Active Methodologies In Higher Education And The Opinion Of Students

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Abstract

The introduction of new degrees in higher education has been a major change in the university. Besides having to adapt the curricula of the subjects, so that their credits can be validated without any problem at any university in Europe, teaching methodology that was used have also had to adapt to the new system. Until now, the prevailing methodology was the lectures where the teacher was the protagonist and the student's role was relegated to the background.

In the new scenario of the EHEA, it makes little sense to continue using this traditional method, since from the beginning the student should be aware that he is the principal agent in the learning process, and therefore the role to be played is far from being a mere copying of notes. Therefore, in this so-called Bologna process, active learning methodologies are very important.

It is well known that among the teachers there are many detractors to these new ways of teaching, because these methodologies break with the patterns of education that have traditionally been followed, and they lead a new planning where, in addition to assessing knowledge skills, attitudes of students to achieve competencies established and related to his future profession are also assessed.

But what do students think about these active methodologies? To answer this question a pilot study has been made with students from a group of first degree in Telecommunications Engineering in the University of the Basque Country. In the subject of Calculus, the study of functions of a real variable has been taught using the traditional method, while for the study of functions of real variables has followed the methodology of Problem-Based Learning. In this paper, we try to answer the above question with the conclusions of the pilot study.

1. Introduction

With the introduction of new grades in all Spanish universities, the process of convergence towards the European Higher Education Area (EHEA) has been completed, which began in June 1999 with the Bologna Declaration which was signed by 29 European states. In that statement, the stage is setting by which members of these states are “favored” in a shared environment, greater mobility, interaction and opportunity.

In order to facilitate this mobility the European Credit Transfer System (ECTS) was created, which unlike the old credit system, which measured only the length of the classes taught by the teacher, these new credit system value the time that the student invests in the acquisition of competences defined in each of the classes they take.

In the London Communiqué [1], the paragraph that refers to the social dimension of the Bologna Process states:

"Higher education should play a strong role and in raising the level of knowledge, skills and competences in society."

So the teacher, in addition to assessing knowledge, must also assess skills and competences. These three aspects are difficult to assess with traditional teaching approach that considers the student as passive recipient of information. The memorization of the content, narrated by the teacher, is the main objective of this teaching process. Stored knowledge is only abstracted. Learning and teaching are considered individual processes with the teacher in front of an audience, composed of a set of individual students [2], [3].

In this educational system, the assessment is mainly involved of a final exam in which students demonstrate the assimilation of knowledge gained.
In active teaching methodologies, however, the main role in the teaching-learning process lies with the pupils, while the teacher becomes mentor in the process. Teacher stops being a mere transmitter of concepts to deepen the skills that students should acquire. It therefore seems clear that the type of evaluation will be different, or should be different, going from traditional assessment to continuous assessment in which the skills and competences that students have obtained are also considered.
We can use, in this sense, active methodologies and Information and Communication Technologies (ICT), including tools already designed such as Moodle platform for the support of our communication with students, in both senses of teaching and learning [4], [5].

2. Development Of An Active Methodology

The University of the Basque Country (UPV/EHU) in order to train their teachers in active teaching methodologies, launched during the 2010-2011 academic year through the Vice-Chancellorship of Quality and Educational Innovation a program called “Eragin” [6].
There are many international and European universities that have used and developed active methodologies with evidence of successful results in the teaching and learning processes. Among the advantages of using these methodologies, and according to Eragin program, educational research refers to the following aspects:

- Increase motivation, interest and student involvement.
- Time of completion of studies shorter and lower rate of abandonment.
- Increase knowledge retention.
- Greater development of skills and competences.
- Closer connection between theory and application, between prior knowledge and that to be learning, and greater integration of knowledge among different disciplines.

Among the objectives raised by this program is to facilitate new levels within the use of active teaching methodologies and learning, particularly, problem-based learning, project-based learning and case method.
To carry out the program and taking into account the territorial scope of our university and the diversity of taught disciplines, 75 academics were selected, 25 for each of the above methodologies.
Specifically, the Department of Applied Mathematics at the Engineering School of Bilbao was chosen to develop Problem-Based Learning (PBL) in the subject of Calculus I, taught in the first four-month period of Engineering Degree in Telecommunications.

2.1. Background work

The program has had a duration of one year (January 2010 - January 2011), and begins with a course that is offered to selected teachers in explaining the characteristics of the chosen methodology.
During the months following the course and with the help of tutors, experts from the UPV/EHU in this methodology, teachers design their PBL as they will implement in the classroom.
In addition to the tutor, other expert teachers of the university are involved in the evaluation of the design. Once it is accepted, teachers detail the evaluation to be carried out. If final approval is given to be developed, the design is implemented in the corresponding subject.

Table 1. Descriptive data of the subject.

Subject	Calculus I
Department	Applied Mathematics
Year/Period	First/First four-month
Credits	6
Language	Basque
Module	Basic
Graduate	Engineering Degree in Telecommunications

At the conclusion of the implementation a final report is produced, which will be again evaluated and forwarded to the appropriate teacher.
As already mentioned, this paper addresses the implementation of the PBL methodology in the subject of Calculus I, whose descriptive data are shown in Table1.

3. Pbl Design For Calculus I

Under the heading "How do we work with functions on our environment?", the problem that students must resolved is explained.
The choice of this problem is based on the theory of Meaningful Learning that developed Ausubel et al [7]. The primary idea is that learning of new knowledge depends on what you know. That is, to build the knowledge begins with an observation of events and objects through the concepts that you already possess.
Students, when they starts to take the subject of Calculus I, have acquired the knowledge to be developed for the real functions of one real variable.
With the dual intention to expand on the concepts that will be developed and to be acquired the skills corresponding this subject, activities that students have to do in the classroom in following ways are designed:

- Face-to-face / non-presencial.
- Individual / group.
- Sharing tasks / not sharing.

Following, competences are explicited (Table 2), as well as learning indicators and their relation to the defined competences (Table 3).

Table 2. Competences of the subject.

C1	Promote mathematical thinking mode and power of abstraction.
C2	Develop the ability to set out and resolve engineering problems with the differential calculus of one and two variables
C3	Improving the capacity to argue and the ability to transmit the results of a problem using appropriate mathematical language, enhancing it with order and precision.

Table 3. Learning indicators related to the defined competences.

Learning indicators	**Competence**
Understand the concept of function of two variables (geometrically is to add another dimension to the plane), and know the common surfaces, and recognize the corresponding contour line.	C1
Identify directional limit as the limit of a function of one variable, relating it to the double limit and use it to define continuity and differentiability.	C1, C2
Understand the concept of partial derivatives and directional derivatives.	C1
Identify the gradient as - Direction of maximum variation of the function, or, - Moments of no change (contour lines).	C1, C2
Set out different exercises in which they have to use the gradient vector, directional derivatives. In each case, represent the corresponding contour lines.	C2, C3
Recognizing function composition and implicit functions.	C1, C2
Identify the types of extrema (maxima and minima) to be calculated and use in each case the appropriate mathematical development.	C1, C2, C3

The study of calculus of two variables is done in the last weeks of teaching of the subject. Specifically, during this academic year 2010-2011, it has been during the weeks 11-15 of the first four-month period.
Since this is the part that has been addressed by PBL, the methodologies for the teaching and learning of Calculus I subject have been different. The first part of the subject has been taught with the traditional methodology through lectures, practical classes and seminars, but in the second one active methodologies have been used, namely PBL.
The traditional way is spread as follows:

- Two hours of weekly lectures.
- A session of one hour practical class per week.
- Four workshops over four non-consecutive weeks of the four-month period.

In the case of active methodologies, for each of the above learning indicators, we have prepared a series of activities that students work individually or in groups of 4 students' tasks. The creation of these groups has been made as follows: in the first part of the subject, which has been provided with traditional methodology, four seminars are scheduled. To perform them, the center has divided students into two groups of 20. Within these subgroups, working groups have created on the basis of proximity in the classroom. These working groups are the ones that have continued in the part of PBL. Moreover, these activities may be face-to-face or not, and most of them are sharing tasks.

4. Results

If we compare the results of two specific problems, the first explained by the traditional method and the second by PBL, one can see a slight improvement in the marks in the second case as shown in the figure below. The average marks of these two problems have been 0.88 and 1.86 respectively.

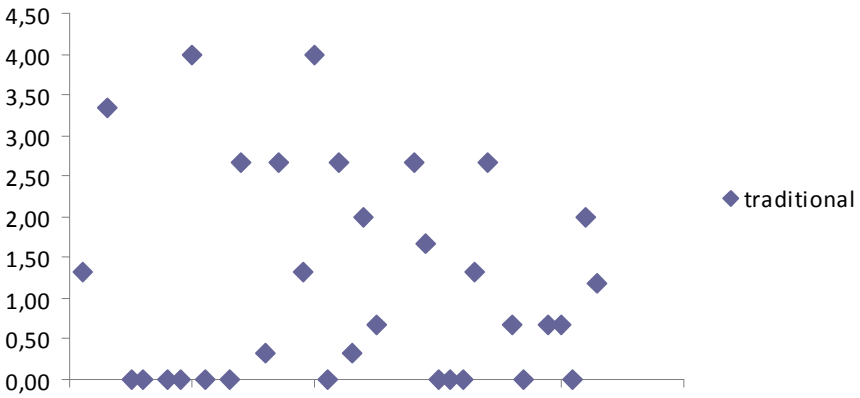

Fig. 1. Marks with the traditional way.

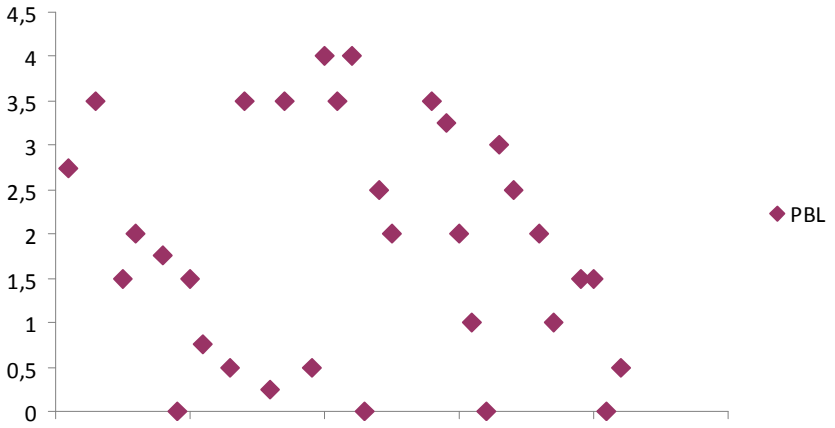

Fig. 2. Marks with PBL.

With regard to the extent that the new methodology has helped students to learn, 68% of students considered that PBL has helped more or equal than the traditional methodology.
With respect to improving the skills of group work, students consider that the active method has helped quite a lot or a lot.

5. Conclusions

Regardless of the methodology used, traditional or active methodologies, it will not succeed if student is not involved in the process of teaching and learning.
Any change raises uncertainty and adaptation in humans, so introducing a new teaching-learning methodology is, at the beginning for the students, a very high cost, which often is not willing to make. To encourage involvement, we must assess it in some way.
The involvement of students in active methodologies is greater, resulting in transfer of ideas and discussions that can help achieve the learning indicators with a more solid basis.
We encountered an increased interest of students to start the PBL. Class attendance is maintained until the end around 96%.
Working in groups is highly valued, but demand more time for the group activities.
Students are not used to read and understand sentences that are not direct, so PBL is a lot of effort outside of classroom that student is not willing to make.

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