

## THE EUROPEAN PROJECT SEMESTER AT UNIVERSITY POLITEHNICA OF BUCHAREST – A CASE STUDY ON DEVELOPING ENGINEERING STUDENTS' SOFT SKILLS THROUGH PROJECT-BASED LEARNING

Anca Greculescu

Lecturer, PhD, Politehnica University of Bucharest

*Abstract: The aim of the current study is to disseminate good practices likely to improve engineering students' soft skills through Project-Based Learning (PBL). The implementation of the European Project Semester (EPS) at University Politehnica of Bucharest has revealed the importance of project-based learning for national and international engineering students. Hence, the need to develop their soft skills proves a prerequisite for their smooth competent professional insertion into the labor market. The European Project Semester benefits from the PBL -an instructional approach that builds on authentic learning activities that engage student's interest and motivation – in view of enhancing the quality of teaching and the engineering students' development of soft skills. Feedback questionnaires were administered to Romanian and foreign students studying an EPS and the research outcomes have illustrated the value of project-based learning in the acquisition of life enhancing skills: language, communication and presentation, organization and time management, research and inquiry, self-assessment and reflection, and group participation and leadership.*

*Keywords: European Project Semester, Project-based Learning, Higher Technical Education*

### 1. RATIONALE

A key objective of European Higher Education is to promote international employability among engineering graduates. There is a pressing need to combat youth unemployment and support targeted measures that aid young people in their transition from education to work. Higher Education Institutions face the challenge of training engineering students for a global, changeable, unpredictable labor market. The workplace scenario is complex and international, but the teaching staff, the methodologies and the contents are based in traditional knowledge areas.

Therefore, traditional engineering education does not suit the needs/expectations of companies to face the challenges of globalization. Industry needs professionals prepared to respond to challenges of professional life, but engineering curricula focus on specialized technical skills rather than on transversal skills.

Thus, soft skills like teamwork, social and communication skills or foreign languages have to be fostered in order to prepare students to work in an international context. Moreover, Higher Education Institutions, including Technical Higher Education, need to link engineering education to the needs of industry by means of a learning-by-doing approach, informed by feedback/input from different stakeholders. Thus, higher education institutions and industry need to collaborate to provide programs that facilitate employability of engineers on an international scale.

In this sense, there is also a need to use multi-faceted approaches to deliver content likely to ensure not only the quality of the teaching and learning process in technical higher education, but also the acquisition and development of engineering students' soft skills.

In reviewing the seminal flowering of the 21st century pedagogy, the Project-based Learning (PBL) plays an important part in the teaching and learning process, touting the acquisition and development of soft skills like: language, communication and presentation, organization and time management, research and inquiry, self-assessment and reflection, group participation and leadership.

It is worth noting that Project-based Learning no longer builds on learning and memorisation, but on students' strengths and interests. This holistic approach provides challenging and real life learning situations, it involves complex work and encourages cooperation and collaborative thinking and learning.

It has been agreed that Project-based Learning (PBL) acts as a model for classroom activity that shifts away from the traditional pedagogical practices of teacher-centred lessons. Thus, PBL learning activities embrace the new educational paradigm of long-term, cross-disciplinary and student-centred topics and practices.

Moreover, this method fosters abstract and intellectual tasks and assists engineering students in exploring complex queries, making judgments, interpreting, analyzing and synthesizing information in meaningful ways.

PBL capitalizes on the rapport between experience and education, on both the old and the new paradigm of education. Where the traditional paradigm relies heavily on subjects and the cultural heritage for its content, the modern one tackles the current issues of a multicultural, globalized and changing society.

According to John Dewey, the history of educational theory is marked by opposition between the idea that education is development from within and that it is formation from without; that it is based upon natural endowments and that education is a process of overcoming natural inclination and substituting in its place habits acquired under external pressure. (John Dewey, 1997, pg. 17)

At present, the subject matter of education in general and technical higher education, in particular, consists of bodies of information and of skills that have been worked out in the past; therefore, the main business of the school is to transmit them to the new generation. In the past, there have also been developed standards and rules of conduct; moral training consists in forming habits of action in conformity with these rules and standards.

It is worth mentioning that the general pattern of school (by which we understand the relations of students to one another and to the teachers) constitutes the school a kind of institution sharply marked off from other social institutions. The former pattern of school included ordinary classrooms, time-schedules, schemes of classification, of examination and promotion, of rules of order.

If we make a comparison between this scene and what goes on in the family, for example, we will draw the picture of the „old” technical university being a kind of institution sharply marked off from any other form of social organization. (John Dewey, 1997, pg. 18)

Furthermore, the main purpose of current technical higher education is to prepare the young for future responsibilities and for success in life, by means of acquisition of the organized bodies of information and prepared forms of skill which comprehend the material of instruction.

With regard to the traditional educational paradigm, since the subject-matter as well as standards of proper conduct are handed down from the past, the attitude of engineering students must, upon the whole, be one of docility, receptivity, and obedience.

Books, especially textbooks, are the chief representatives of the wisdom of the past, while teachers are the means through which students are brought into effective connection with the material. Teachers are the agents through which knowledge and skills are communicated and rules of conduct enforced. (John Dewey, 1997, pg. 19)

By way of conclusion, the traditional scheme is, in essence, one of imposition from above and from outside. It imposes adult standards, subject-matter, and methods upon those who are only growing slowly toward maturity. The gap is so great that the required subject-matter, the methods of learning and of behaving are foreign to the existing capacities of the young. They are beyond the reach of the experience the young learners already possess.

That is why, there has been a constant need to shift away from this traditional approach to a new revolutionary one, based more on the students' experiences.

The belief that genuine education comes about through experience does not mean that all experiences are genuinely or equally educative. Experience and education cannot be directly equated to each other since some experiences are miseducative. (John Dewey, 1997, pg. 20)

A given experience may increase a person's automatic skill in a particular direction, may be immediately enjoyable and yet promote the formation of a careless attitude.

We must admit that the trouble is not the absence of experiences, engineering students do have experiences in school, but their defective and wrong character - from the standpoint of connection with further experience. As John Dewey would claim, hence, the central problem of an education based upon experience is to select the kind of present experiences that live fruitfully and creatively in subsequent experiences. (John Dewey, 1997)

In other words, an education based upon experience is an education based upon projects, which builds upon learning and teaching through projects.

As an instructional approach, PBL deals with learning activities and real tasks that have brought challenges for students to solve. These activities generally reflect the type of work people do in the everyday world outside the classroom, the type of assignments engineering students will have to carry out on the labour market.

Performance is assessed on an individual basis and takes into account the quality of the product produced, the depth of content understanding demonstrated, and the contributions made to the ongoing process of project realization.

All in all, PBL stems from a tradition of pedagogy which asserts that students learn best by experiencing and solving real-world problems. According to researchers (Barron & Darling-Hammond, 2008; Thomas, 2000), project-based learning essentially involves the following:

- students learning knowledge to tackle **realistic problems** as they would be solved in the real world;
- increased **student control** over his or her learning;
- teachers serving as **coaches and facilitators** of inquiry and reflection;
- students (usually, but not always) working in **pairs or groups**.

Teachers can create real-world problem-solving situations by designing questions and tasks that correspond to two different frameworks of inquiry-based teaching: *Problem-based learning*, which tackles a problem but doesn't necessarily include a student project, and *project-based*

*learning*, which involves a complex task and some form of student presentation, and/or creating an actual product or artifact.

These inquiry-based teaching methods engage students in creating, questioning, and revising knowledge, while developing their skills in critical thinking, collaboration, communication, reasoning, synthesis, and resilience (Barron & Darling-Hammond, 2008).

Researchers have identified several components that are critical to successful PBL (Barron & Darling-Hammond, 2008; Mergendoller & Thomas, 2005).

While project-based learning has been criticized in the past for not being rigorous enough, the following features will greatly improve the chances of a project's success:

1. A realistic problem or project
  - aligns with students' skills and interests;
  - requires learning clearly defined content and skills.
2. Structured group work
  - groups of three to four students, with diverse skill levels and interdependent roles;
  - team rewards;
  - individual accountability, based on student growth.
3. Multi-faceted assessment
  - multiple opportunities for students to receive feedback and revise their work (e.g., benchmarks, reflective activities);
  - multiple learning outcomes (e.g., problem-solving, content, collaboration);
  - presentations that encourage participation and signal social value (e.g. exhibitions, portfolios, performances, reports, scientific communication sessions etc.).
4. Participation in a professional learning network
  - collaborating and reflecting upon PBL experiences in the classroom with colleagues. (<https://www.edutopia.org/pbl-research-learning-outcomes>).

## **2. WHAT IS AN EUROPEAN PROJECT SEMESTER?**

The European Project Semester (EPS) is a programme offered by 18 European universities in 12 countries throughout Europe (Romania, Spain, United Kingdom, the Netherlands, France, Germany, Austria, Poland, Norway, Belgium, Portugal, Finland) to students who have completed at least two years of study. EPS is created with engineering students in mind, but other students who can participate in an engineering project are also welcome.

It is crafted to address the design requirements of the degree and prepare engineering students with all the necessary skills to face the challenges of today's world economy. EPS is a mixture of "Project Related Courses" and Project organized/problem based Learning.

Students work in international and usually interdisciplinary teams of 3–6 students on their projects, and most of the projects are interdisciplinary. Some projects are done in cooperation with commercial businesses and industries, other projects are more academic.

Students learn to learn and to take responsibility for their learning and their project work and they develop their intercultural competences, their communication skills and their interpersonal skills.

It is worth mentioning that there are slight differences in EPS among providers. Nevertheless, all providers have agreed about "The 10 Golden Rules of EPS":

- 1) English is the working language of EPS.
- 2) EPS is multinational with a group size of min. 3 and max. 6 students being 4 — 5 the ideal number; min. 3 nationalities must be represented in an EPS-group.

- 3) Ideally, but not necessarily, an EPS-project is multidisciplinary.
- 4) An EPS-semester is 30 ECTS, the duration of which is not less than 15 weeks.
- 5) An EPS-project is minimum 20 ECTS and the subjects between 5 and 10 ECTS.
- 6) The main focus of EPS is on teamwork.
- 7) The subjects addressed by EPS must be **project supportive**; English and a basic crash course in the local language must be an option.
- 8) The subjects must include Teambuilding and Project Management in the beginning of an EPS-semester.
- 9) Project supervision/coaching must focus on the process as well as the product.
- 10) EPS must have continuous assessment including an Interim Report and a Final Report.(retrieved from <http://europeanprojectsemester.eu/info/Introduction>, January 28<sup>th</sup>,2017).

The EPS is a semester-long programme, which is designed to train graduate engineering students to work in international teams. The semester is divided into two parts:

- A study programme including courses on different subjects such as project management, problem-solving techniques, sustainability, communication skills, cross-cultural behaviour, and languages.
- A real life project on site of and for a real company, performed by a multi-national, multi-disciplinary team of students.

EPS is a 30-credit unit course according to the ECTS Qualitative Scale System.

The main objective is to train students from different countries and different disciplines to work together in multi-cultural and multi-disciplinary groups. The students work together to execute an integrated engineering-design-and-business project, focusing on:

- The development of personal competences, especially the ability to work and communicate within cross-cultural groups.
- The interrelated work of several educational disciplines like mechanical & electrical engineering, design engineering, information technology, business & management etc.

### **3. EPS AT UNIVERSITY POLITEHNICA OF BUCHAREST**

University POLITEHNICA of Bucharest has become an EPS provider in **2013**, at **St Polten - Austria**, when it was admitted in the consortium. UPB has agreed to implement the EPS program in compliance with the „10 Golden Rules” established by the consortium.

The European Project Semester was first launched and implemented within the Faculty of Mechanical Engineering and Mechatronics, the Department of Industrial Design in 2014.

Since 2013, there have been formed 9 multinational student teams working on various projects, requiring abilities from a wide range of engineering fields: mechanical, electronic, computer science, chemical. The projects have been carried out in collaboration with industrial agents in the field of automated systems, medical rehabilitation and furniture design and manufacturing.

In 2016, EPS coordinators tried to identify the strengths and drawbacks of the use of Project-based Learning in the running of the program.

Hence, the first stage of the survey, which is part of a further ampler research, illustrates some of the EPS students expectations:

- to work in an engineering company;
- to work in their home country;
- have entrepreneurial/soft skills.

The open question posed was: “What is PBL for you? What does it mean to you?” The target group was made of both local and foreign students representing Spain, the Netherlands, Portugal, India, Tunisia, Poland, France and Greece with studies in mechanics and mechatronics, computer science, information technology, bio medical engineering and electrical engineering.

The results of the survey illustrate EPS students’ opinions as far as Project-based Learning is concerned and the role of this approach in fostering their soft skills. Thus, for them, PBL is:

- challenging;
- team work & personal involvement;
- educational/instructional (due to rich subject matter);
- students’ choice and voice within and outside the team;
- cross-disciplinary;
- springboard for the world beyond school;
- interesting and motivational;
- thought-provoking;
- clash of ideas, personalities and cultural backgrounds;
- reliable means of developing soft-skills;
- constant “quarrel” among team members;
- demanding and sometimes exhausting;
- a real life/professional situation.

#### **4. CONCLUSIONS**

There is a growing need for a meeting point between university and industry - designing coherent programmes that help in the transition from engineering education at university to the needs of the workplace - bridging the gap through company-university collaboration in course design.

By expanding the number and diversity (in terms of country and type of education) of the participating institutions in higher education, the international and intercultural character of the programme will grow. Moreover, exchange opportunities for students and teaching staff will increase.

For these reasons, we believe that to improve the quality of learning, in terms of equipping students with transversal skills to survive and adapt easily to real workplace scenarios, and preparing them for the demand of the real life globalized employment market, new training programmes are required and should be based on multidisciplinary collaboration between Higher Education Institutions and companies at an international level.

According to Arvin Andersen, the founder of the program in Denmark, modern engineering education should be focused on some generic competences: teamwork, interpersonal skills, the ability to work in an international team with students of different disciplines, nationalities and study levels.

All in all, the development of soft skills through PBL, provided by EPS program, lies at the very heart of integrated engineering. Such integrated engineering projects are learning and teaching methods by which new materials and competencies may be introduced, it is not just an opportunity to practice what has been taught.

This multidisciplinary approach requires the collective effort of specialists with different kinds of expertise.

It is said that teams promote synergy where results outweigh the sum of individual team member’s contribution. It is important therefore, that each member of the team not only

contributes but also adapts and is ready to accept different ideas and opinions. It is therefore important for engineering students to adapt and become tolerant and understanding of various cultural backgrounds.

The implementation of the Project-based approach, within an European Project Semester program, aims to get the most out of each engineering student in terms of his/her skills and competences and to endow them with the soft skills likely to facilitate their smooth insertion into the work market.

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