Continuous assessment strategies as a way to motivate students in Technology careers

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Estrategias de evaluación continua como forma de motivar a los estudiantes en las carreras tecnológicas

Estratègies d'avaluació contínua com a forma de motivar els estudiants a les carreres tecnològiques

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ABSTRACT

Society demands that new strategies for learning processes put a greater focus on the students. Thus, new methods must be implemented in higher education studies, leaving guided learning, which is evaluated at the end of the course. The high percentage of abandonment of university studies calls for the implementation of teaching systems in which students are the main actors of the learning processes, under the guidance of the faculty. Moreover, a continuous assessment of students would help to increase student motivation by the continuous feedback of their effort as the course is underway. This work collects the results of different experiences carried out in three different degrees in the University of Seville (Mechanical Engineering, Chemistry and Materials Engineering). These experiences follow a methodology based on case studies, which finally motivated students in every course analysed and promoted the obtainment of higher marks.

Keywords: guided learning; motivation; feedback; assessment

RESUMEN:

Cada vez más se exige que las nuevas estrategias para los procesos de aprendizaje pongan un mayor enfoque en los estudiantes. Así, se deben implementar nuevos métodos en los estudios de educación superior que empleen alternativas a la evaluación final. Por otra parte, el alto porcentaje de abandono de los estudios universitarios exige la implementación de sistemas de enseñanza en los que los estudiantes sean los principales actores de los procesos de aprendizaje, donde el profesor actúe de guía. Además, una evaluación continua de los estudiantes ayudaría a aumentar la motivación de los mismos mediante la retroalimentación continua de su esfuerzo a medida que avanza el curso. Este trabajo recoge los resultados de diferentes experiencias llevadas a cabo en tres Grados de la Universidad de Sevilla (Ingeniería Mecánica, Química e Ingeniería de Materiales). Estas experiencias siguen una metodología basada en estudios de casos, que finalmente motivaron a los estudiantes en los cursos donde se aplicó, donde además condujo a mejores calificaciones.

Palabras clave: Aprendizaje guiado, motivación, retroalimentación, evaluación

RESUM:

Cada vegada més s'exigeix que les noves estratègies per als processos d'aprenentatge posin un enfocament més gran en els estudiants. Així, s'han d'implementar nous mètodes als estudis d'educació superior que facin servir alternatives a l'avaluació final. D'altra banda, l'alt

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percentatge d'abandonament dels estudis universitaris exigeix la implementació de sistemes d'ensenyament en què els estudiants siguin els actors principals dels processos d'aprenentatge, on el professor actuï de guia. A més, una avaluació continuada dels estudiants ajudaria a augmentar la motivació dels mateixos mitjançant la retroalimentació contínua del seu esforç a mesura que avança el curs. Aquest treball recull els resultats de diferents experiències dutes a terme a tres Graus de la Universitat de Sevilla (Enginyeria Mecànica, Química i Enginyeria de Materials). Aquestes experiències segueixen una metodologia basada en estudis de casos, que finalment van motivar els estudiants als cursos on es va aplicar, on a més va conduir a millors qualificacions.

Paraules clau: Aprenentatge guiat, motivació, retroalimentació, evaluació

1. INTRODUCTION

Education has changed over the last decades. In traditional education, the main player of the educational process is the faculty, who is considered to be the sole bearer and guarantor of knowledge. In this case, the faculty-student communication pathways established in the classroom are unidirectional (Al-Qahtani and Higgins 2013; Mazoue 2013). Thus, in traditional education, faculty members teach masterclasses (or lectures) that consist of a dissertation on a topic in front of students who listen passively, take notes and, at some point, intervene when they are asked by the faculty member (Lunenberg and Korthagen 2009). This educational perspective does not seem to respond to the current social demands and, moreover, it is not in agreement with the principles established to develop the high-level skills and knowledge that are present in the current educational models throughout the European Higher Education Area (EHEA, based on the development of competences) (Ríos et al. 2010). University careers must not ignore this context and therefore faculty members should reconsider their current role in higher education, and adapt the learning process to these new tendencies (Niculcara et al. 2009; Johannes et al. 2011; Griffin et al. 2012). To overcome this challenge, faculty members must significantly change points of view related to pedagogical, epistemological and psychosocial areas with the aim of implementing new teaching strategies that will eventually improve student motivation (Pintrich and De Groot 2003). More specifically, Fernández-González (Fernández González 2013) indicated that science education in scientific-technical careers represents a real challenge for faculty members, who hardly succeed in student motivation (Fernández González 2013; McNeil et al. 2019). Therefore, the importance of seeking alternatives to traditional methods by the use of innovative teaching methods that allow greater motivation in the student is key to succeed in the current challenges of our society (Unesco and United Nations Educational Scientific and Cultural Organization 2015). Among the different existing learning methodologies, those that allow students to play an active role in their learning stand out. In this group, we find those in which the student becomes an intentional and reflective learner who acquires concepts and skills by observation and repetition (Prados et al., 2014). New student-centred methodologies empower students so that they are able to think critically and to learn to work in a group solving problems collectively (Neo and Kian 2003). In active learning, accordingly, students become active subjects who actively listen, think, ask, suggest, propose, decide, act, seek and express their ideas and concerns. In this context, faculty members act as guides or facilitators of their learning processes, showing available tools and teaching key concepts (Assessment Reform Group 2005). Thus, according to the UNESCO report (UNESCO 2014), learning is more effective when students achieve their objectives through the following types of learning (from most to least important): participatory, collaborative and problem-based. This active methodology is especially recommended in fields such as engineering and scientific areas due to their applied character (ChanLin 2008). Many authors have shown the importance of continuous assessment in higher education (Trotter 2006; Francisco Márquez Vázquez et al. 2008; Mohr et al. 2013; González-Campos et al. 2018). This method allows for the interrelated continuous learning, which involves greater student participation and interaction with the field of study Different strategies have been proposed, such as that described by Nistal (Nistal 2012), who implemented a method where students had to carry out and deliver content-consolidation exercises throughout the course. Moreover, Niculcara (Niculcara et al. 2009) proposed various real simulations where students had to solve scheduled tasks, providing continuous feedback to the students. Most of these authors agree that this type of evaluation generates a greater teaching load, in some cases becoming incompatible with the rest of teaching and research activities that faculty members must carry out (Trotter 2006; Niculcara et al. 2009; Nistal 2012). Consequently, it is necessary to search for a methodology that allows a continuous assessment of the students, increasing their motivation and without assuming an excessive teaching load.

This work presents the application of an experience carried out in three different degrees (Mechanical Engineering, Chemistry and Materials Engineering) in the University of Seville, in Spain. The methodology followed was based on the resolution of real problems associated with the analysed degrees, promoting the continuous learning process of the participating students.

2. METHODOLOGY

Active learning was used as a methodology in the present study, placing the students as the main engine of their learning process, acquiring a leading role. This type of strategy has already been shown to be adequate in bachelor and master's degrees due to the maturity and greater autonomy that these students have compared to those in pre-university education (Ruiz, 2006).

Furthermore, a fundamental aspect of this methodology is based on promoting the motivation of both the students and the faculty involved, in order to reinforce the teaching-learning process (Bacete and Betoret, 2000).

Thus, in the present study, students of three different subjects from different degrees of the University of Seville underwent an alternative assessment, consisting in an active learning. These three subjects were: General Chemistry (40 students in the first course of the degree in Mechanical Engineering), Project Management (30 students in the fourth course of the degree in Chemistry) and Biomaterials (40 students in the third course in the degree in Materials Engineering). This alternative assessment involved voluntary participation in a series of proposed activities. Therefore, instead of simply conducting the traditional assessment by taking a single final exam at the end of the course, an alternative evaluation was continually developed, consisting of the development of different practical cases involved with the part of the subject that was being developed at this moment. The latter allowed students to be continually evaluated through a series of tests that were conducted during the course and two partial exams which offered the chance of passing the course without attending the final exam. This active methodology was explained by the teacher during the presentation day of the subject and the students could choose this continuous assessment as long as they fulfilled the following requirements:

i) having a grade of "Average" in all the tests prior to each partial examination and
ii) having attended 80% of the classes.

These requirements were applied in order to promote a real interest of students in the subject taught in the course, as well as to increase the number of tutoring queries carried out by the students enrolled in the proposed assessment. Furthermore, the faculty members were also expected to increase their motivation due to the greater active participation of the students in the class, leading to an increase in student performance. At this point, it is interesting to mention that several methodologies had been used previously, which aimed to reduce students' absenteeism at post-compulsory levels, as well as to encourage their continuous work, without satisfactory results. The evaluation of the proposed activity was carried out through a satisfaction survey to be completed by the students enrolled, as well as through an analysis of the qualifications obtained by two population samples: students who followed the alternative evaluation and those who did not. The analysis of the results was carried out considering the characteristics of both populations, as well as the percentage of success of each of them.

Finally, it should be noted that the proposed methodology aims to respond to the diversity of students using this active assessment, as well as performing a more personalized follow-up of the students. Both requirements are in accordance with the demands recently provided by UNESCO (Elfert, 2017).

3. RESULTS

The continuous assessment methodology may have more harm than benefits by undermining the motivation of both students and faculty members, who can see that their respective efforts are in vain (Alfalla-Luque et al., 2011). Considering this, the tasks proposed were voluntary, resulting in a high percentage of participation. Thus, Figure 1A shows the percentage of participation in the proposed methodology in the different University degrees evaluated in the present study (Mechanical Engineering, Chemistry and Materials Engineering).

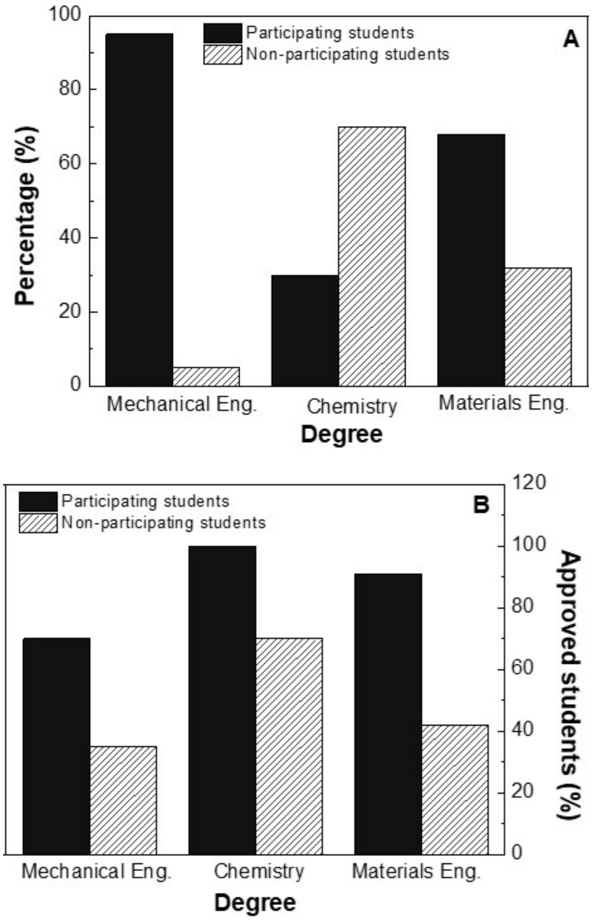

Figure 1: *(A) Participation percentage and (B) pass percentage according to participation or not participation in the activity.*

The percentage of participation changed considerably depending on the degree where it was applied. Thus, the participation percentage in Engineering degrees (mechanical: 95% and materials: 68%) was considerably higher than in the degree in Chemistry (30%). This difference could be due to the course in which the methodology was carried out. In this way, in the degree in Mechanical Engineering, the experience was carried out in the General Chemistry subject, which is taught in the first semester of the first course. In this case, students are more used to guided learning (more typical in compulsory levels and high school). Thus, the predisposition to this type of experience could be easier for students eager to adapt to the University courses. In the degree of Materials Engineering, the experience was carried out in the subject Biomaterials (third year), with a significantly lower acceptance from the students. At that point, students are more mature, and they are more accustomed to more independent learning processes, where the role of the faculty as the main engine of learning is less prominent. This fact is reflected by a greater extent in the Chemistry students, who were studying the subject Project Management, which is taught in the last year of the degree, with an even lower participation percentage. In this sense, some authors have already pointed out that students have greater independence in their learning process in post-compulsory levels. Thus, they are responsible for their own progress (Hills, 1976). Another interesting fact to consider is that Engineering students are more likely to use the proposed methodology than Chemistry students, where the participation was considerably lower, being inferior to the non-participation response. This could be explained by the fact that students are given more freedom to develop their knowledge in scientific degrees than in engineering degrees, where education is more governed by standards (Cornejo et al., 2012).

However, the greater participation in the continuous assessment activities did not necessarily imply a greater percentage of approved students. Therefore, the relationship between the percentage of students who passed the subject and those who participated in the alternative methodology through the proposed activities was analyzed (Figure 1B). As can be seen, the percentage of students that passed the subject is clearly higher among the students who participated in the proposed activities in every degree considered. Thus, a positive difference between the percentage of approved students and that of failed students of 36, 30 and 50% was detected in Mechanical Engineering and in Chemistry and Materials Engineering, respectively. These results could support the hypothesis that students who followed the proposed methodology had a higher success rate. However, this analysis fails to explain the reasons why these students had a higher success rate. So, this success could not be attributed solely to the used methodology, as other factors should be considered. At this point, the presumably greater responsibility of the students that voluntarily decided to enrol in the alternative methodology should not be disregarded. Their greater care for the learning processes led to their initial participation in the activity but also derived in a higher workload at home, which finally could explain the higher success rate. It could be concluded that students who have good study habits participate more in the activity, and that common characteristic could also contribute to the detected higher success rate, regardless of their participation in the activity (Pérez and Barberis, 2005). Therefore, in order to establish a relationship between the participants in the activity and the approval to failing rate, the participation and the successful student percentages was determined. Thus, 85.0 ± 14.5 of those who participated in the proposed methodology passed the subject, while 52.0 ± 17.5 of the non-participants succeeded. These results indicate that there is a direct relationship between participation in the activity and the higher number of approved students. Anyway, the percentage of participation depends on the analyzed degree, as it is reflected by the high standard deviation value. This relationship has already been found in other strategies, where problems have been used to increase the understanding of the subject using a problem-based methodology (Sobek and Jain, 2004).

On the other hand, Figure 2 shows the approval percentage of each of the preliminary tests that took place prior to the partial exams, which were graded simply as pass/fail. This analysis will help to further analyze the commitment of the students to the proposed activity. As can be observed, the percentage of passing students in each of the tests is quite high in all the degrees considered, being 100% in the degree in Chemistry. As was previously mentioned, this percentage difference could be due to the fact that the students in the last year of the degree in Chemistry are more mature, which could lead to a greater commitment, despite the fact that the participation rate in the alternative evaluation was lower. In addition, it should be mentioned that, as the activity is inclusive, the students who failed those preliminary tests could still pursue the partial evaluation. However, they were asked to solve personalized problems as extra homework based on the errors detected in those tests for analysis and subsequent delivery to the faculty. In this way, it was intended to meet one of the goals of the present study, that is, the continuous monitoring of the subject by the students throughout the course, without separating them from the continuous learning process. Nevertheless, it is necessary to analyze the results of the approval percentages obtained together with the results obtained in previous courses where this methodology was not implemented. In this sense, the average percentage of the passing students in the previous course was 42 %, which is lower than that of the course where the study took place, thus, it seems there may be a relationship between participation in the activity and the passing rate. Nevertheless, this behaviour could be due to other external factors.

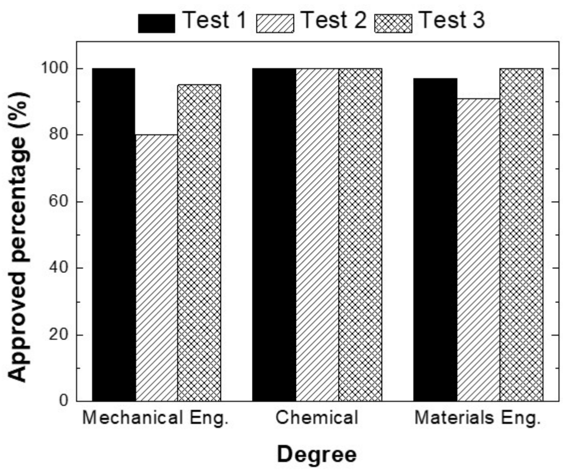

Figure 2: Percentage of passing students in every preliminary test.

Finally, Figure 3 shows the score obtained based on participating (A) and non-participating (B) students in the feedback questionnaire in order to assess the perception of the contribution of the proposed methodology to student motivation. The questions were:

(1) did you find the continuous assessment interesting?
(2) Did you feel more motivated to learn the subject?
(3) Do you consider this methodology to be useful?
(4) Would you like this methodology to be replicated in further subjects?
(5) Overall rating of the followed methodology

According to the data shown in Figure 3, the A students who participated in the activity found it positive, as it helped them to follow the subject up. In addition, they would participate in it again. On the contrary, the B students who did not enrol in the continuous assessment tasks probably did not do so because they did not initially find the activity interesting and it did not help them to pass the course. However, at this point it should be noted that the highest scores were obtained for the overall qualification (5) and the replication of the methodology in further subjects (4), indicating that some of these students would be willing to participate in it in future years. It is noteworthy highlighting the fact that question 3 obtained a high score for the Chemistry and Materials Engineering students, which could confirm that, due to the maturity of these students, even if they consider the activity useful, they probably did not participate in it because they are more used to another type of learning since they were students closer to the end of their degree studies and experiences like these are commonly scarce in those degrees.

4. CONCLUSIONS

According to the results obtained in this study, it can be affirmed that there are alternative strategies that can help to increase the participation and motivation of the students in the teaching-learning process at the university level. Thus, a large number of students voluntarily followed this active learning methodology based on continuous work to cultivate the required competencies and skills, which eventually led to the greater performance. However, it should be noted that students who are more accustomed to guided learning are more open to this type of experience. Nevertheless, the performance of the proposed activity had a generally positive evaluation by the participating students, while non-participating students did not discard future participation in similar teaching strategies.

5. DATA AVAILABILITY

All data included in this manuscript that support the findings of this study are available from the corresponding author upon reasonable request.

6. ACKNOWLEDGMENT

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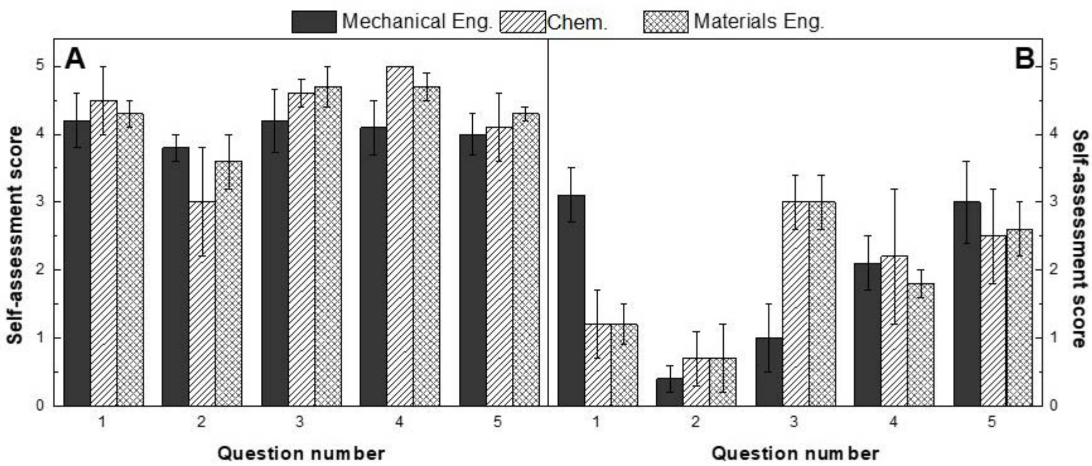

Figure 3: Scores obtained in the feedback questionnaire of participating students (A) and non-participating students (B).

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