Sprints	Problem research (1) User Persona* (2) Empathy Map* (2)	Solution research (1) Value Proposition Canvas (2) Advanced version of MVP (1)	Customer Journey Map* (2) Customer Story Map* (5) MVP* (1) (ready to be tested) Solution test (1)	Lean Canvas* (Complete) Final version of the project	Pitch preparation (PowerPoint Presentation & Prototype Presentation)

* Tool commonly used in the Design Thinking Methodology
In brackets, minimum number of items required from each work team.

3.2 Application

To validate the appropriateness of the methodology proposed and the students' satisfaction with its application in the course, we considered the use of different metrics. In particular, we proceeded to develop three different analyses. Firstly, we compared the students' final grades in the course project from previous years with those of this last year, in order to explore whether the students' average grades, and consequently their learning, had improved thanks to the application of the new methodology. Secondly, we proceeded to carry out a study of students' positive and negative perceptions of the new methodology. Finally, we developed a questionnaire to quantitatively analyse students' satisfaction with the course.

3.2.1 Results achieved and comparison with previous years' courses

Although the students' final grades in the practical sessions and the project may be conditioned by specific influences such as the assessment criteria, we consider that their comparison with those of previous years, although not a definitive fact, can provide a priori information on their level of learning achieved, the level of effort developed and their involvement. Table 2 shows, for all students involved in the course during the last years, the mean grades (on a scale of 0 to 10) and standard deviations of the practical sessions and course project grades.

Table 2. Average grades of the students in the practical sessions and the project in the last five academic years. Source: own elaboration.

	Practical sessions		Project	
	Average grade	Std. deviation	Average grade	Std. deviation
2021/2022 Course	7,74	2,22	7,55	2,59
2020/2021 Course	5,85	3,24	6,72	3,56
2019/2020 Course	6,50	3,03	6,76	3,14
2018/2019 Course	7,25	2,77	6,65	2,93
2017/2018 Course	6,45	2,89	6,72	3,50

As can be noticed, the average marks in both the practical sessions and the project reached their highest values in the last academic year, i.e. the year in which the new methodology was applied. This fact suggests a priori the existence of greater involvement of the students in the course thanks to its application.

3.2.2 Analysis of students' perceptions and satisfaction

In order to gather the students' perceptions of the methodology and the process followed in the practical sessions and the course project, we made use of two main tools.

Firstly, from a more qualitative point of view, a retrospective task following Scrum methodology and based on an online shared whiteboard on the Miro.com platform was developed, which allowed us to collect the students' opinions based on five questions:

- What do you take with you?
- What should we stop doing?
- What should we continue to do?
- What should we start doing?
- What could you apply professionally in the future from what you have learned?

The information was gathered from the students after the final presentations of the course project. The results obtained are presented in Fig. 3.

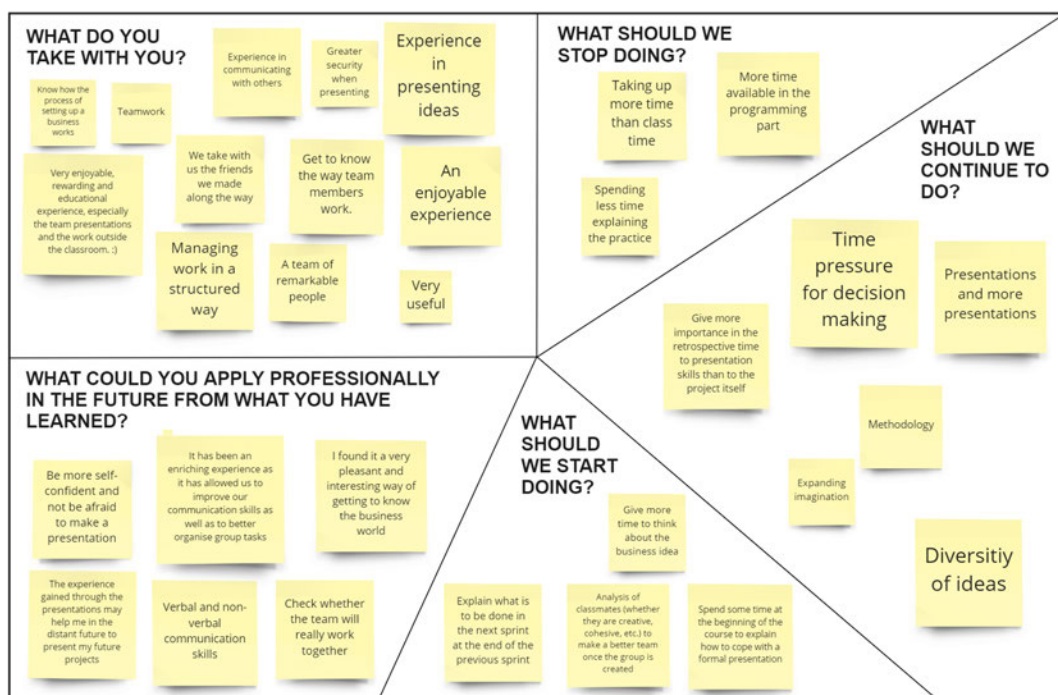


Figure 3. Students' perceptions of the adopted methodology in practical sessions and course project. Source: Own elaboration from Miro.com

On the whole, the students' perceptions are positive, highlighting in the professional sphere the communication, decision-making and teamwork skills that they have been able to acquire during the practical sprints. On the other hand, they also highlight, from a more emotional point of view, the greater security and self-confidence they have gained after the different sessions, as well as the bonds of friendship established with their classmates. Finally, they also point out possible improvements to be incorporated by the instructors, such as better management of class time and of the tasks carried out by students, as well as better management in the formation of work teams and in the definition of the business idea of each one of them, among others.

Complementarily, we used a second information source to collect the students' opinions from a more quantitative perspective. In this case, we set up a 15-question questionnaire based on a 1-5 Likert scale (from 1-Strongly disagree to 5-Strongly agree) to find out the students' level of satisfaction with the new methodology adopted. All students answered the questionnaire during the final project presentation session. Therefore 57 completed questionnaires were collected. The main results are shown in Table 3.

Table 3. Mean and standard deviation of the answers to the questions of the questionnaire.

<i>Question</i>	<i>Mean</i>	<i>Std. deviation</i>
The explanations given by the lecturers during the practical sessions were appropriate	4,57	0,50
The tools used in each practice seemed to me to be very appropriate	4,20	0,83
The methodology used in each practical session seemed to me to be very appropriate	4,23	0,77
The methodology used facilitated the interaction between the members of the working group	4,53	0,61
The time devoted to each of the tasks during the practical sessions was adequate	3,63	0,94
The time management of the teachers in each practical session was adequate	3,37	1,00
Trello is a very interesting software for teamwork and coordination in the practical sessions	4,31	0,68
The knowledge acquired during the practical sessions was considered very useful	4,29	0,75
The presentations made in each practical session allowed me to improve my communication skills	4,37	0,81
The way of learning during the practical sessions has been adequate	4,11	0,83
The practical sessions allowed to motivate me and to awaken my interest in business topics	3,93	1,14
The way of learning in these practical sessions is better than in other courses that I have taken	4,34	0,80
The practical classes have been fun to a certain extent	4,26	0,74
I found the practical classes somewhat stressful to some extent	3,11	1,13
My overall satisfaction with the practical classes is very high	4,23	0,69

Source: own elaboration

These new results confirm the good perceptions obtained from the students through the two previous analyses carried out. In this sense, students find in this new study both the methodology and the tools and explanations provided during the practical sessions and those for the development of the project satisfactory. In addition, they also value very positively the presentations given during each practical sprint session. On the other hand, students highlight a greater motivation and personal interest in business topics after the course, which, a priori, is also relevant since students are enrolled in technical studies which are far from the knowledge area of entrepreneurship and business management. Finally, and from a more negative point of view, students assign a lower score to the time management carried out during the practical sprints. This fact, already highlighted in the qualitative analysis above, should motivate the course managers to improve it throughout the different sprint sessions.

4 CONCLUSIONS

In this work, a novel methodology based on Scrum and Design Thinking has been applied in the practical part of a business management course of the bachelor's degree in Computer Engineering.

Through its implementation, the aim has been for students to work in a team to solve a challenge, improve their communication skills, become familiar with company roles, improve their critical thinking and creativity, know the technological tools to create and organise themselves, practise critical and

digital literacy, develop time management skills, develop self-confidence and teamwork skills and experience different roles within project development.

The results and perceptions of the students obtained from the analyses and studies carried out from qualitative and quantitative sources after the application of the methodology have been encouraging, as they confirm our initial expectations and improve student performance.

However, it is also important to stress certain aspects that should be taken into account in the application of agile methodologies in the classroom. In this sense, students have highlighted the importance of strict time management by the facilitators in each sprint in order not to generate delays and mismatches between the different scheduled activities. Furthermore, they have also stressed the need for better management in the formation of work teams and in the definition of the business idea.

In any case, the positive results obtained together with improved administration of these aspects and the progressive incorporation of new complementary training needs in the classroom such as the aspects of sustainability and social and ethical responsibility for the achievement of the United Nations Sustainable Development Goals [9] motivate us to continue with the implementation of this innovative learning framework in future years.

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