

# SUCCESS ON INCREASING NUMBER OF STUDENTS THAT PASS THE COASTAL ENGINEERING SUBJECT

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## Abstract

Spanish universities are currently undergoing an educational transition that implies significant changes in learning and teaching methodologies, in compliance with the European Higher Education Area (EHEA). Within this phase, the use of information and communication technologies (ICT) provides the opportunity to enhance student performance and improve academic assessment. An experimental procedure has been implemented within the Coastal Engineering course (Sea Sciences Faculty) to decrease academic failure (to date, 25% of no-show and 35% of fails), and to allow students to achieve better grades. During the last academic year, students were encouraged to follow a new learning plan based on coursework performance, the duration of which was similar to the theoretical lessons, i.e., two hours a week. Assignments were not mandatory, and they only represented 10% of the final mark. Weekly homework was directly related to the main aspects of the theoretical lessons, and included practical exercises as well as research of particular cases about the topics explained in class. Hence, in addition to improving students' knowledge of the subject by encouraging them through the possibility of increasing their final grades, this method also supports the application of cross competencies that allow students to:

- a) check their learning progress;
- b) introduce them to e-learning;
- c) learn complementary concepts of scientific research by using e-databases;
- d) refresh and update the theoretical concepts provided during the live lectures;
- e) add new teaching material to enhance the comprehension and study of the subject;
- f) think for themselves by becoming autonomous when the course is over.

Despite representing only a low percentage of the final mark, a complete dedication of the students was achieved. This experience resulted in 97.4% of the students successfully passing the final exam, thus achieving better grades.

Keywords: student assessment, learning feedback, course final grades, cross competencies, coursework.

## 1 INTRODUCTION

Spain is going through a transitional period as far as academic plans are concerned, changing the university degree structure to comply with the new European Higher Education Area (EHEA). The main purpose of the EHEA is to improve international competitiveness of the European Union universities. The university community should jointly establish good practices and values that guarantee the quality of higher education.

The adaptation of university degrees to the new EHEA framework requires all Andalusian universities to improve their quality because of the introduction of internal and external assessment mechanisms, as well as European criteria and guidelines [1]. The project of a European Common University means that along with a rational organisation and an international recognition of the studies, there should be a change in the educational methodologies. This change to the educational paradigm must focus on the substitution of excessively theoretical teaching by an active education, and must rest on more practical training

and education as well as the use of new technologies [2]. Thus, the EHEA emphasises student involvement in the learning process [3].

In the EHEA field, didactic planning for subjects should be performed based on an innovative model in which procedures, teaching methods, and the assessment system are integrated according to the aims and competencies to be achieved. The main teaching and learning methods that have been used in innovation experiences have been: main lecture, exercises and problem-solving, case studies, problem-based learning, and guided material. This makes students more involved in the teaching/learning process, creating critical minds that allow them to improve their training, and to think about the world around them [4].

All of the Spanish universities, to a greater or lesser extent, try to implement information and communication technologies (ICT) into university teaching in order to improve the teaching/learning process. Hence, the role of ICT is to encourage students to look for resources themselves, and to try new working methodologies through ICT [5]. As a result, the process of European convergence has prompted the implementation of teaching methodologies focused on students' autonomous work [6].

Black and Williams's [7] comprehensive review of formative assessment emphasises the extraordinarily large and consistent positive effects that feedback has on learning compared with other aspects of teaching. It is proven that students tend to earn higher grades on coursework assignments than on examinations, which predicts long-term learning better from coursework than from final exams [8]. Students consider coursework to be more fair than exams, because it measures a greater range of abilities, and allows students to organise their own work patterns to a greater extent [9].

## **1.1 Students in the Coastal Engineering course**

The Coastal Engineering course is included in the third year of the Sea Sciences degree at the Faculty of Marine and Environmental Sciences in Puerto Real (Cadiz, Spain). The degree in Sea Sciences is focused on students who intend to have multidisciplinary training. Therefore, subjects based on mathematics, statistics, chemistry, applied physics, biology, geology and other subjects related to environmental technologies are included in the students' performance. However, there is a lack of engineering knowledge in the marine-terrestrial field, despite the fact that the province of Cadiz invests large amount of money on the coast, the beach, and dune system maintenance [10] [11] [12]. Hence, the Coastal Engineering course is aimed at the Sea Sciences students, providing them a basic engineering approach to the problems generated by waves and their possible solutions. The teaching modules are: basic hydrodynamics; small amplitude waves and other waves; extreme wave analysis and spectral description; wave diffraction, reflection and refraction; sediment transport and wave breaking, numerical models and laboratory models; maritime works; and finally beach nourishment activities. Hence, as these activities are directly related to the solution of real problems, the Coastal Engineering course requires the students' active participation both in the classroom and outside of it.

During the last ten years, the ratio of students that did not take the final exam in Coastal Engineering at the University of Cadiz was 1/4 of the total number of enrolled students. Furthermore, the ratio of students who did not pass the final examination was more than 1/3. Hence, approximately 1/2 of the total number of students successfully passed the exam. This fact demonstrates that in practice, students are not encouraged to look for relating ideas, broad principles, or functioning knowledge [13].

Consistent with Vilanova and Ponsa [14], the main contribution of this paper is instruction based on real experiences, and how the development of appropriate feedback channels can lead to improved academic results. In order to improve students' grades, a working procedure hypothesis was implemented based on an innovative learning plan. By the implementation of cross competencies through the application of ICT, students were encouraged to expand their knowledge of the subject, with the possibility of improving their final mark.

## 2 METHODOLOGY

One of the contexts where teaching innovation experience is developed, is based on problem-based learning, which ensures that students in groups, independently, and guided by the teacher, find the answer to a question or problem. Hence, achieving it means having to find, understand, and integrate basic concepts of the subject [15].

To enhance student interest and engagement towards the subject, a learning method based on encouraging students through the ability to increase their final grades by 10% was implemented. This procedure suggested that students complete some of the exercises at home each week. This coursework should have a similar duration to that of the theoretical lessons, i.e., two hours a week. These assignments are not mandatory, but provide the opportunity to study and assimilate the subject concurrently with the theoretical classes. They are focused on the need for a continuous effort and personalised monitoring, as autonomous learning requires. Weekly homework is directly related to the main aspects of the theoretical lessons, and practical exercises as well as research of particular cases about the topics explained class. During the class that follows, any possible questions based on the exercises are clarified.

This methodology allows the students not only to increase their knowledge of the subject because of their motivation to possibly improve their grades, but also allows the university and the professor to apply some transversal competencies within the subject. So far, this is not commonly done, but is enormously useful when the aim is to ensure the students' training in those skills to be used throughout their undergraduate studies.

For approximately a decade, the support of information and communication technologies (ICT) within the European schools and universities is one of the priorities of government education policy. This policy has been stimulated and guided by the e-Europe action (<http://ec.europa.eu/education/policy/higher-education/>) for the development of an information society, and particularly by the e-Learning program, adopted at the Lisbon meeting in 2000 by the European Union [16].

By using ICT, the professor has the ability to add new teaching materials to enhance the comprehension and study of the subject; while students are able to check their learning progress, learn complementary concepts of scientific research by using e-databases, introduce themselves to e-learning, as well as refresh and update the theoretical concepts provided during the live lectures [17]. As a result, one of the goals of the EHEA is achieved: for students to become more autonomous after their educational experience.

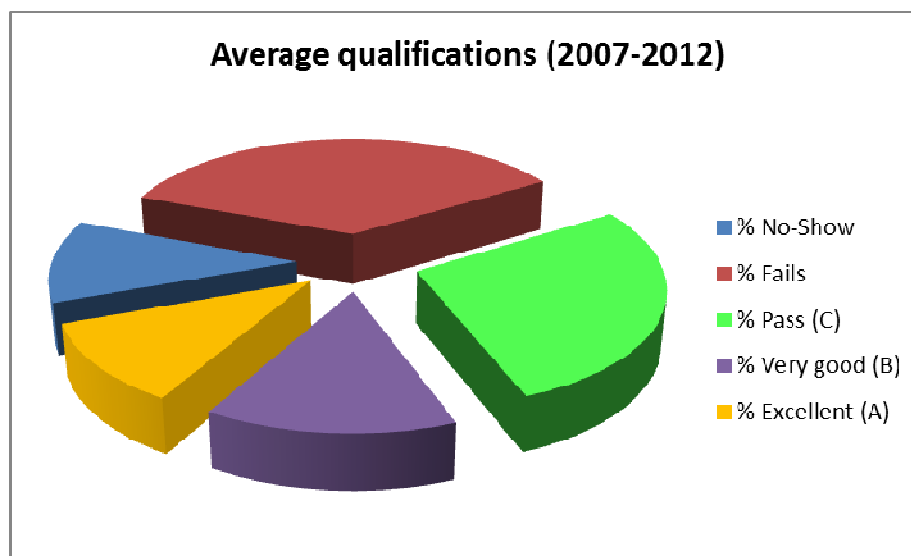
## 3 RESULTS AND DISCUSSION

The effects of the application of this methodology has been analysed by comparing the results obtained in the last academic year (2012-2013), and those of the previous five years. Therefore, the number of enrolled students, no-shows, fails, and passes are shown in Table 1.

**Table 1.** Number and percentage of students who failed or passed the final exam in the subject of Coastal Engineering from 2007 to 2013.

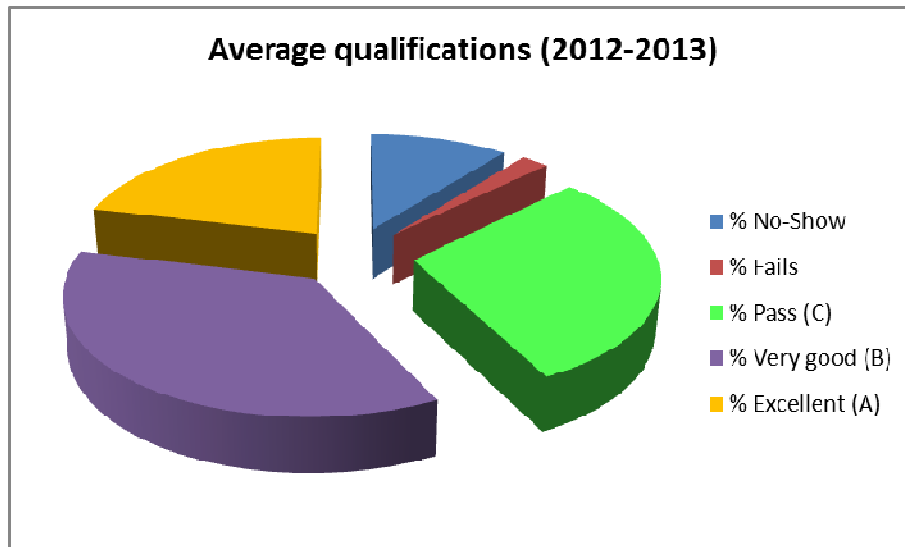
Academic year	Enrolled students	No-show	% No-Show	Fails (D)	% Fails	Total Pass	% Total Pass
2007-2008	140	114	81.4	26	18.6	95	67.9
2008-2009	211	12	5.7	122	57.8	77	36.5
2009-2010	122	12	9.8	70	57.4	40	32.8
2010-2011	142	16	11.3	42	29.6	84	59.2
2011-2012	121	20	16.5	17	14.0	84	69.4
<b>Average 2007-2012</b>	147.2	34.8	24.9	55.4	35.5	76.0	53.1

The results from Table 1 show that the average of the enrolled students during the last five academic years has been of 147, and the percentage of students that failed the subject was 35.5%. From 2007 to 2012 the total percentage of students who passed the final exam ranged between 32.8% and 69.4% (Figure 1), showing a relative increase of 10.2% in the number of students that passed the final exam from 2011 to 2012. This slight improvement on the students' grades may be influenced by the fact that during the academic year 2011-2012, a specific book, *Regular waves* [18], written by the professor of the Coastal Engineering subject, was applied as a useful tool to enhance the students' learning because it also included great number of exercises with solutions provided. Thus, students had the opportunity to attend the classes with the material provided, without needing to take notes on all the topics. In addition, the book was totally designed for the Coastal Engineering students of the Sea Sciences degree, including all the theoretical explanations and mathematical equations properly detailed.



**Figure 1.** Average qualifications before applying the method (2007-2012).

In addition to this significant step, after the application of the aforementioned new methodology, an important increase in the percentage of students that passed the final exam has been achieved. In the academic year 2012-2013, 87.2% of the enrolled students successfully exceeded the passing grade threshold, with only 2.1% failing. Positive results are evident during this last phase among students who take the final exam, while the percentage of no-show students remains relatively constant, when comparing the last academic year with the averaged five year research period (10.6% vs. 11.4%). Thus, the total number of students who have passed during 2012-2013 has increased by 64% in relation to the average of those previous five years (Figure 2).



**Figure 2.** Average qualifications after applying the new learning method (2012-2013).

**Table 2.** Qualifications of the students who passed the final exam in the Coastal Engineering course from 2007 to 2013.

Academic year	Enrolled students	Pass (C)	% Pass	Very Good (B)	% Very Good	Excellent (A)	% Excellent
2007-2008	140	58	61.1	29	30.5	8	8.4
2008-2009	211	56	72.7	20	26.0	1	1.3
2009-2010	122	26	65.0	13	32.5	1	2.5
2010-2011	142	51	60.7	17	20.2	16	19.0
2011-2012	121	17	20.2	22	26.2	45	53.6
<b>Average 2007-2012</b>	147.2	41.6	55.9	20.2	27.1	14.2	17.0
<b>2012-2013</b>	47	14	34.1	17	41.5	10	24.4

Within this percentage of students who passed the final exam, most of them obtained better grades with “very good” (+255%) and “excellent” (+192%) qualifications, as can be seen in Table 2. However, the most interesting aspect after the application of these new techniques has been the great decrease of students who did not pass the exam, falling from 35.5% to 2.1%.

## CONCLUSION

Despite representing a low percentage of the final grades, a complete dedication of the students was achieved by applying a feedback methodology through coursework tasks. After the application of this procedure during the last academic year, 97.4% of the students successfully passed the final exam, and the ones that passed the subject obtained better marks. Thus, what started with a simple incentive, ended up with the achievement and implementation of various cross competencies that enabled students to become more autonomous.

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