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PROPOSAL FOR A SUBJECT: CREATIVITY, ECODESIGN AND PATENTS

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ABSTRACT
A proposal for a new free-elective course in the Technical University of Catalonia, namely *Creativity, Ecodesign and Patents*, is presented. The course brings together three previous free-elective courses in order to concentrate knowledge and class time, and eliminate some repetition.
The course provides knowledge and practice in product design with special emphasis on creativity and ecodesign principles. Students are required to develop a conceptual product design and write a patent.
To enhance student motivation, an initial discussion on water and energy problems is conducted. The students' contributions (in the form of a technical object) towards the solution of these problems may transform into actual patents.
Knowledge is consolidated by means of two individual/group exercises based on the "Exchange of Mental Schemes (EMS)" methodology.
This paper details the syllabus, schedule and methodology of a course which brings together three well-known aspects of engineering design, i.e. creativity, ecodesign and patents. In the final section, conclusions are drawn.

Keywords: Creativity techniques, ecodesign, patents, mental schemes

1 INTRODUCTION

A new free-elective course will be offered at the Technical University of Catalonia (UPC) from the 2010-11 academic year on. It is the fusion of three existing free-elective courses: *Innovation and Patents* (from 1996-97), *Ecodesign* (from 2000-01) [1], the full contents of which are kept, and *Creativity, Development and Innovation* (2008-09), which is only partially kept. The contents of these courses are not well defined any current UPC syllabus, and the new subject comes to fill a gap of knowledge. The course brings together three well-known aspects of engineering design, i.e. creativity, ecodesign and patents, covering the fundamentals of these subjects to provide students with basic knowledge for further studies.
Three goals of the new course are to concentrate knowledge, eliminate repetitions and save time while preserving the basis of knowledge of the previous subjects. The course entails less lecturer workload than the three previous courses and may serve as a bridge to future courses resulting from changes in the current UPC syllabus.
The course has a short term scope as the number of optional and free-elective courses in Spanish universities is to be reduced by the Bologna Process. Nevertheless, these courses are likely to be offered about four more years. Also, chances are that some will be offered again in the next period of changes (10-12? year cycle).
In order to consolidate knowledge, exercises based on the "Exchange of Mental Schemes (EMS)" methodology [2], [3] are performed. That is explained below (4.4).
Several authors [4], [5], [6], universities and entities [7] have approached the subject of creativity together with ecodesign in many different ways, for example, using patent databases. However, in this new course, students are required to write a patent of the technical object that they have designed. The expectation levels are not high on account the students' inexperience, but the path to the goals is certainly an interesting one.

2 OBJECTIVES

The course aims to help students develop their individual creative capacities through product design, and enhance their ability to compare their inventions with existing ones. Other goals are to provide students with criteria to reduce environmental impacts of their products and insights into patent writing. Finally, students will familiarise themselves with the dynamics of group work, and learn strategies to become autonomous learners capable of finding and applying related knowledge, as well as acquiring product design skills.

3 SYLLABUS

The general syllabus has three main topics:

- Creativity techniques
- Ecodesign principles
- Patent concepts and practices

Other secondary topics include water and energy problems, general guidelines for product design, and analysis of advantages and disadvantages.
Below is a detailed description of the syllabus.

3.1 Creativity techniques

Application of some creativity techniques to solve inventive problems. The following blocks are proposed:
C (I): Exercises of imagination [8].
C (II): Brainstorming [9].
C (III): Mind Maps [10].
C (IV): Six Thinking Hats [11].

3.2 Ecodesign

Description of ecodesign principles to reduce the environmental impacts of products:
E (I): Environmental impacts and consequences. Sustainability. General ecodesign principles.
E (II): Life Cycle Assessment [12], [13]. Cradle to cradle (C2C) concept [14].
E (III): General ecodesign strategies. MET Matrix. Ecoprofile [15].
E (IV): Impact eco-points [16].

3.3 Patents

Description of patent concepts and tools for patent searching. Students familiarise themselves with patent structure. At the end of this block, students are required to write a patent. Results at this level are often poor, but the exercise is proposed as an initial approach to patent writing.
Pt (I): Basic concepts. Patent search.
Pt (II): Spanish patent agency [17]. Other patent agencies and international treaties [18].
Pt (III): Patent structure. Claims.
Pt (IV): Spanish patent writing.

3.4 Water and energy problems

Water and energy problems set in a Spanish context serve as the trigger to the students' work. Four blocks are devoted to each of the topics.
One of the main goals is to know the magnitude of these problems and motivate students to design products that help reduce them.

3.5 Design process

One of the topics addressed in the course is the general design process. However, as first and second-year students lack both knowledge and experience in product design, they are placed in groups with fourth and fifth-year students, who are acquainted with this matter.
Students must analyse the advantages and disadvantages of their product and then write a patent.

3.6 Schedule

Table 1 shows the course plan, as follows: class sessions (lasting 2 hours each and held twice a week) are listed in the left column. In the right column, where (T) stands for theory and (P) for practical

classes, contents of each session are detailed. Approximately 30-45 minutes of class time are devoted to theory. The course is divided into topic blocks, for example three blocks for water scarcity and the energy problem, and four blocks for Creativity, Ecodesign and Patents. Note that some topics are preceded by a preparatory block.

Table 1. Schedule of Creativity, Ecodesign and Patents classes. Contents are defined above. Theory (T), Practice (P). Milestones in italic capital letters.

1 - 3	T: Course view. Water scarcity (I - III). Energy problem (I - III). Creativity (I - III). P: General exercise of imagination. General brainstorming exercise. General Mind Maps (MM) exercise. Information search (Internet). *GROUPS AND TOPICS ARE DEFINED.*
4 - 8	T: Patents (I). Ecodesign (I). Water scarcity (IV). Energy problem (IV). Creativity (IV). P: Specific exercise of imagination. Analysis of information contributed. Analysis of patents contributed. First-level solutions, sub-solutions, sub-sub-solutions of a Mind Map (MM). Choice of sub-sub-sub-solutions. Six Thinking Hats.
9	T: Ecodesign (II). P: 1st EMS exercise.
10	*FIRST PRESENTATIONS.* *DISCUSSION.*
11 - 12	T: Ecodesign (III - IV). P: Application of general strategies, MET and Ecoprofile. Impact eco-points exercise
13	T: Review of concepts P: Final product definition *PRODUCTS ARE DEFINED.*
14 - 17	T: Patents (II - IV). P: Patent search. Patent writing. Final design. Patent writing.
18	T: SWOT - Strengths, Weaknesses, Opportunities, Threats. P: Review of patents. Advantages and disadvantages of products. *PATENTS ARE WRITTEN.*
19	*FINAL PRESENTATIONS.* *DISCUSSION.*
20	*FINAL PRESENTATIONS.* *DISCUSSION.* *EXAMINATION (if necessary).*

Several milestones are foreseen (see italic capital letters). By class session 3, student groups and presentation topics must be defined. In the middle of the course students are required to deliver a first presentation and an analysis of the work conducted so far. The features of products must be specified in session 13. At the end of the course students give final presentations, write patents and participate in discussions.

4 METHODOLOGY

The course methodology consists in having students develop a project of a product design, placing special emphasis on creativity techniques, ecodesign principles and basic patent writing.

4.1 General methodology

Students work in small groups of three to five people. A topic is chosen among those proposed by the lecturer or a company. Alternatively, students can make their own choices, in consultation with the lecturer.

Since time is limited, topics must be simple. In addition, students may be in their 2nd to 5th year, which means that they may be doing several different specialities. The choice of topics is of secondary importance and so are the results in comparison with the acquisition of basic knowledge and abilities, although interesting results and even real patents are pursued.

Topics are related to water and energy scarcity, and proposals of technical solutions are at a simple level.

Students are required to draw the final products. However, groups can make mock-ups of products outside class time if they wish to.

4.2 Steps

The steps involved in product development are conceptual design, basic design and patents.
As shown in Table 1, the design process starts with the production of new ideas, which are subsequently contrasted with patent databases and other sources of information. Next, the conceptual designs are roughly refined and alternatives are analysed applying ecodesign principles. After selecting a solution, the final definition of products is obtained. This last stage takes approximately 2/3 of the course time. Patents are then written and advantages and disadvantages are discussed.

4.3 Interaction flows

Figure 1 illustrates interactions between the course actors, i.e. lecturer and students, and knowledge.
There is an interaction between lecturer and Individual (I) students (see small circles I), and lecturer and Group (G) of students (see large circles G). Self-interaction between individual students within the group is also enhanced (see curved arrows representing interactions between Individuals (I) in the group).
For clarity, Individuals (I) and their interactions are not represented in the other groups.
The lecturer and Individuals (I) in the Groups (G) have their own knowledge acquired mainly in the degree, but information about the current state-of-the-art, other solutions and further knowledge must be obtained. This is a crucial point, and therefore there must be a good flow of questions between the actors and the world of knowledge.

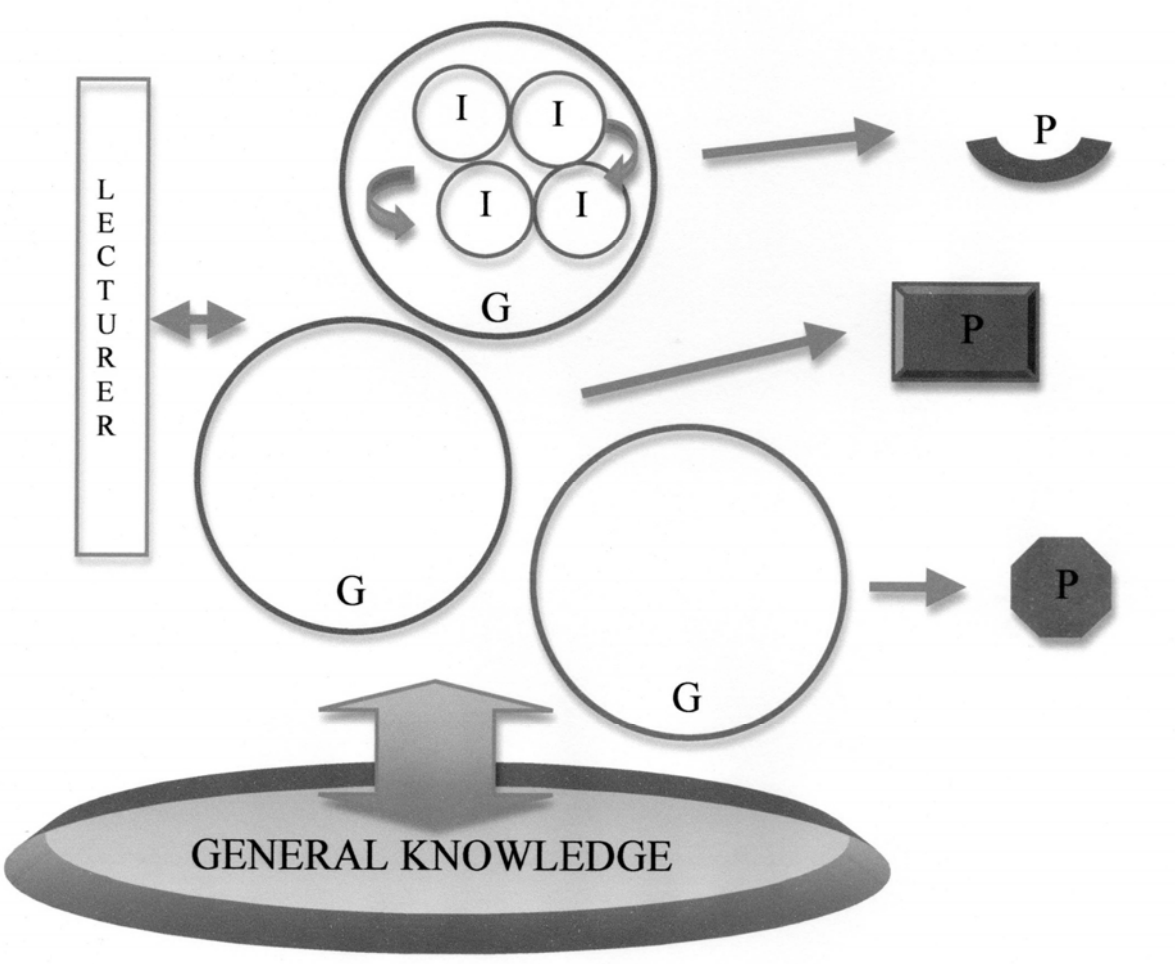

Figure 1. Interactions between individual student (I), group of students (G), lecturer and general knowledge towards the achievement of design products (P).

This flow of questions –answers is shown in Figure 1 by a wide double arrow representing the interaction between actors and the world of knowledge, illustrated by a one-base spherical segment (actually only the tip of the iceberg). Fortunately, some Internet patent databases can be easily

consulted, as well as other sources of information, which, though not always complete or reliable, is enough for the purpose of the course.
The lecturer helps students learn and acquire design skills that enable them to obtain a technical solution in the form of a product for the water or energy problems proposed. The results are new or improved products, as represented in Figure 1 by geometrical figures with a "P". All the products must be different (P).
The number of Individuals (I) comprising the groups and the number of groups can range between three and five, and three and six, respectively (see Figure 1).

4.4 EMS

Self-interaction between individual students within the group is particularly enhanced (see curved arrows between Individuals (I) in Figure 1) by using the Exchange of Mental Schemes (EMS) technique. This method is based on the free exchange of concepts -or mental schemes- related to a topic of knowledge within the groups.
The exchange of concepts has several benefits; for example, deeper knowledge is gained, conceptual errors are eliminated and students are equipped with knowledge related to the topics under study.
Students perform two exercises based on Exchange of Mental Schemes (EMS) within the group, answering questions prepared by the lecturer. In this way, students polish their knowledge, eliminate conceptual errors, and may ask further questions to the lecturer. At the end of the exercises, students must answer a final set of questions individually. These are more complex than the previous ones. These exercises are to be conducted in the middle and at the end of the course.
Students are evaluated on their projects and oral presentations, attendance and the above set of questions. If there are doubts about performance, the student must take a written exam.

5 LEARNING OUTCOMES

Upon completion of the course, students should be able to:

- Improve their creative skills with creativity techniques.
- Obtain conceptual design solutions to inventive problems.
- Provide alternative solutions and choose the best, bearing in mind ecodesign principles.
- Verify the possible inventions and be inspired by state-of-the-art inventions.
- Find and analyse several sub-alternatives.
- Show knowledge of patent structure.
- Work in groups, discuss learned concepts and eliminate misconceptions about them.
- Write a basic patent for their invention.

6 CONCLUSIONS

The *Creativity, Ecodesign and Patents* course, which is the result of merging three free-elective courses, simplifies some concepts while looking deeply into others. It is meant to fills gaps in the current syllabus of the engineering design courses taught at the Technical University of Catalonia, and serve as a bridge to the future syllabus.
The course is complementary and voluntary, and is offered to all UPC students. The number of student places available is half the number of students specializing in design at Engineering School of Barcelona (ETSEIB).
Despite involving voluntary lecturer work, this course could be a pleasant experience, as was the case of the preceeding three free-elective courses, and an education experiment aimed at increasing student motivation and familiarising students with some engineering design aspects.
In the next academic year (2010-11), the Exchange of Mental Schemes (EMS) technique by Dr. Laura Carnicero [3] is expected to be applied.
The syllabuses and methodologies of this course and other similar courses covering creativity, ecodesign, or patent consultation differ in several ways, the main differences being that the former combines these three subjects with production of a final patent and that it applies the EMS technique to consolidate knowledge.

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