EXPERIMENT WITH PERSONAL RESPONSE DEVICES
Advantages and Drawbacks Identified in Engineering Studies

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Abstract: This work presents the main results and conclusions drawn from a teaching experiment, in the studies of Mechanical Engineering from the Polytechnic School of Córdoba University (Spain), in the 2010 to 2011 course. This experiment was to use extensively, in one of the theory groups, an interactive system based on personal response devices. The main purpose of the meeting was to compare the results with other group in which the system was not used. Also we wanted to know the opinion of the teachers and students participating in this experiment. In this way we could know both the advantages and the disadvantages of its implementation, the technical dificulties and if it is a really useful teaching tool. The results can be interesting for teachers and educational supervisors who want to know the advantages and limitations of these systems.

1 INTRODUCTION

The implementation of the European Higher Education Area is a new approach for teaching and assessment methodology, in which the teacher must focus their efforts on value, not only the students' level of knowledge, but also the so-called competences (Goñi, 2005). The acquisition of contents and competences by the students is largely based on activities and teaching methods applied in the classroom throughout the course (Herruzo, 2005). Any action designed to facilitate both the development and evaluation of these tasks will be well received. On the other hand, any face activity requires an active and continued involvement of students. Students can remain neither passive nor non-development of exhibitions and activities proposed. Any resource that encourages the students' participation will be equally well considered.

There are several works related to the personal response devices, also called clickers (Morling 2008, Shaffer 2009). All of them develop experiments about different teaching methodology and indicate the benefits from this technology. This paper is organized as follows. Section 2 indicates the objectives of the experiment. Section 3 presents the main features of the system. In section 4 the experiment is described. Section 5 shows the

assessment of the experiment. Finally we draw some conclusions.

2 OBJECTIVES OF THE EXPERIMENT

The development of this experiment was intended to cover the following main objectives:

Promoting participation. The current reality of university students, at least in the target group of this pilot scheme, is that they are mere spectators of the presentations made by the teacher (Ellis, 2005). The little or no student participation is precisely one of the main complaints of the teachers involved. Therefore, one of the main objectives of this experiment was trying to encourage such participation in classroom activities scheduled.

Continuous assessment facilitators. The teacher need to have the mechanisms that would allow a continuous assessment throughout the course. These tools are not easy to find in traditional methodologies and resources (Waters, 1997).

Improving academic performance. Another objective was to check, in situ, the students content assimilation level in each face to face session. This suggests that the correct implementation could trigger a reasonable improvement of students'

academic performance object of the experiment.

Comparison of the results. Another purpose of this work was an analysis and comparison of the academic results with the group that did not use the system. It was also to detect their main advantages and drawbacks and its outstanding implementation difficulties. This would give an overview about the advisability of its use in courses and related degree programs.

3 MAIN FEATURES OF THE SYSTEM

The teacher asks some questions during the session and the students answer them together using a wireless remote control (clicker) that has been individually assigned. The global answers can be visualized instantly during the session; the individual assignment of each clicker allows a later assessment of the students.

3.1 Advantages

The main advantages of this implantation are:
The increase of attention. According with different researches, the level of student attention shows ups and downs during a typical master class.
The increase in the level of participation. An active participation of the students is needed during the face to face session where different questions are asked and consistent answers are demanded. It is possible to build up some questions with fixed close answers, test the general opinion or open a debate.
The improvement in the withholding of the concepts. It is boosted the withholding of the concepts giving immediately the right answer for each question asked. It also allows the teachers to know the knowledge level about the subject and to decide about if the less successful contents ought to be reinforced or repeated.
Continued assessment. The continued use of the system and the later individually results treatment allows easily to administer the knowledge level and to get competences in a continuous assessment system.

3.2 Difficulties

The main difficulties are:
Considerable initial investment. To carry out an experiment that it is opened to a Degree or a Study Centre, the inversion cost can be higher due to the number of clickers that are needed.

Users need training. The methodology of teaching that is used, to obtain their maximum result as a pedagogical tool, can be complicated. This tool has to be adapted to the every teaching by teachers in their lesson (Barker, 1993).
Logistic control and adaptation to spaces. Classroom with enough equipment and computer supports should be available. A permanent staff for the maintenance and coordinating of the system has to be designated. Its implementation can be a full failure, and all its advantages can be lost, if these risks are not taken into account.

4 DESCRIPTION OF THE EXPERIMENT

As it has been said, a very important aspect that it has to be taken into account for a successful result it is the appropriate training for the teachers involved. In this case, the training had been carried out in several sessions. A first session to inform about the experiment and the resources that are needed to develop it was carried out. Then, others lessons with technical character were developed. In these classes the participants were instructed about the use of the tool, the main advantage, its applications and the possible use during the class.

To obtain the equipment and software for the first implementation, several innovation projects were carried out, both the Polytechnic School of Córdoba University (Spain) and the Vice President for Quality and Innovation at the University of Córdoba provided the financial recourses.

The implementation was carried out, at the beginning, in the first year of the Engineering Mechanical Degree from the Polytechnic School of Córdoba University (Spain) and only in one of the two theoretical lesson groups. In this way, the results obtained could be compared with the blank group, about the same lessons and the same teachers.

To coordinate the results and to make easy the use of the system, an individual assignment was carried out, so each student could use the same remote controller in every lesson, which it allowed to know globally the evolution of learning.

At the end of the year, a survey to the teacher who participated in the experiment was carried out, through an online test that it included questions as general character about the participation, performance or tool's use, as other with a more specific character as the suitability in his interests, kind of use that was did.
In a same way students were pulled. In this case the

test was carried out in a face-to-face way, the interactive controller, what it served to analyze the some of the result there, helped us, it allowed the participation and comments of the audience.

5 ASSESSMENT

In this section, some of the main questions asked in the questionnaires will be presented. Not only those carried out by the teachers, but also the ones directed to the students.

A further analysis will be devoted to the obtained results in the academic field as well as in the other aspects assessed. These results will be compared with those of the other group and the final conclusions will be exposed.

5.1 Questionnaire for Teachers

The questions asked to the teachers participating in the experiment were divided into several blocks, related to methodological aspects, the evaluation criteria applied as well as others which trying to know if the interactive control system served as a tool for evaluation and qualification. The aim was to deduce whether the results were comparable in both groups. Another blocks of questions were focused to find out the goodness or adequacy of the system to the type of subject being dealt with; the difficulties come across for its application in the classroom and the teachers and students general impressions on these tools, as well as some questions related to the satisfaction on the management and coordination during the use of the system.

5.2 Questionnaire for Students

The questions were divided, as in the previous case, in several blocks. The first one the students' impressions about how they were personally affected by the use of the tool from the improving learning viewpoint were analyzed. A second block was focused on the use of the system as evaluation tool and the perception that students had on the usefulness and effectiveness in this evaluation.

Finally, the students' opinion was sought in relation to the use of the tool that the participant teachers had created relation to aspects of coordination, management skills, as well as using it to improve teaching quality in general.

5.3 Analysis of Results

The results obtained in the questionnaires already

mentioned and the views expressed by the participating members enable us to clearly glimpse into the benefits and limitations of using such tools.

They are not as conclusive, however, in the aspect of academic performance, mainly due to the already mentioned constraints, and because only 25% of teachers applied the same criteria for evaluation and teaching methods in both target groups.

In this regard and with the reservations already mentioned, it must be said that only in the subjects in which the system was used as a tool of teaching support, reinforcement of principal ideas, enabling and encouraging student participation, academic performance was significantly higher.

In the cases where it was used as an evaluation tool, the results were very similar or even worse in the target group compared to the blank group.

5.3.1 Analysis of Teacher Survey

The 70% of the teachers used the tool as a means of testing the level of content knowledge and understanding of students or to support and reinforce key ideas, but they did not considered it as an evaluation and rating tool. Practically the total number out of this 70% agreed that students had a good impression on the use of the tool. Moreover, they believed that its use did help the students get a better grade.

A 30% of users stated that students did not perceive it in a positive way and they did not think it helped the students get a better grade in their subject.

A 25% believed that it was difficult to adapt the use of interactive controls to their commonly used teaching methodology, another 15% did not find it very difficult and the remaining 60% considered it easy or very easy. All in all, the 100% were interested in using it again in future.

5.3.2 Analysis of Student Survey

Nearly 100% of the students appreciated the use of new technologies by the teachers. However, approximately 40% had poor or very poor impression on the use of clickers, 50% did not have a very clear idea on the issue and only 10% considered it good or very good. Their further arguments were that they were reluctant to be constantly evaluated or graded, as they seemed to understand when using the clickers regularly.

On the other hand, over 75% of them believed that the use of the controls forced them to be more attentive and participative in class and also it

allowed them to refresh and set key ideas.

However 60% did not think it favored the process of learning, which is contradictory with the previous statement. Once discussed these result with the students, they believed that teachers in general had failed to properly integrate the tool in the teaching methodology of the subjects. In fact, one question focused specifically on whether teachers need better preparation as well as coordination to unify criteria and the vast majority, over 85%, thought so.

Nearly 80% stated that they would have got better grades if they had not used the system of controls and that they preferred the use of controls not as an evaluation tool, but as tool to support teaching.

To sum up:

- The students' perception is that the teachers have failed to properly integrate the tool and adapt it successfully to their methodology.
- While recognizing that the use of controls has forced them to be more attentive and participatory and even has helped them retain the key concepts, they do not like the idea of being constantly evaluated.
- They reject the use of controls as an assessment tool, substituting the traditional methods. In fact, they are convinced that they would have obtained better grades without the use of the system.
- Finally, they consider their teachers need more preparation and coordination for proper use of the system.

6 CONCLUSIONS

It is not easy to establish definitive conclusions by comparing the results between the two groups studied, especially regarding academic issues.

The main conclusions are:

- This type of interactive tools, like any others, require proper training to be used by teachers, not just technical but also methodological and adjustment to each subject (Salinas, 2004).
- Its usefulness is demonstrated as a catalyst, encouraging the participation of students and their activation in the face to face sessions.
- It is a tool that improves content retention as well as key ideas.
- Clearly, if the equipment is used only as an evaluation tool, the perception of students is not satisfactory, creating a rejection that cripples its methodological qualities.

Therefore, it appears not to be used as a substitute for conventional evaluation tools, but as a complement to them.
- Despite the difficulties in the implementation of any system for the first time, virtually all of the teachers would like to reuse it in future times, which shows its good sense in this group.
- The students, meanwhile, only show a high degree of satisfaction and they want to use it when the system is used purely for educational purposes and not as an evaluation tool.
- This tool has a great potential in the improving of methodological and didactic aspects. It is easily adaptable to most subjects and contents and it can be integrated and extended without too much effort to a whole Course, Degree Program or Study Centre.

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