

EUROPEAN PROJECT SEMESTER: 30 ECTS OF PBL IN SUSTAINABILITY WITH MULTICULTURAL AND MULTIDISCIPLINARY BACHELOR STUDENTS GROUPS

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Abstract

Since 1991, the Technical University of Catalonia has focussed on introducing Sustainability education in all its engineering and architectural programmes through two environmental plans (1996-2000, 2000-2005), and currently through the UPC Sustainable 2015 [1] plan. Under this framework, the School of Engineering of Vilanova i la Geltrú (EPSEVG) has designed and coordinated the European Project Semester (EPS), an innovative learning programme which responds to the challenges of society and the European Higher Education Area.

EPS trains engineering students by applying Project Based Learning in intercultural and multidisciplinary groups. The working language is English and the programme is designed for 1st cycle (Bachelor) degrees. The EPS programme offered at the EPSEVG emphasises the introduction of competences in sustainability [2] and human technology.

The main objective of the EPS is to improve the learning outcomes and competences of engineering students in relation to communication and teamwork skills, the ability to work in intercultural settings, and the ability to work in real multidisciplinary projects with students from different degree backgrounds.

The EPS is divided into seminars (worth 10 ECTS) and a project (worth 20 ECTS). The seminars include courses in Sustainable Technologies, Business and Sustainability and Human Technology, among others. The projects are proposed by local companies and research groups. Since 2008 the number of participants has increased from 9 in 2008 to 30 in 2011. The students, who have participated in 15 projects, have come from 16 different European and North American universities and from over 18 different academic disciplines.

This paper shows the design methodology used in the EPS programme its structure and the sustainability competences achieved by the students.

Key words: *Education, Sustainability, Engineering, Multidisciplinary*

1. Introduction

We need a fundamental, transformative shift in thinking, values and action by all society's leaders, professionals and the general population if we are to follow a path of sustainable development. To quote Albert Einstein: "*The significant problems we face cannot be solved at the same level of thinking we were at when we created them*"¹.

Society needs scientists, engineers, managers and politicians who can shape the systems of our society in a way that sustains, rather than degrades the natural environment and enhances human health and well-being.² In this context higher education institutions have the responsibility to produce graduates that have achieved both the moral vision and the necessary technical knowledge to assure the quality of life for future generations. Sustainable development therefore, must be the framework in which higher education has to focus its mission³.

Since 1991, the Technical University of Catalonia (UPC) has aimed to introduce Sustainability Education in all its engineering and architectural programmes through two environmental plans (1996-2000, 2000-2005), and currently through the UPC Sustainable 2015 plan⁴. Under this framework, the School of Engineering of Vilanova i la Geltrú (EPSEVG) has designed and coordinated the European Project Semester (EPS), an innovative learning programme which responds to the challenges of society and the European Higher Education Area.

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There are many documents referring to the competences in sustainability that students should have when graduating in higher education institutions. Within the field of engineering there is a reference document which includes the Barcelona declaration⁶ approved during the celebration of the EESD conference in 2004 which declares that today's engineers must be able to:

- Understand how their work interacts with society and the environment, locally and globally, in order to identify potential challenges, risks and impacts.
- Understand the contribution of their work in different cultural, social and political contexts and take those differences into account.
- Work in multidisciplinary teams, in order to adapt current technology to the demands imposed by sustainable lifestyles, resource efficiency, pollution prevention and waste management.
- Apply a holistic and systemic approach to solving problems and the ability to move beyond the tradition of breaking reality down into disconnected parts.
- Participate actively in the discussion and definition of economic, social and technological policies, to help redirect society towards more sustainable development.
- Apply professional knowledge according to deontological principles and universal values and ethics.
- Listen closely to the demands of citizens and other stakeholders and let them have a say in the development of new technologies and infrastructures.

2. The European Project Semester and the School of Engineering of Vilanova.

The EPS was first developed in Denmark at the Copenhagen University of Engineering in the Industrial Design field, and has grown to include several other European universities. The EPS is a new programme adapted to the European Higher Education Area for Engineering and Business students of 3rd year. In brief, the programme has the following characteristics:

- It is international, multidisciplinary and multicultural;
- English is the working language;
- It addresses the real needs of companies;
- It is an intensive, one-semester programme;
- It is worth 30 ECTS credits;
- It works out the Sustainability competences.

The EPS has two complementary parts:

A project: during the semester and under the guidance of an academic tutor, an international team of four to six students works on a real-life multidisciplinary project for a Spanish or an international company. The work teams are made up of students with different academic backgrounds from all over Europe. Individual and group tutorials are offered during the semester.

Intensive seminars: a short intensive programme with practical workshops about topics related to project management is also be offered to enhance the work related to the project. These complementary workshops also help students develop their communication and cooperation skills.

The School of Engineering of Vilanova i la Geltrú, is one of the 17 schools of engineering of the UPC Barcelona Tech and is located 40 km south of Barcelona. The School offers a set of 6 Bachelor degrees (Mechanical engineering, Chemical Engineering, Electric Engineering, Electronic Engineering, Telecommunications Engineering, and Computer Science Engineering) and a master degree in Electronics and Industrial Automatics. This multidisciplinary range of degrees allows the school to offer a real multidisciplinary EPS programme.

3. The European Project Semester at the School of Engineering of Vilanova.

The EPS programme designed at the School of Engineering of Vilanova i la Geltrú follows the same philosophy as the EPS offered in Europe with specific emphasis on Sustainability competences. The programme is divided into the intensive seminars listed in the following table (Table 1) with a total load of 10 ECTS and a project workload of 20 ECTS. There are two optional courses in English and Spanish language.

Table 1 Intensive seminars offered at the EPS of the School of Engineering of Vilanova

Area	ECTS	Intensive seminars	ECTS
Communication	3	English Language	1
		Communication skills	1
		Teambuilding	1
European Law and Market	1	International Marketing	1
Sustainability	2,5	Human Technology	0,5
		Sustainability and business	1
		Sustainable Technology	1
Spanish Language and Catalan culture	1	Spanish language and Catalan culture	1
Project Management	2,5	Project Management	1,5
		Systematic Innovation	1
Project	20	Project	20
TOTAL	30	TOTAL	30

The projects are real-life projects proposed by companies. The project proposals from the companies must meet the following criteria:

Multidisciplinary: the project should require skills from different fields of engineering, business knowledge and abilities and skills, if it is to be completed successfully.

Complexity: final year Bachelor students should be able to carry out the project.

Difficulty: the project can be completed in 12 weeks.

Supervisor: the company has to provide a supervisor and facilitate all the information needed to carry out the project in English.

The EPS schedule (Figure 1) is divided into three parts. Part 1: Intensive seminars taught in the morning (afternoons are free to allow students to apply the skills they learn in the seminars to their project). Part 2: this stage lasts 12 weeks and is the period in which the project is realized. During this period English and Spanish lessons continue, supervisors closely monitor the development of the project and students are assessed on the work they have completed so far. This assessment includes an oral presentation, a written report and the outline plan for the final 6 weeks of the project. Part 3: this final part lasts around 10 days and is the period in which students deliver both their final report –scientific paper- and a poster and present their conclusions orally in front of a scientific evaluation committee.

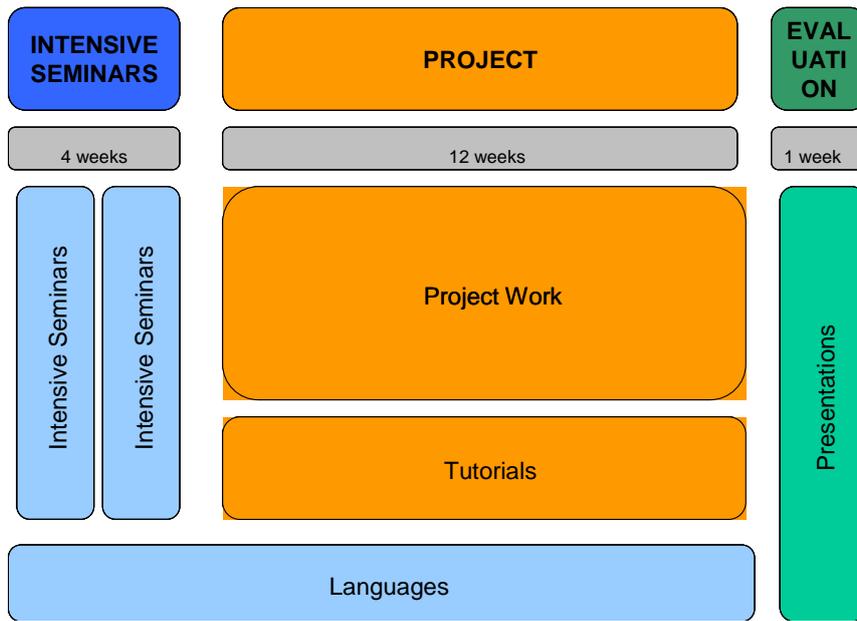


Figure 1: Schedule of the EPS programme

4. EPS Programmes

In February 2008 UPC started its first EPS. Nine students from six different nationalities and five different engineering specialities participated in the first programme. The students worked in three projects proposed by different university departments. Since then the numbers of students, nationalities, students' background and projects has increased, as shown in tables 2 to 6 .

Table 2 EPS Programme 2008

Project	Students Background
Design and marketing plan of renewable energy equipment for the new EPSEVG roof (Local Energy Agency)	Mechanics Electronics
Autonomous Acoustic Buoy (Bioacoustics Application Lab)	Computer Science
Design and construction of a Meteorological Data Station for a Marine buoy with communication by satellite (SARTI research group)	Electricity Mining Machinery ICT

Table 3 EPS Programme 2009

Project	Students Background
Emergency Evacuation system for Disabled people (Accessibility Chair of Barcelona Tech)	Business Electronics Engineering
Design and development of testing and evaluation methods for Intelligent Transport systems and Advanced driver assistance systems (IDIADA Automotive Technology)	International Sales& Purchase in Engineering Ceramic Engineering Electrical Engineering Mechanical Engineering
Robotic cell (KUKA Robots IBERICA)	Marketing & Commerce
Autonomous Acoustic Buoy (Laboratory of Applied Bioacoustics)	Civil & Structural Engineering Industrial Engineering Computer Science Design, Technology Management

Table 4 EPS Programme 2010

Project	Students Background
Design of a state-of-the-art wheelchair (Accessibility Chair of Barcelona Tech)	Mechanics Computer Science
Design and creation of different simulation architectures for hybrid and electrical vehicles (Centro Técnico SEAT)	Technology & Management Biotechnology
Cable optical fiber preparation for quality measures through robots (Prysmian Cables y sistemas)	Industrial Engineering Electronics
Autonomous Acoustic Buoy (Bioacoustics Application Lab)	Electricity/Electronics Marketing
Theoretical investigation on photovoltaic technologies and the possibility of applying them to vehicles in general (Centro Técnico SEAT)	Applied Sciences International Sales Automatics Vehicle Engineering

Table 5 EPS Programme 2011

Project	Students Background
Interactive Information Point (Theatre El Principal)	Mechanics
Investigation into the structural behavior of an electric vehicle, from the perspective of passive safety (Centro Técnico de SEAT)	Computer Science Telecommunications Human Technology
Automatic Asset tracking system (AENA)	Industrial Management
Digital talking books: DAISY convertor (Accessibility Chair of Barcelona Tech)	Electronics Civil Engineering
Autonomous Acoustic Buoy (Bioacoustics Application Lab)	Technical Engineering
Energy efficiency study of wirehoods machines which manufacture wirehoods for cava (Lligats Metàllics)	International Sales Purchase in Engineering

Table 6 illustrates the range of nationalities of the participating students.

Table 6 General overview of students' nationality 2008-2011

Country of origin	2008	2009	2010	2011
Germany	3	8	5	6
Spain	2	4	5	6
Turkey	1	3	4	-
Finland	1	-	-	4
Austria	1	-	-	-
Romania	1	-	3	2
Poland	-	1	3	4
Netherlands	-	2	5	4
Sweden	-	1	-	1
United States	-	2	1	-
Norway	-	1	-	-
France	-	-	1	1
United Kingdom	-	-	1	-
Estonia	-	-	-	1
Belgium	-	-	-	1
Total	9	22	28	30

5. Results

The assessment of the programme shows excellent results as all the students who have participated in the EPS at the EPSEVG have successfully passed the EPS programme. The faculty results from the SEEQ questionnaire⁷ are also very high in all the evaluated aspects (see figure 2). More than 40 teachers have participated in the EPS either as teachers or supervisors during the 2008, 2009 and 2010 programmes.

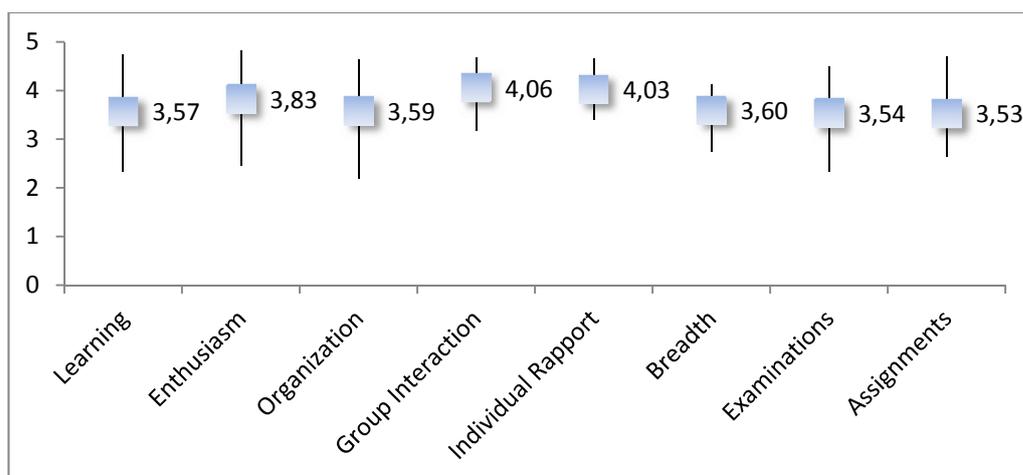


Figure 3. Assessment of teachers of the seminars (0 Low – 5 High)

Most importantly the programme has always been very highly rated, and the comments from students have always been very positive. By way of example here are some comments from

students who took part in EPS 2008 which reflect this:

- *“Developing devices in an international team with different mother languages was really challenging. To communicate with team members or supervisors the specific terms had to be used and thus the range of special vocabulary increased significantly. Also, the varying kinds of mentality in the group or the Spanish way of working have been sources for in future helpful experiences. Things do not always have to be exactly on time or work perfectly. For students it is even more useful if they can learn because of the mistakes which were made. Summed up, the EPS for me was a great programme and will for sure help me in my future life”*. Student from Oulu University of Applied Sciences. (Finland)
- *“From my point of view, I can only recommend everybody, who wants to taste a bit of the real working life, to take part in the EPS project, because it will be an unforgettable experience”*. Student from Fachhochschule Kiel of Applied Sciences (Germany)
- *“My overall impression of this semester is clearly positive. Teachers were always cooperative and communication in English was easy with everybody”*. Student from Fachhochschule Kiel (Germany).

The Spanish Ministry for Higher Education started to adapt university degrees to the European Higher Education Area (EHEA) in 2009. This forced us to redesign all our programmes. An example of the success of EPS is that it has been included in all the new bachelor programs that we are now offering in our school under the EHEA framework.

6. Conclusions

When we first designed EPS we were sure that this programme would be very valuable for our students in terms of learning to work in real projects, self-learning, to work in interdisciplinary frameworks, to work in intercultural teams, communication skills in English and overall acquiring sustainability competences. Nevertheless organizing such a programme in our school was really challenging taking into account the lack of previous experiences in this kind of Project Based Learning programmes in English. However the results from the four years that EPS has been running and the high demand from international students in the current year reveal that EPS is very successful.

When organising such new programmes it is crucial to involve all the actors (students, faculty, administrative staff, the university board and the business sector) from the very beginning of the designing process. This involvement helps everybody to understand the relevance of the programme. It also adds high-quality inputs to the organisation of the programme and it facilitates its implementation.

Based on the experience from the EPS, the EPSEVG is currently planning to organize a new Design Project Semester that will start in spring semester of 2012.

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