EXPERIENCES OF THREE FREE ELECTIVE SUBJECTS

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ABSTRACT
There are several types of credits that students must complete to obtain a degree in Spanish universities, for example free elective subject credits, which amount to 10% of the study load of the engineering degree programme at the Technical University of Catalonia (UPC). The contents of these credits must be different from the contents of compulsory and optional subjects. Students have several ways to obtain these credits, as will be specified below.
Three simple, practical, specific free elective subjects: "Innovation and Patents", "Ecodesign" and "Product Appreciation and Aesthetics", their objectives, contents and the way in which they are given are discussed.
These three subjects, which focus on the conceptual design phase, are a complement to the product design subjects offered at UPC, and future curricula might include these contents. Experiences of this type of subjects are positive inasmuch as professors can introduce new contents. Thus, professors can share with students how engineering design evolves and students can receive updated information. These types of subjects must remain part of university curricula since they are an interesting way of transmitting the evolution of knowledge to students. However, their presence in engineering curricula is at stake.

Keywords: Educational freedom, complementary aspects of conceptual design, research.

1 INTRODUCTION

In the 1995-1996 academic year, a new typology of specific free elective courses was introduced in Spanish universities and, in particular, in the Technical University of Catalonia (UPC). Students may choose from a variety of specific free elective subjects, subjects included in other studies or other activities.
By taking these subjects students may obtain the number of credits required to complete a degree. Free elective subjects, which account for 10% of the study load, provide an opportunity for students to choose subjects or activities of special interest for them.

The Engineering Syllabus [1] is composed of compulsory subjects, optional subjects and free elective subject. Students must obtain 375 credits (1 current credit = 10 class hours). However, with the new European credit system, students need 300 ECTS credits [2] to obtain their degree, 206 of which correspond to compulsory subjects, 44 to optional subjects, 30 to free elective subjects and 20 to the final project. The European

Credit Transfer System (ECTS) is a student-centred system based on student workload which facilitates mobility and academic recognition. One credit equals approximately 25 to 30 working hours such as attending lectures and seminars, independent and private study, preparation of projects and examinations. Free elective subjects are considered low workload and are semester-based. Thus, they can be taken either from September to January or from February to June.

Students at UPC have three different ways to obtain free elective credits:

- By taking specific (or pure) free elective subjects included in the degree curriculum.
- By taking compulsory or optional subjects included in the engineering curriculum or other degrees.
- By taking part in activities of academic interest such as language or music learning, educational cooperation agreements, internship programs, etc. Thus, students may obtain the so-called recognition credits.

Free elective subjects are conceived to provide students with useful knowledge on a number of aspects that may not be part of the regular syllabus contents offered by UPC.

Specific free elective subjects are based on what professors' offer voluntarily as extra activities and at zero cost for the university. Professors may design subjects freely and teach and assess what and how they wish. These subjects must subsequently be approved by the academic board. Moreover, quality controls, which include student surveys and number of enrolments, are performed. In these subjects a professor is responsible for class organization and other professors or PhD students can take part as lecturers.

In general, the trend has been for students to increasingly select free elective recognition credits obtained by choosing activities of academic interest since these are easily performed and the offer has increased in the last few years. Thus, the number of enrolments in these activities has risen from 91 in 1995 to 1,442 in 2005. By contrast, the number of enrolments in specific free elective subjects has declined because more effort is required of students and professors become tired of volunteering their time and work. The average enrolment rate in these subjects is 10 students. However, since students need to obtain 37,5 credits of this type, students usually choose from the three different ways.

At present, the prospects for free elective subject credits are their elimination from new engineering curricula according to the European convergence process (Bologna).

2 THREE FREE ELECTIVE SUBJECTS FOR THE CONCEPTUAL DESIGN OF PRODUCT ENGINEERING

Three specific (or pure) free elective subjects, namely "Innovation and Patents", "Ecodesign" and "Product Appreciation and Aesthetics", are taught at UPC. Their characteristics and a simple example of the type of exercises done by students are given below. These three specific subjects are offered throughout the degree programme in the first semester (from September to January), having run every year until now:

- "Innovation and Patents" [3] was first taught in the academic year 1996-97.

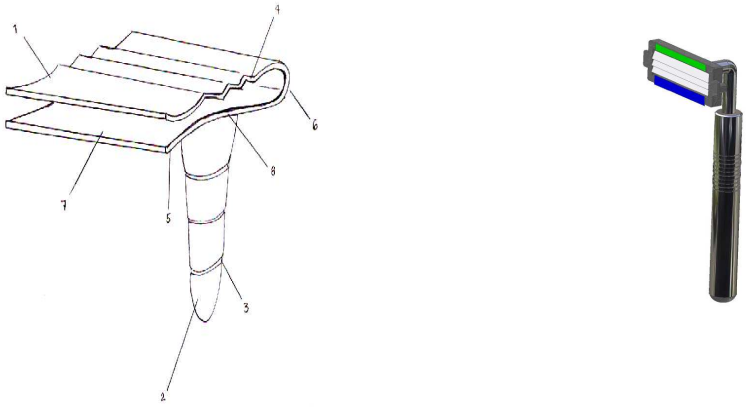
The aim of this subject is to provide students with knowledge of the conceptual process to improve a simple product and with the necessary information to enable them to write a patent. Creativity techniques and searches of patent databases are applied to innovate a simple product. At the end of the course for the subject, students are required to write the patent for the innovated product.

An example of the work conducted by students is shown in Figure 1a. A teamwork [4] devised a solution to the problem of the beach towel rising when wind blows, consisting in a small piece of plastic with the shape of a hair clip that can be fixed to a corner of the towel and a punch-shaped part that is introduced into the sand. Under ordinary conditions, that is, on normal sea breeze days, four of these pieces should suffice to hold the towel in place.

- "Ecodesign" was first offered in the academic year 2000-01.

The objective of this subject is to provide students with useful knowledge to design more ecological products based on the Life Cycle Analysis (LCA) method [5] in order to minimize impact eco-points [6].
This subject benefits from the experience of "Ecodesign" [7], a subject taught in doctoral programmes which was first offered in the academic year 1995-96.

An example of students' work [8] is shown in Figure 1b.



a *b*

Figure 1. (a) Towel clip to fix it at the beach sand; (b) Redesigned razor

This new design of razor requires less material for the detachable head of the razor blades than a current commercial razor. In addition, several ecological improvements are obtained over a specific model on the market, like material homogenization and new design and materials for the handle. The impact eco-points calculated for the original razor are 123 milli-points, whereas the new eco-design has only 31 milli-points. The points of both razors were calculated with one hundred small blade heads per one handle and without final recycling. This result implies a significant eco-improvement in this model of razor.

- "Product Appreciation and Aesthetics" [9] has been taught since the academic year 2003-04.

In this subject, design principles are explored for a better appreciation of the product in order to create both useful and attractive products.
The pictures in Figure 2 illustrate one such example.

a *b*

Figure 2. (a) Bags hung on a park bench; (b) Park light poles with hanging elements.

A students' teamwork [10] observed some problems in a city park, for instance where to hang the bags while playing the game of pétanque. Figure 2a shows some bags hanging on a bench. A non-scale solution is provided in Figure 2b. This new design makes use of a light pole in the park. As can be observed, two circular pieces with symmetrical grooves serving as safety hanging elements have been added.

The above three subjects have complementary aspects within conceptual engineering design.

2.1 Common class structure

A similar class structure is used in the three subjects. Class groups are divided into 4-5 students' work teams of 3 to 6 members each who work on a design. The first 20 to 45 minutes of class time are devoted to theory while the rest of the 2-hour class is spend on supervision of students' work.

Several aspects are considered in the evaluation of students, namely attendance, small exercises and final work. The final work is the most important factor for the evaluation. It is a written document that must also be orally presented. At the end of the oral presentation, questions are asked. An 80% attendance rate is required. In the rare case of poor attendance or work results, students must take a rather difficult written examination. All the conditions are explained before the start of the course.

Classes are structured to enable students to produce continuous, creative work.

3 RESULTS

The results of student surveys about these three subjects performed at the end of each course are generally positive. Some students complain of excessive work; however, the number of enrolments remains constant, in particular above average. From the professor's point of view, these types of subjects provide a certain amount of educational freedom that cannot be found in other contexts. Professors enjoy transmitting new knowledge and experimenting with new subject contents and forms of teaching.

With regard to students, they can complement their studies with aspects of conceptual design that are not included in UPC's study plans.

In this way, new subject contents and study forms are investigated and experienced. A small number of PhD students have attended some sessions and tried some new design techniques. As can be seen, students, PhD students and professors all benefit from these classes.

4 CONCLUSIONS

Student work creativity is a factor of student and professor motivation. This type of subjects opens the mind to new objectives, but it also requires a continuous, extra effort on the part of professors, who often receive no recognition and regret not being able to devote more time because of other work demands.

Experimenting with new knowledge or abilities may result in poor class performance, but it is an effective way to gain experience and test this knowledge.

Nowadays free elective subjects are complementary subjects in technical studies and they will perhaps be included in future study plans. These subjects are likely to remain part of University curricula for some years before contents are replaced by new education plans. For this reason, free elective subjects should receive greater recognition by UPC.

The 10% study load required to obtain the degree has proved to be excessive in present conditions (lack of resources). This has led to an increment of recognition credits given by performance of any activity, which results an increase of easily obtained credits and low final quality. Furthermore, the original purpose of free elective subject credits is lost to a great extend.

Subjects allowing freedom of teaching and learning should remain part of University curricula everywhere, since they make it possible for both professors and students to keep abreast of current development in their fields of knowledge.

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Acknowledgements

The author gratefully acknowledge the aid of the Oriol, C. and Bort, N. from Studies Coordination and Secretariat of School of Industrial Engineering of Barcelona (ETSEIB) in this research. Different data of characteristics and students inscription of free elective subjects. (Consults: December 2006 – March 2007).

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