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Problem-based learning and other active methodologies as support for distance teaching during the COVID-19 pandemic

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Abstract

This manuscript presents an innovative experience in the teaching–learning process with three objectives. The first is to incorporate the principles and values of social justice, reciprocity and solidarity in the subject 'Statistics Applied to Business' in the bachelor's degree in Business Administration and Management at the University of the Basque Country. The second objective addresses how to apply active methodologies in the teaching of economics and business from a competency-based approach in order to investigate its impact. The third one, on the other hand, tries to explore how to provide students with active distance learning tools to improve and guarantee the quality of the teaching–learning process. The results of the experience demonstrate the potential of technical subjects for the development of transversal competencies and the capacity of students to design and solve complex problems with creativity and knowledge of social and labour realities. Likewise, greater motivation, better knowledge acquisition and appropriation of the work by the students are also detected. Finally, this article shows the potential of methodologies that involve the combined responsibility of students and teachers in the generation of knowledge that favours a professional development that is permeable and sensitive to the changes occurring in the social and labour world.

Keywords: Problem-based learning, distance teaching, pandemic, teaching innovation.

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1. Introduction

Today's society is increasingly complex and changing. Humanity must adapt to social, economic, cultural and technological changes at an increasing rate. The field of education is also affected by this changing environment, and it must respond with flexibility, adaptability and efficacy to the challenges posed, as has been stated by authors like Gonzalez-Sanmamed, Sangra, Souto and Estevez (2018, p. 15): 'Education is being challenged to respond to the demands of a changing society'.

Naturally, this changing context has a remarkable impact on higher education, according to Gonzalez, Lucas, Franco and Rodriguez (2019): 'universities are public and educational institutions. Therefore, they cannot be excluded from the challenges posed by these new contexts'.

Thus, universities have a responsibility towards society, which is materialised into the so-called university social responsibility (USR). Authors such as Gaete-Quezada (2011, p. 110) assert that USR is a transforming perspective: 'The role of USR is to lead the contributions and reflections that allow attaining a more equitable and fair society'. Universities contribute to the creation of solutions to the main social problems and needs that exist in the present time. Similarly, universities must go beyond the training of professionals; they must train citizens with ethical awareness and civic engagement, linking values training to their teaching (Michelsen, 2015). This type of training and opening to the citizens allows society to perceive universities as accessible institutions capable of transforming society through the practical application of values that make us all the more human (Nunez, Calvo & Alvarez, 2015). Since universities are specialised educational entities, they play an important role in the development of programmes, actions and strategies for the promotion of social values. This poses challenges in several dimensions, such as the teaching–learning model, in which the leading role of the teacher is passed to the student, who takes greater control over his/her own learning.

In this regard, and due to the new demands that universities must meet, it becomes necessary to adapt the teaching–learning methodologies to the proposed model. Problem-based learning (PBL) is a methodology in which the teacher presents a problem and the students are the leaders of their own learning (Branda, 2011). However, it is important to be cautious, since the ways in which PBL is applied by research participants do not necessarily reflect the real applications of PBL (Alrajeh, 2020, p. 1007), thus an accurate ex ante implementation strategy is required.

Since late 2019, a world pandemic has affected society in an increasing number of sectors: healthcare, social, economic, environmental and education.

This article presents an experience of educational innovation adapted to the pandemic context, using the capacities of new technologies and adapting face-to-face teaching to distance teaching.

1.1. Active methodologies for social values teaching–learning in the UPV/EHU

Since the past few years, the University of the Basque Country (UPV/EHU) has promoted the use of active methodologies for the improvement of the teaching–learning processes, as well as the adaptation of the new realities. Therefore, teachers have been trained in different teaching methodologies, such as service learning, teaching case studies and PBL, which are the ones applied in the experience presented in this article.

This process of methodological innovation is incorporated in the educational model known as 'Ikaskuntza kooperatiboa eta Dinamikoa-Cooperative and Dynamic Learning' (IKD), developed in UPV/EHU.

This model proposes the curricular development to be based on: 1) the promotion of professional development through different training programmes aimed at teachers and at the encouragement of innovation; 2) territorial and social development, linked to the role of the university and its social and community commitment; 3) institutional development and 4) active education, which transforms students into the leaders of their own learning and promotes initiative, opening to reality and the willingness to learn from different sources. These objectives have led to the search for methodologies like the ones mentioned above.

Moreover, the IKD model has been recently updated and adapted to the European pedagogical guidelines. Thus, now it aims to respond to the main challenges of the 21st century, which are included in the 2030 Agenda for Sustainable Development. The resulting version is called IKDi3: 'ikaskuntza, ikerkuntza and iraunkortasuna', which is Basque for 'learning, research and sustainability', respectively. This means multiplying 'learning' × 'research' and 'sustainability', which will lead to the exponential growth of each of these elements. IKDi3, and understanding its possible results, will improve the training of people who study in this university (UPV/EHU, 2020).

Therefore, the UPV/EHU potentiates the realisation of an innovative teaching experience in the classroom, combining new methodologies for the development of the teaching–learning process, along with social values teaching, linking them to sustainability.

1.1.1. Information and communication technologies (ICTs) as support for teaching in the state of alarm due to the COVID-19 pandemic

In late 2019, the first cases of a new virus [named SARS-CoV-2 by the World Health Organisation (WHO)] were detected in China. In the early 2020, this virus spread, with the first cases in Europe being reported in February 2020. At the beginning of March 2020, in view of the uncontrolled spread of the virus, the first measures were implemented at the European level. On March 11, the WHO declared that COVID-19, which is the disease caused by the SARS-CoV-2 virus, could be characterised as a pandemic. Several days later, the Spanish government issued Royal Decree 463/2020, on March 14, by which it declared the state of alarm to manage the health crisis caused by COVID-19. This had a direct impact on the population, since every citizen was confined in their homes, except for cases of basic needs.

The pandemic has caused a world crisis that has affected the entire education system (Paredes-Chacin, Inciarte & Walles-Penaloza, 2020). The temporal overnight cessation of students' face-to-face activities has changed the way in which they interact with the teacher and with their classmates (Cabrera, 2020).

In the context of the Basque Country, where the first cases appeared, the UPV/EHU had to quickly adapt to the new reality, providing alternatives and training to teachers and students, in order to allow them to continue the teaching–learning process with the least possible disturbance. According to Supriyatno, Susilawati and Hassan (2020, p. 1105), the e-learning media is practical, valid and an effective criterion to improve the level of students' uncritical thinking skills.

Thus, the use of new information and communication technologies (ICTs) was proposed. ICTs are not new in the teaching scope, including the UPV/EHU, which offers a specific service for their use and promotion, known as eCampus. This service manages and develops all the aspects related to learning and teaching through telematic methods or procedures in the university. In this regard, it is understood that both (learning and teaching) are connected through ICTs, in general, and through the

Internet, in particular (UPV/EHU, 2020). The eCampus service played a fundamental role at providing specific digital teaching platforms, as well as in the training of teachers in digital teaching.

Therefore, the use of ICTs was considered to be the way to respond to the challenge posed by the pandemic and the general population confinement context, also considering that it could be an opportunity for their development and generalised application in the UPV/EHU. According to Varguillas and Bravo (2020, p. 220), 'ICTs do not only provide tools, means, resources and contents, but also, and mainly, environments that promote educational interconnection and innovation interactions and experiences'. Thus, this new type of interactions and experiences would allow the development of new ways of generating knowledge by teachers and students.

1.1.2. PBL and cooperative learning techniques

The pedagogical proposal that was applied in the present experience was based on PBL methodology, which is centred on the student and proposes the latter to learn on his/her own about a theme or topic suggested by the teacher, through the resolution of a real-life problem. Thus, PBL promotes a pro-active and leading role of students in the teaching–learning process, thereby facilitating the self-regulation of learning. It potentiates the development and improvement of professional competencies. The teacher assumes the role of a facilitator who organises and stimulates learning (Branda, 2011; Gil-Galvan, 2018).

The proposed problem must be relevant, cover the pedagogical objectives set and have a certain level of complexity in order to promote multidisciplinarity and incorporate different hypotheses for its verification (Restrepo, 2005). To this end, teachers offer materials or questions that trigger a process developed in successive phases.

The problem or question to be solved must respond to a real situation, giving the student the chance to approach more or less complex situations of real life in a creative manner, even with an in situ approach to such reality. Fictitious problems can also be used, as long as they respond to the pedagogical structure of the methodology. This methodological process involves the tutored and self-directed team work of the students, with the aim of combining the acquisition of knowledge with the development of general skills and useful attitudes for the personal and professional scopes (Gil-Galvan, 2018).

However, methodologies such as PBL cannot be reduced to a technique or a set of techniques, since they must have a strategic meaning that follows the logic of the pedagogical process. It is interesting to incorporate cooperative techniques that mobilise the learning of all students.

Cooperative learning techniques promote the discussion, interaction, reflection and collective analysis of the proposed problem. They must gather the objective and subjective aspects of the practice or reality in which a group operates, enabling its educational reflection (Garfella & Morera, 2017).

2. Methods

2.1. Objectives of the project

The development of this teaching experience was based on the following questions: Is it possible to implement values education in a subject like Statistics Applied to Business? How is it related to the transversal competencies of the BSc?

These questions led to the design of a teaching proposal with the following objectives:

- To incorporate the principles and values of social justice, reciprocity and solidarity in the subject 'Statistics Applied to Business' in the degree in Business Administration and Management at UPV/EHU
- Address how to apply active methodologies in the teaching of economics and business from a competency-based approach in order to investigate its impact.
- To provide students with active distance learning tools, ensuring the quality of the teaching–learning process.

The subject taught was Statistics Applied to Business, in the second year of the BSc, at the Faculty of Economics and Business (UPV/EHU). The aim is to teach students the fundamental aspects of statistical inference and its application to business analysis. It is an eminently practical subject that combines the theoretical explanation of the fundamental aspects with practical analysis and problem-solving, using exercises that increase in complexity along the course of the subject. This subject delves into the competencies acquired in the subject taught in the first term of the second year of the BSc (i.e., Statistics and Data Analysis), which is the foundation that provides the necessary knowledge to approach inference.

Through this subject, apart from the specific competencies, a series of transversal competencies were taught: TC3, written communication; TC6, information search and management (level 1); TC7, analysis and synthesis capacity (level 1); and TC10, social and ethical responsibility (level 1). These competencies, particularly TC10, enable teachers to propose a relationship with social values. Working on these values grants students a broader and more multidisciplinary view of their future role in companies, thus it is fundamental to teach and learn them for the sake of competency improvement.

2.2. Teaching-Learning process

This experience is the second phase of the innovation process that began in the academic year 2019/2020, focused on training for transversal competency TC10 (social and ethical responsibility, level 1). In the academic year 2019/2020, it was decided to further delve into social and ethical values and grant greater relative weight to this competency, going from 10% to 50% in the evaluation of the subject. Regarding teaching, the explanation of the teacher about the concepts of statistics is combined with practical and computer lectures. Five teaching modalities were contemplated, which later underwent some of the following changes, shifting from a face-to-face format to an online format:

- In the master class mode, the theoretical fundamentals were briefly presented, dedicating most of the face-to-face time to the execution of different activities, generally working in groups, and conducting some individual activities in some cases.
- In the practical lectures, the students solved problems individually or in groups, with the supervision of the teacher. Problem-solving in the classroom was carried out in a participatory manner. Problems and exercises were given for the students to solve individually or in groups, which allowed delving into the theoretical knowledge of the subject matter and associating statistics with other related areas. Question formulation and open discussion were promoted, in a way that the students would acquire skills related to verbal communication, synthesis capacity and team work.
- In the workshop lectures, the students solved problems in groups, working on different contents of the subject in an interrelated manner.

- In the computer lectures, the students learned to use the Excel software for problem-solving. This skill was fundamentally developed during the lockdown.
- In addition, the students could use the tutoring hours to solve doubts related to the concepts, exercises and tasks carried out in the lectures.

2.2.1. COVID-19 pandemic context: adaptation to distance teaching

With the state of alarm, teaching had to be adapted to the new reality. In order for education to continue with a distance model, the UPV/EHU applied two basic measures:

Regarding the infrastructure, digital tools were potentiated, such as:

- Virtual classrooms for BScs, official MScs, university's own degrees and PhDs, known as eGela. This is a platform based on the Moodle system and it was the basic tool of support for the teachers and students.
- Virtual classrooms for continuous training, called eGelapi, available for the whole university community as a tool of support for education. This is also a platform based on the Moodle system and served as support for the digital training of the teachers.
- Virtual meetings through the Blackboard Collaborate Ultra platform. This is a tool especially designed for use in the educational context to hold training and information sessions, tutoring, workshops, ... etc. This platform enabled synchronous communication via different channels (chat, audio and video) and provided additional options to present the contents and share applications, as well as a virtual blackboard and user moderation tools.
- Other digital tools, such as e-portfolios.

Regarding teacher training, a set of training courses about the use of each of the abovementioned platforms were provided. Throughout the course of the term, and in response to the request of the teachers, this general training was complemented with specific training sessions about the use of the digital tools of distance evaluation, such as the digital questionnaires provided by Moodle and other tools.

The teachers had to adapt the subject to the new distance environment. This implied adapting the curriculum through a new Virtual Curriculum that provided a clear response to the needs of the subject and of the students.

Basically, the teaching change consisted of the use of different digital platforms, as well as other usual channels such as e-mail. The content of the subject followed the planned programme, although the teaching–learning process was carried out with the following alternative methods:

- Weekly virtual lectures with Blackboard Collaborate within official lecture hours always notified the students in advance via email.
- Extra materials (videos, tutorials, readings and exercises) were uploaded to eGela for each topic of the subject, which the students had to work on and study.
- Assignments could be sent via email.

Moreover, the evaluation had to be adapted as well, orienting it towards a continuous evaluation that would also allow the asynchronous interaction between the teachers and the students in the lectures and the submission of the evaluable activities. Thus, in the framework of the subject 'Statistics Applied to Business', the weight of the assignments and of the partial group exams in the continuous evaluation increased from 50% to 60%. Two types of evaluation were proposed:

- Final evaluation (100%): through an exam conducted either through an online questionnaire or a final assignment of 13–15 sheets.
- Continuous evaluation: partial group exams and assignments (60%), and final individual exam (40%). The students who chose the continuous evaluation had to take two partial group exams (30%) at the scheduled time and date through the eGela platform. Another 30% of the subject marks would be evaluated through group tasks in eGela (two assignments), and the remaining 40% would be evaluated with a virtual final individual exam at the official date. The criteria to carry out this evaluation would be the same as that for the face-to-face curriculum. The exams, as in the previous case, would be taken either through an online questionnaire or the submission of a six- to eight-page assignment.

Furthermore, the students were given the possibility of completing, in groups, a questionnaire with the concepts learned every week. The digital platform selected for the completion of the questionnaires was Socrative. Every week, each group had to present their questionnaires through the Blackboard Collaborate meetings platform, where they were discussed and corrected by the other students. An additional mark of 0.5 points was given for this task.

3. Results and discussion

3.1. Participants

Table 1 shows the number of second-year students in the subject 'Statistics Applied to Business'. There were two classes: one taught in Basque and the other taught in Spanish. The distribution by sex showed very similar percentages in both classes, with 57% women and 43% men.

Table 1. Student profile

	Range	Basque	Spanish	Total	Percentage
Sex	Men	16	33	49	43.36%
	Women	24	40	64	56.64%
	Total	40	73	113	100.00%

Source: developed by author

Table 2 shows a total of 80 students who participated in the activities of cooperative learning and, thus, chose the continuous evaluation.

There were a total of 23 work teams of 3–5 people each: 10 in Basque and 13 in Spanish. By sex, the percentages were balanced with respect to the total sample of students, with 52% women and 48% men.

Table 2. Work teams by language and sex

	Sex	Basque	Spanish	Total	Percentage
Groups		10	13	23	
	Men	10	28	38	47.50%
	Women	15	27	42	52.50%
	Total	25	55	80	100.00%

Source: developed by author

3.2. Development and techniques used

This section briefly explains the development of the PBL and cooperative learning techniques used in the subject. The first two techniques, i.e., 1+2+4 and Poster, were conducted face-to-face, whereas the PBL was affected by the COVID-19 pandemic, thus it had to be carried out remotely, which obviously had a decisive impact on its development.

3.2.1. Firstt technique: 1+2+4. What is inferential statistics? (face-to-face)

The first practice consisted of discussing inferential statistics, its purpose and how it differs from descriptive statistics, which was taught in another subject of the first term. This was carried out with the participatory technique '1+2+4'. The first topic of the subject explained the basic concepts of inferential statistics. Therefore, this activity was designed as an introductory task aimed at identifying the basic inferential concepts, comprehending and defining such concepts and understanding that the subject is related to events of economic reality.

A text with a thorough definition of statistical inference was given to the students, along with usual examples in which it was used. In the first phase, the students were asked to individually read the text and identify the most relevant terms and examples. In the second phase, they were asked to organise in pairs and collate the identified concepts, create a consensual list with them and establish a first definition of terms without external help. In the third phase, in groups of four members, the students were asked to complete a single list of concepts and define these, for which they were allowed to make use of their mobile devices (smartphones, laptops, iPads, etc.). Lastly, each group explained the concepts they worked on and the rest of the students made comments and improvements. Each group had a secretary, who was in charge of writing down the terms and the definitions, thus completing a definition that was uploaded in the eGela platform for all students to have access to it.

3.2.2. Second technique: poster, inferential statistics, discrete and continuous distributions and values: Is it possible to transversalise social values in statistics? (Face-to-face)

The second practice was an assignment conducted using the poster technique. After studying the first topics of the subject, and with the aim of working on the transversal competency 'social and ethical responsibility' (TC10), the students were asked to carry out a small investigation about a social topic of choice among four options: fair trade, social and solidary economy, environmental sustainability and NGOs for development. They had to transversalise elements of these topics and link them to basic statistical problems using statistical tools. The objectives of this work were to reflect on social and ethical responsibility, identify and understand its possible associations with inferential statistics, and synthesise and disseminate the information in a clear and concise manner.

To carry out this task, considering that the participants were second-year students who were not familiar with the different forms of research dissemination, the teacher showed them academic posters and explained the criteria that they had to meet. The day on which the practice was conducted the students were asked to gather in groups of three to four members and debate about a social topic of their interest. Each group had to carry out a small investigation about the chosen topic and then present it in a poster. Specifically, each group designed a poster that showed the title of the research, the context, examples of transversalisation of values in inferential statistics and some conclusions. Once ready, the posters were presented in the eGela platform, since it was at that time when the state of alert was declared, with the subsequent cessation of face-to-face education.

3.2.3. Third technique: PBL (remote)

The third active methodology was the resolution of a problem through PBL. By the time of its realisation, the state of alert had already been declared, thus all the activities had to be conducted remotely. The eGela and Blackboard Collaborate platforms were used as interaction channels, as well as Skype and email.

With the topics already developed, this method would allow the students to thoroughly understand inferential statistics and see their applicability to the current socioeconomic reality, i.e., a company of the province of Álava (Spain). The objectives of this PBL were to understand, analyse and associate concepts of social and ethical responsibility, to use tools of statistical inference, to demonstrate writing skills through a written presentation and to be capable of making group decisions with the aim of solving the proposed problem.

The students worked in groups of four to five members. They were given a problem to solve, in order for them to develop an active role. They were presented with a specific scenario and a triggering problem that they had to solve from the perspective of the company that they had previously chosen: '*You work in a social company. As in every company, you have statistical data at your disposal, which determine your business duty. You must perform an analysis of the current economic situation of your company and conduct a statistical contrast on random variables that are related to elements of social and ethical responsibility. From such analysis and contrast, you will draw conclusions and write a short report about it, with a maximum of 5 pages*'.

The students had to identify, with the help of the teacher, the adequate statistical tools for the contrast, as well as the elements of social and ethical responsibility to be considered. Then, they searched the contrast data and the type of contrast, and they carried out the contrast. Subsequently, making use of their capacity to interpret those data and understand what the situation was, they drew conclusions and recommendations about the options that the companies had. Initially, if it had been possible to carry out this in the practical lectures (i.e., face-to-face), field notes would have been taken about the comments and observations of the students with respect to the tasks and assignments conducted, as well as the contributions. This information gathering would allow monitoring the process and contrasting the progress of the students in competencies and knowledge, as well as the early detection of elements for improvement. However, since group sessions could not be held face-to-face, this format was replaced with a personalised group-by-group attention through the Blackboard Collaborate virtual meetings platform, whereas the interesting doubts were shared in the virtual classroom sessions, reserving a specific space for this. The experience had great acceptance and served the objectives, since the students were able to frame and apply the knowledge of statistical inference in cases of real companies.

However, the data that the students had to search in the companies were not always available, not only due to the lockdown situation but also to the inactivity of the companies, which hindered the possibility of contacting the people who were in charge of them. Therefore, in some cases, it was decided to use fictitious estimations, which served the original purpose of the PBL, given the circumstances.

3.2.4. Fourth technique: socrative platform (remote)

The students were exceptionally offered the possibility of earning up to 0.5 points more if they prepared, in groups, a set of multiple-choice questions to be implemented in the digital questionnaire

platform Socrative. The participants had to review the theoretical/practical concepts of the previous week. Once per week, each group had to present their questionnaire through the Blackboard Collaborate meetings platform. This exercise was developed, managed, implemented and corrected during lecture hours (in the first 10–15 minutes) by the students themselves, supervised and motivated by the teacher.

It was an interesting and well-accepted experience, since it was self-directed and self-corrected by the students. It also helped to settle the knowledge acquired during the teaching–learning process and to make the students aware of both their learning and that of their classmates.

4. Conclusion

The health crisis and the need to adapt the university teaching–learning process to this new reality have posed an important challenge to the educational community, although new opportunities have also appeared.

These experiences of teaching innovation demonstrate the potentiality of technical subjects for the development of transversal competencies related to social values and the capacity of students to design and solve complex problems, with creativity and knowledge of the social and labour reality. Such knowledge favours a professional development that is permeable and sensitive to the current social changes.

Working with the PBL methodology potentiates social values training, since it brings students close to the socioeconomic reality. The adaptation carried out in this innovation experience did not pose a loss for the social values learning of the students, although they had to work in a different manner. The responsibility of the teachers and students, with the help of ICTs, allowed for the good development of the teaching–learning process. However, this new model of digital teaching was not exempt from different difficulties:

- The need for specific teacher training in the use of digital environments, considering the pedagogical changes required to adapt to the new reality, posed an important effort.
- It was necessary to adapt the curricular programmes to the digital environments and distance evaluation tools in a very short time and with little experience.
- The process was not exempted from resistance, by both teachers and students, against replacing the face-to-face scope with digital environments.
- The experience required an important change in the teaching role, since it was necessary to dynamise pedagogical/didactic strategies, in order to respond to the practical lectures and the scheduled synchronous and asynchronous interaction processes.
- It is necessary to approach the evaluation of the PBL programmes systematically and in time (Alrajeh, 2020).

To conclude, in the face of the current world crisis, there are changes that may have come to stay, and these changes will require universities to increase their capacity to respond to unpredictable contexts.

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