

Adaptation experiences to the European Higher Education Area at the School of Design Engineering

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Abstract — Next academic year, new Bachelor degrees designed according to the European Higher Education Area (EHEA) shall be implemented in all the European Universities. As a first stage towards the implementation of these new degrees, the School of Design Engineering (ETSID) of the Polytechnic University of Valencia (Spain) has undertaken, during this academic year, the development of pilot experiences in the first year of its current Bachelor Engineering (BEng) degrees in Electronic Engineering and Mechanical Engineering.

The guidelines of these pilot experiences have been defined in accordance with the EHEA approaches: to organise courses into different subject matters; to implement a new teaching-learning system, based on competences acquisition using active learning methodologies and formative assessment; to design an academic calendar consistent with these assessment strategies; to implement an individual curricular evaluation at the end of the year; to prepare a learning contract whereby students take the responsibility for their own learning.

The design and implementation processes of these pilot experiences are initially described. Then, an analysis of the results obtained so far in these innovative groups for the adaptation to the EHEA is performed. This study reveals that academic achievement together with dropout rate of these groups are improved when compared to the results that are traditionally obtained in the first year of these BEng degrees currently offered at ETSID.

Index Terms — European Higher Education Area (EHEA), active learning, formative assessment

INTRODUCTION

These last years, European Universities have undertaken several reforms within the framework of the Bologna process [1,2], aiming at creating a European Higher Education Area (EHEA), with degree programmes based on profile, learning outcomes, competences and student workload [3,4]. Next academic year 2010/2011, new Bachelor degrees designed according to the Bologna requirements shall be implemented in all the European Universities.

As a first stage towards the implementation of these new degrees, the School of Design Engineering (ETSID) of the Polytechnic University of Valencia (Spain) has undertaken, during academic year 2009/2010, the development of pilot experiences to adapt its Bachelor Engineering (BEng) degrees to the EHEA model. Such innovative experiences have been performed in the first year of the BEng in Electronic Engineering and the BEng in Mechanical Engineering, currently offered at ETSID.

In order to fit the educational requirements of the EHEA system to improve knowledge, abilities and competences acquisition of students, these pilot experiences have been designed according to the following main objectives:

1. Implementation of a new learning system process based on the use of student-centred teaching, learning and assessment approaches.
2. To enhance horizontal coordination of this course by reorganising its subjects contents.

This work provides a detailed analysis of the design and implementation processes of the pilot experiences developed for EHEA adaptation in the first year of the BEng in Electronic Engineering and the BEng in Mechanical Engineering at ETSID, as well as the results obtained so far within these innovative experiences.

DESCRIPTION OF THE STUDY

Design and development of these innovative experiences have been carried out by two Commissions that are formed by the teachers who are responsible of the first course subjects of the current BEng degrees in Electronic Engineering and Mechanical Engineering at ETSID, respectively. In order to design and plan the implementation of these pilot experiences, meetings of both Commissions were periodically organised from March to July 2009, when the inscription of new students has taken place at ETSID.

The guidelines of these pilot experiences have been defined in accordance with the following EHEA approaches:

- To organise courses into different **subject matters**. In particular, the Mathematics and Physics related subjects of the first course of the current BEng degrees in Electronic Engineering and Mechanical Engineering were grouped into a single annual subject matter named as “Mathematics” and “Physics”, respectively. This has implied a better organisation of the contents of both subject matters, and hence the improvement of horizontal coordination of the course. The rest of the subjects conform by themselves a subject matter.
- To implement a new teaching-learning system based on competences acquisition using **active learning methodologies** that promote dynamic learning and autonomous and responsible work of students, such as cooperative work, problem-based learning, etc [4-6]. In order to facilitate an adequate implementation of these methodologies, a new schedule has been specifically designed for each one of these Pilot Groups. Teaching hours of each subject matter have been distributed in these schedules in accordance with the didactic methodologies employed in each one of them. For instance, for “Mathematics” and “Physics” subject matters, sessions with theoretical activities have been grouped at the beginning of the week and those with practical activities have been programmed at the end of the week (Figure 1).

	Monday	Tuesday	Wednesday	Thursday		Friday	
8:00-8:30							
8:30-9:00				Physics B	Computing (1)		
9:00-9:30	Engineering Design	Mathematics	Mathematics		Materials (2)	Mathematics A	Mathematics B
9:30-10:00					A		
10:00-10:30							
10:30-11:00							
11:00-11:30				Physics A	Computing (1)	Mathematics A	Mathematics B
11:30-12:00	Engineering Design	Computing (1)	Physics		Materials (2)		
12:00-12:30		Materials (2)			B		
12:30-13:00							
13:00-13:30			Chemistry (1)	Tutorship		Chemistry (1) English (2)	
13:30-14:00	Physics	Tutorship	English (2)				
14:00-14:30							

FIGURE 1

ANNUAL SCHEDULE OF THE PILOT GROUP OF THE BENG IN MECHANICAL ENGINEERING
(STUDENTS ARE DIVIDED INTO TWO GROUPS -A AND B- FOR PRACTICAL SESSIONS)
(1) FIRST SEMESTER SUBJECT MATTERS – (2) SECOND SEMESTER SUBJECT MATTERS

- To implement **formative assessment approaches** in every subject matter, that will take into account both classroom/laboratory activities and autonomous activities, that are performed in such subject matters. Table 1 shows as example, the evaluation methods employed in the Pilot Group of the BEng in Mechanical Engineering, which are similar to those used in the Pilot Group of the BEng in Electronic Engineering.

Evaluation approach	Design Engineering	Physics	Computing	Mathematics	Materials
Written examination		60%	40%	40%	60%
Test			15%	20%	10%
Oral examination					10%
Report	70%	10%		30%	10%
One minute paper			30%		
Diary	20%				
Portfolio		20%			
Project work			10%		
Case work					10%
Data recording (observation checklist, rate scaling.....)	10%	10%	5%	10%	

TABLE 1

SUBJECT MATTERS ASSESSMENT IN THE PILOT GROUP OF THE BENG IN MECHANICAL ENGINEERING

Besides traditional written examinations, other alternative evaluation approaches, such as reports, one minute paper, portfolio, project work, etc. are used in these innovative groups [7]. At least, three of these alternative evaluation methods are applied in every subject matter.

- To design an **academic calendar** consistent with these formative assessment strategies, that combines periods of classroom/laboratory activities with (non-teaching) periods for evaluation and retake (Figure 2). In particular, two evaluation periods per semester have been established: one at approximately the middle of each semester and another one at the end of each semester (november and december 2009 for the first semester, and march and june 2010 for the second semester). Furthermore, in order to better facilitate formative assessment, a retake period per semester has also been included at the end of each semester (january 2010 for the first semester and july 2010 for the second semester).

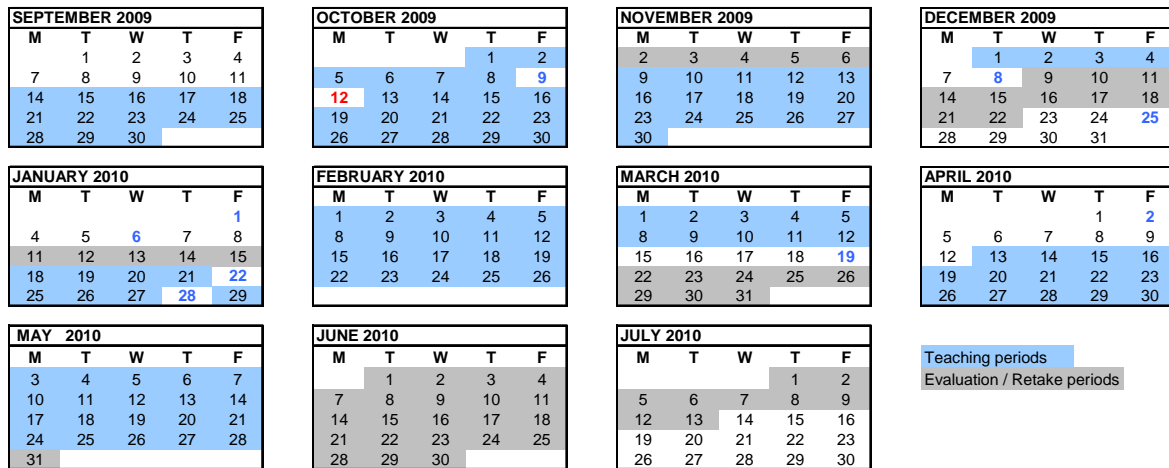


FIGURE 2
ACADEMIC CALENDAR OF THE PILOT GROUPS

- To implement an individual **curricular evaluation** at the end of the academic year. Commissions of both Pilot Groups will perform a curricular evaluation of their students in July 2010, according to the guidelines of this kind of evaluation that have been recently approved at the Polytechnic University of Valencia.
- To prepare a **learning contract** that students have signed during the first week of the academic year [8,9]. After this deadline, no new students were admitted in these Pilot Groups. By means of this learning contract, students take the responsibility for their own learning, commit themselves to carry out all the tasks and activities that are required in every subject matter, and to regularly attend the course. Students commit themselves to attend at least 80% of the classes of each subject matter, during each one of the four teaching periods. In case that unjustified absences are higher than 20% of all classroom/laboratory sessions of every subject matter, the student will be automatically excluded from the Pilot Group.

As result of the work carried out by the Commissions of both Pilot Groups, two leaflets were prepared with all the relevant information of these innovative groups. Students were properly informed about these Pilot Groups during their inscription period (July and September 2009). Members of both Commissions personally explained to the students the main characteristics of these Pilot Groups, as well as the commitments that the student has to undertake when participating in such innovative groups. Moreover, leaflets were distributed to students and their electronic version was available at the ETSID website. Inscription to these Pilot Groups was voluntary and was performed following the inscription order until all the vacancies were filled.

RESULTS

In order to monitor these pilot experiences, both Commissions have met periodically during the academic year. The first meeting of these Commissions took place a week before the beginning of the academic year, in order to arrange the beginning of the course and to inform the teachers about the exact number of students that were finally inscribed in each group (65 students in the Pilot Group of the BEng in Electronic Engineering and 60 students in the Pilot Group of the BEng in Mechanical Engineering). The second meeting was performed one month later, in order to exchange views about the running of both Pilot Groups. The rest of the meetings have been programmed after each evaluation or retake period, in order to analyse the evolution of each group, and more specifically, the results that were obtained in each subject

matter. Finally, a new meeting is planned at the end of the academic year, so that both Commissions can perform the curricular evaluation of their students.

Concerning the academic results of these pilot experiences, Figure 3 shows the results obtained by the students of the Pilot Group of the BEng in Electronic Engineering in the core subject matters during the first semester. Similar results have been obtained for the students of the Pilot Group of the BEng in Mechanical Engineering. As it can be observed, up to now, 34% of the students have passed all the core subject matters, whereas 26% of them have passed three of the four core subject matters. This implies that at least 60% of the students are able to completely succeed the course. Furthermore, only 10% of the students have not passed any subject matter.

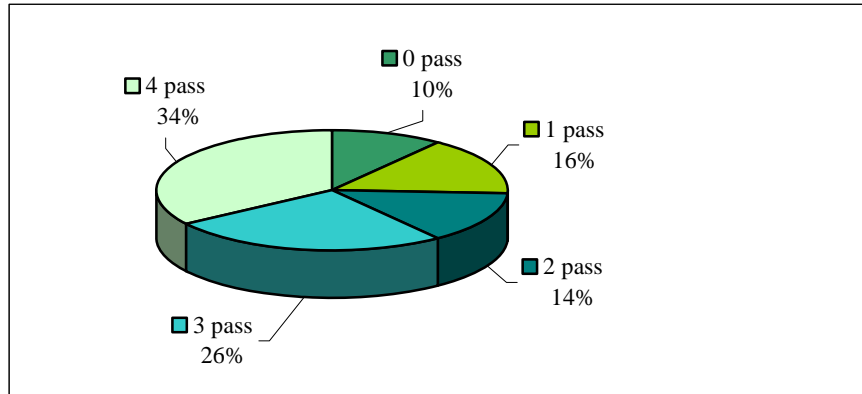


FIGURE 3

ACADEMIC RESULTS OF THE STUDENTS OF THE PILOT GROUP OF THE BENG IN ELECTRONIC ENGINEERING DURING THE FIRST SEMESTER IN THE CORE SUBJECT MATTERS.

On the other hand, at the end of the academic year, the academic achievement rate, the efficiency rate and the success rate of each Pilot Group will be assessed. These parameters will be then compared with those obtained in the rest of the groups of the first year of the same degree.

Moreover, at the end of the academic year, students will be asked to complete a survey, so that their agreement degree with this experience can be assessed (Table 2).

	Strongly agree	Agree	Neither agree or disagree	Disagree	Strongly disagree
The teaching methodology has improved my learning process					
The practical workload has been appropriate					
The time (excluding the classes hours) devoted to study and to other learning activities has not met my expectations					
In general, for each activity, its weight in the final mark matches the time devoted to it.					
The marks I know so far do not meet my expectations					
All things considered, I think this experience is positive for my training					

TABLE 2

STUDENTS SURVEY FOR THE PILOT GROUPS

In the absence of the results of this survey, but considering the views exchanged by teachers during the Commissions meetings, as well as the comments made by students during the academic year, it has been noticed that, in general, most of the students positively accept the implementation of these teaching and assessment methodologies.

On the other hand, teachers admit that it is still necessary to make some effort in order to get the more reluctant students to assume their active role and to appropriately adapt to this type of methodology. Moreover, teachers point out it is necessary to adequately program contents and activities, in order to combine, in a balanced way, the student workload with the demand level on its competences and minima contents acquisition.

Finally, it is worth mentioning that 90% of the students that have signed the learning contract of the Pilot Groups have regularly participated in the activities performed in these groups.

CONCLUSIONS

During academic year 2009/2010, the School of Design Engineering (ETSID) of the Polytechnic University of Valencia has undertaken the development of pilot experiences in the first year of its current BEng degrees in Electronic Engineering and Mechanical Engineering, in order to implement a new teaching-learning system, as a first stage towards the implementation of its new degree programmes adapted to the EHEA model.

This innovative experience has implied a contents reorganisation, as well as a review of the employed teaching methodologies and assessment strategies, in order to improve knowledge, abilities and competences acquisition of students and to enhance progress in their training.

This methodology requires a greater dedication from teachers that is partly compensated by their satisfaction degree in the development of their daily activity. On the other hand, students seem to positively accept the implementation of this new teaching-learning methodology.

Partial results available to date reveal an improvement in the academic achievement of these Pilot Groups, when compared to results that are traditionally obtained in the first year of the BEng in Electronic Engineering and the BEng in Mechanical Engineering, currently offered at ETSID. Moreover, the dropout rate is lower to the average of these current degrees.

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