

# THE EPS@ISEP PROGRAMME: A GLOBALISATION AND INTERNATIONALISATION EXPERIENCE

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## Abstract

Higher Education Institutions (HEI) design and implement globalisation and internationalisation policies to promote the image, expand influence and increase both the number and quality of staff and students. This is especially important for engineering schools competing for the reduced cohort of motivated Science, Technology, Engineering and Mathematics applicants available yearly. Moreover, to train future engineers, engineering education needs to depart from the traditional teacher-centred paradigm. Student-centred learning is central to maintain high student motivation and to drive the development of hard (scientific and technological) and soft (inter-personal) skills. For students to develop these 21st-century engineering skills, today's curricula must embed student centred pedagogical methods, address the design and implementation of solutions guided by ethics and sustainability, and expose undergraduates to multicultural multidisciplinary teamwork, under strong efficiency constraints.

The European Project Semester (EPS) is a project-based, international teamwork initiative, that replaces the capstone design semester of undergraduate engineering degrees. It is offered by a network of 19 HEI located in 12 different European countries [1]. The network develops transnational projects together and exchanges students, staff, ideas, and best practices, expanding the influence of the providers.

EPS at the Instituto Superior de Engenharia do Porto (EPS@ISEP) runs in the spring semester [2]. It provides 30 European Credit Transfer System Units (ECTU), with 20 ECTU assigned to the project module and 10 ECTU equally divided by five support modules: Energy and Sustainable Development, Ethics and Deontology, Foreign Language and Culture, Marketing and Communication, and Project Management and Teamwork.

The programme is offered to international and local students, but during its 12-year existence most students were international. The students are placed in teams considering psychological profiles. The multiculturalism and the diversity of skills within teams also fosters a more inclusive and enriching learning experience. The sustainability and ethics objectives are requirements to be considered in the solution design and in the choice of technologies and components for the project implementation. The weekly project meetings between the teams and the coaching panel (7 teachers from 6 different departments), are not only pivotal to the project-based learning process but promote the internal dialogue between departments and scientific areas.

The reduced project budget provides a strong creative stimulus, while reinforcing the sustainability criteria, since turnkey solutions and waste are incompatible with a constrained bill of materials. Besides the positive effect of the programme on student training/education, as shown by the grades and the projects' documentation, EPS@ISEP has strongly influenced the teacher's skills and performance, as attested by the number of programme-related publications and its influence on other courses and modules offered by ISEP.

EPS@ISEP is an effective low-cost programme that acts as a testbed and catalyst in the process of bringing engineering education into the 21st century, following sound ethical and criteria. EPS@ISEP contributes to the globalisation and internationalisation of ISEP as well as to the dissemination and adoption of best practices in engineering education.

**Keywords:** Capstone design semester, engineering education, European Project Semester, ethics, globalisation, internationalisation, multicultural teamwork.

# 1 INTRODUCTION

The objective of the ERASMUS+ programme is to provide students with a multicultural experience, placing them in contact with fellows and teachers from other nationalities. As a side effect, that should improve the learning and teaching processes. On a normal ERASMUS+ mobility, students travel to another country, in small groups of students from the same country, and contact with local students. They usually realize a capstone project, with a limited amount of social interaction, when compared to other educational activities. When attending other types of classes, they are not at ease because they are seen as outsiders by many local students. Sometimes, their presence is an obstacle to change in educational methods, as a strong effort to produce multilingual educational material needs to be done, at a short notice, invalidating other activities.

# 2 EPS@ISEP

To replace the traditional capstone design semester of undergraduate engineering degrees, a project-based, international teamwork initiative called the European Project Semester (EPS) has been created. It is offered by a network of 19 HEI (from 12 different countries) that exchanges of students, staff, ideas, and best practices, as well as promotes joint projects.

The EPS implementation at the Instituto Superior de Engenharia do Porto (Polytechnic of Porto's Engineering School) is known as EPS@ISEP. It has been running on the spring semester since 2010/2011 and lasts 15 weeks. Besides the main project module with 20 ECTU assigned, there are five other support modules: Energy and Sustainable Development, Ethics and Deontology, Foreign Language and Culture, Marketing and Communication, and Project Management and Teamwork. The support modules share 10 ECTU, totalling 30 ECTU.

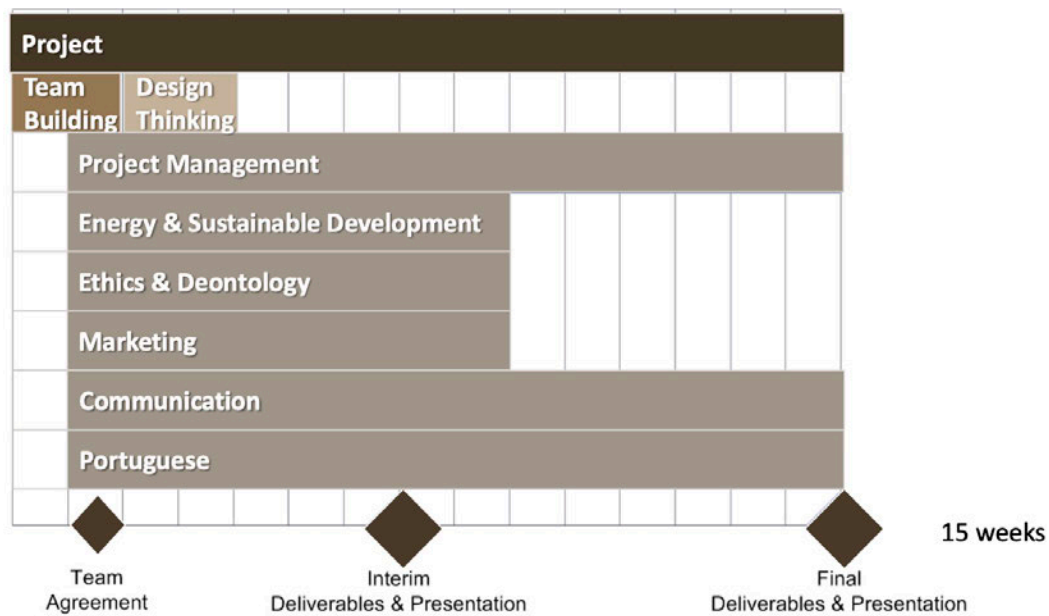


Figure 1. The EPS@ISEP Timeline.

In the past 12 editions, EPS@ISEP has welcomed 252 students from Angola, Austria, Belgium, Brazil, Switzerland, Estonia, Finland, France, Germany, Greece, Hungary, Italy, South Korea, Lithuania, North Macedonia, Netherlands, Poland, Portugal, Romania, Spain, Turkey, United Kingdom and United States. These students were enrolled in 69 different degrees offered by 51 HEI, including ISEP, and participated in 50 teams/projects. A detailed graph (from 2011 till 2022) can be seen in Figure 2.

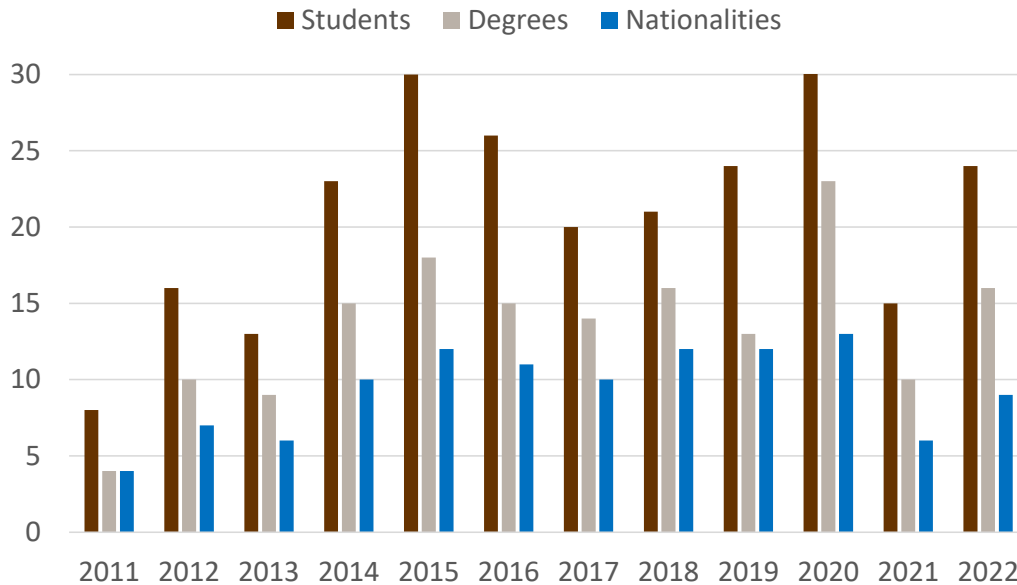


Figure 2. The EPS@ISEP Team Composition.

The team formation is done considering technological background, cultural heterogeneity, and psychological profiles. EPS@ISEP teams comprise students from diverse multinational and study fields, maximizing the cultural experience, that starts with team-building and relies on extensive teamwork.

In sharp contrast with typical capstone projects where there are only one (or two) supervisors, EPS@ISEP presents a coaching panel (7 teachers from 6 different departments). As the project is based on an open-ended Project-Based-Learning methodology, a truly diverse coaching panel is needed to provide the support the teams need. As a communication tool, each team has a public wiki, that is used to place the various deliverables, including the report, and the agenda for weekly project meetings between the teams and the coaching panel. These meetings are central to the project-based learning process and, together with the teamwork, ensure that the students practice their communication skills [3] resulting in a strong student-centred learning process, as can be seen on Figure 3.

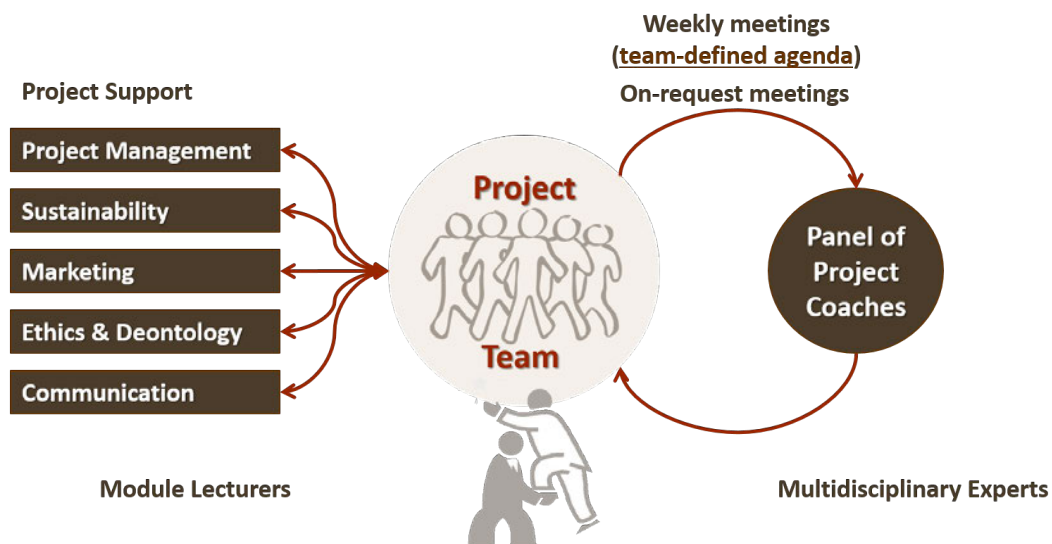


Figure 3. The Student-Centred Process.

The enlarged supervision group works also as catalyst for other projects, and pedagogical innovation among teachers. A typical mobility student has not a strong influence on teachers, in teaching methods or curriculum as, due to their limited number, they are exceptions. The enrolment of international students in EPS@ISEP ensures their collective influence on the pedagogical methods of the host HEI.

### 3 RESULTS AND CONCLUSIONS

The different modules that constitute EPS@ISEP are not water-tight units, but work in dialogue and in permanent cross-influence. The influence and seriousness of the modules can be seen from an analysis of the areas that are related to the students' projects (2011-2022). There are four projects related to Sustainable Robotics, nineteen about Smart Cities, four about Human Health, eleven about Sustainable Food Production, and seventeen about Environmental Sustainability. These areas are aligned with United Nations' Sustainable Development Goals and should be an integral part of the training of every engineer, despite being still ignored in many engineering curricula.

According to employers, Soft Skills proficiency is lacking in engineering graduates [16]. The most basic soft skill is communication, and as any skill needs practice. This can be achieved by experiencing the importance of proficient communication within a multicultural and scientifically diverse team, as is done in EPS@ISEP. As a counterpoint, when placed in a traditional capstone project, the student interacts only with people from the same scientific and cultural backgrounds.

Another disadvantage of a typical capstone project is the writing of the final report, that is supposed to teach the student to write, with the sole help of the supervisor. In contrast, EPS@ISEP students have the support of a Communication module, where they produce a wide variety of documents for different targets. Besides the report, each group authors a technical article, a product brochure/flyer/leaflet, a poster, a user manual for the product, a presentation, and a video. All these deliverables ensure that the students not only document their work but must also think about the communication process and targets, adapting their message to very different media.

The publication of scientific papers in international conference proceedings, with the students as co-authors, is a motivational tool, a demonstration of the acquired skills, and, to some extent, an indicator of the success of the programme. Over 30 articles have been published in conferences like ECUMICT 2014 [4], TEEM 2015 [5-7], CISPEE 2016 [8], SEFI 2017 [9], ICL 2016 [10,11], ICL 2017 [12,13], ROBOT 2019 [14] and EDUCON 2020 [15].

From a series of interviews with all the participants in the 2021/2022 edition of EPS@ISEP, it is possible to draw some results about its strong points. For many students, the increased interaction level required by EPS, when compared with other types of student mobility, has brought a significant improvement in the usage of English, and a stronger level of self-assurance when using English in public. The same interaction, coupled with the multicultural and diverse technical background of the groups' members, has helped the students to develop further their soft skills. This perception is verbalised by the students as "Up to now, I had group work always with the same-minded people" and "It is hard to work with different people, and we learned how to do it."

For engineering students, EPS expands their scope of action. They venture into fields other than their major, namely, project management, software development (Web/Mobile Apps and Internet of Things), chemical, mechanic, and electrical analyses, considering ethics, market, and sustainability dimensions, and finally understanding the role and the value added by product design to the project outcome.

The design students consider valuable the technical knowledge gained from the contact with engineering students, finally seeing the whole process from the ideation stage to a functional prototype, giving closure to the design. This perception is summarised by the following words of a design student: "Now I have a confirmation that my degree is useful."

The interviews with the students were also valuable to collect improvement suggestions. While students consider all scheduled activities relevant and necessary, their main suggestions focus on the relative weight and time distribution of some activities.

In conclusion, EPS@ISEP has been battle-tested in 12 editions and has been validated as an effective programme for modernizing and internationalizing engineering education, bringing it into the 21st century. EPS@ISEP contributes to the globalisation and internationalisation of ISEP as well as to the dissemination and adoption of best practices in engineering education. These objectives are attained through low-cost, ethics, market and sustainability driven methodologies, that can be implemented in other institutions/situations.

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