



BOOST I&E CONCEPT FOR URBAN MOBILITY EDUCATION

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ABSTRACT

Modern higher education needs to provide skills needed in working life, such as entrepreneurship, besides the more traditional technological competence. The Boost

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I&E Project² was developed in 2020 and 2021 with the aim of generating a set of guidelines for innovation and entrepreneurship challenge-driven projects for master's programmes. The added value was created by collaborating and exchanging best practices among higher education institutions in seven different countries, with the aim of developing students' skills with an international perspective and exposure to the knowledge triangle. The implementation of Boost I&E would allow learning about the advantages and disadvantages of different approaches in a practical way, while courses on urban mobility were provided. The activities involved more than 100 students over two years.

The experience concluded with the adoption of a set of guidelines based on best practices, covering several aspects. Most emphasis was placed on the methodology of the course, on sharing activities and on finding best practices and implications for stakeholders. Our experience can be useful for universities that want to open up their students to I&E.

1 INTRODUCTION

In the last 15-20 years, there has been a push to renew higher education, shifting from a technical knowledge-focused paradigm to a model that, without losing scientific and technological competence, also provides skills needed in practice. Students need to be trained to meet the demands of society at large. Students from all disciplines need to be trained in discovering the most relevant needs of their communities, defining alternative solutions, choosing the most impactful ones based on approaching users and other stakeholders and, finally, designing and developing the chosen solutions; this last step being the only one usually carried out in traditional curricula. There are many societal needs that can be addressed through this approach, such as all those mentioned in the UN Sustainable Development Goals (SDGs) [1], which are reflected in the EIT's Strategic Objectives for Urban Mobility [2]. Urban mobility is one of the themes best suited to this new approach, as the urban population as a whole is the target and many of the stakeholders are public institutions. It would therefore be reasonable to emphasise human- and user-centred design in the curricula, while promoting our students' skills in social innovation and entrepreneurship so that they become the drivers of change in our communities.

The Boost I&E project was developed with the intent to investigate such aspects in the context of urban mobility within various European universities. The consortium partners already had experience with different types of teaching and learning activities suitable for this purpose, but not with all of them and not to the same extent. A practical "learning by doing" approach was proposed:

- Each institution adapted a suitable existing course (or developed a new one), using different methods and a common topic on urban mobility.
- Teaching experiences and learning outcomes were shared through meetings, faculty exchanges, and joint events with the students from the different institutions.
- The results and process were analysed and a set of guidelines was proposed for designing appropriate teaching and learning methods for I&E education, mainly focused on Masters programmes.

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1.1 Existing alternatives to deploy I&E education

The more relevant alternatives that could be considered for develop I&E skills within a course or part of a course are the following:

- The Case Method. A set of cases are presented that have a real basis but are tailored to be useful for learning. Solving the cases forces the students to make decisions that can be compared to the decisions made in existing (“traditional”) solution [3].
- Project-Based Learning (PBL). Although it allows for different definitions and implementations, the most comprehensive is the replacement of part of the teaching methodology of one or more courses with a project that forces students to search for information, learn methods, and make decisions that will provide them with learning outcomes that are coherent with the objectives of the course. The cases are usually artificial and are defined by faculty members and not by external stakeholders. [4]
- Product Development Project (PDP). A team of students carries out a project to develop a product or service to solve a challenge that is usually specified by an external organisation (e.g., from the industry or public sector). Although this modality is more suitable than the previous one for the objectives of this project, most PDP carried out in engineering schools start from requirements and even specifications based on decisions already made by the external entity. The user approach is thus limited and part of the creative phase may be lost. [5]
- Challenge-Based Learning (CBL). In this case, usually, a very open challenge is provided to the team by the external organisation. Usually a Design Thinking methodology is used. The team of students must carry out an in-depth research to discover the users' needs related to the challenge, choose the most relevant ones, define different solutions, and choose the most appropriate one, developing a proof-of-concept prototype. Decisions in all phases should be based on feedback from users and other stakeholders. [6]
- Hackathons and Intensive Courses. They are shortened versions of a CBL course, with more or less open challenges. The hackathon carries out the whole process in a short time, for example two days, and the intensive courses can last 1-2 week(s), which can be separated over the semester. [7]

1.2 Context

Most institutions within Boost I&E implemented one or more of the learning modalities described in the previous section, although in most cases students from the same or closely related disciplines were included.

The most relevant features in relation to Urban Mobility are:

- following a user-driven environment;
- defining the challenges together with actors from the urban mobility sector;
- developing innovative ideas that can result in a start-up or that can be transferred to existing development platforms;
- training graduates with a set of skills suitable to transform innovation into a socially driven paradigm according to the EIT's overarching learning outcomes.

1.3 Goals and Scope of the Boost I&E Project

The purpose of the Boost I&E Project was to experience and recommend New Guidelines for an I&E Challenge-driven Academic Activity for Master's Programmes with the added value of boosting performance through collaborating and sharing best practices across institutions, focusing on developing students' I&E skills with an international perspective and exposure to the Knowledge Triangle.

The following objectives were effectively addressed to achieve this goal:

- Objective 1 - Propose initiatives for I&E challenges at academic level. Most universities participating in the project already had some experience of 'learning by doing' approaches, presenting open challenges to their students. Some institutions had specific I&E rooms to develop innovative solutions to real challenges with the participation of local stakeholders.
- Objective 2 - Real challenges for urban/urban mobility actors. One of the main points of this initiative was to add an extra value to the courses by making challenges faced by the Urban and/or Urban Mobility Actors occurring at European level.
- Objective 3 - Innovation and Business Mindset. The challenges presented were real-life and therefore the solutions had to be approached from a business perspective. The whole process had to be guided by observers from the business world.
- Objective 4 - Share best practices. The best way to improve the performance of the challenge project was to share methodologies and best practices to improve the project courses in each institution.
- Objective 5 - Sustainability and Scalability Mindset. As cities may face similar problems, the proposed approaches should focus on deploying sustainable and scalable solutions in a global market.

So far, there have not been many examples of international experience sharing among I&E spaces. Most challenges are usually identified and developed locally and with local stakeholders [10] or if they are international, are not embedded in courses [9]. By sharing challenges that are similar but have a different context in each city, students develop skills to better cope with global markets. Moreover, this experience helps to enhance the capacities of faculty members who lead academic I&E activities and disseminate this way of teaching in their own institutions in the framework of courses included in the curricula.

The intention is to extend the results of this project to other academic units within the consortium, and once the guidelines are well established, they can serve as an example for other higher education institutions. One of the particularities of urban mobility compared to other fields is its multidisciplinary perspective and the participation of cities, which propose to work on challenges that are very close to the needs of citizens.

2 METHODOLOGY

2.1 Implementation of the Project

Figure 1 shows the different phases of the project with regard to the activities in 2020 and 2021. The projects had a duration of one year and two editions were implemented. During the second year, additional partners joined this initiative, which can therefore start from the experience gained in 2020.

The **Kick-off Meetings** were held in early January 2020 and early January 2021, respectively, with representatives from all academic partners in order to establish the academic framework for the development of the project.

Train-the-Trainers events were intended for university teachers and managers of educational programmes involved in entrepreneurship education. The Train-the-Trainer sessions were based on experiential learning principles and were designed as a short entrepreneurship course, using teaching approaches and methods previously tested by Aalto Ventures Programme. In 2020 it was held at the beginning of the year, in 2021 in mid-March and with a different focus.

I&E Challenge Development, during the first semester of the year from the beginning to the end of the course in each institution, student teams worked on their solutions

Their work was not only supervised by academic staff, but also by representatives of companies and cities. Each institution could also integrate lectures on different aspects of I&E and relevant topics related to the problem to be solved.

Exchange of faculty observers, the original aim was to visit other institutions face-to-face. Because of COVID-19, this was changed to online meetings to share experiences, virtual visits to the courses, student presentations including final presentations, and partner questionnaires to gauge the opinions of the other institutions.

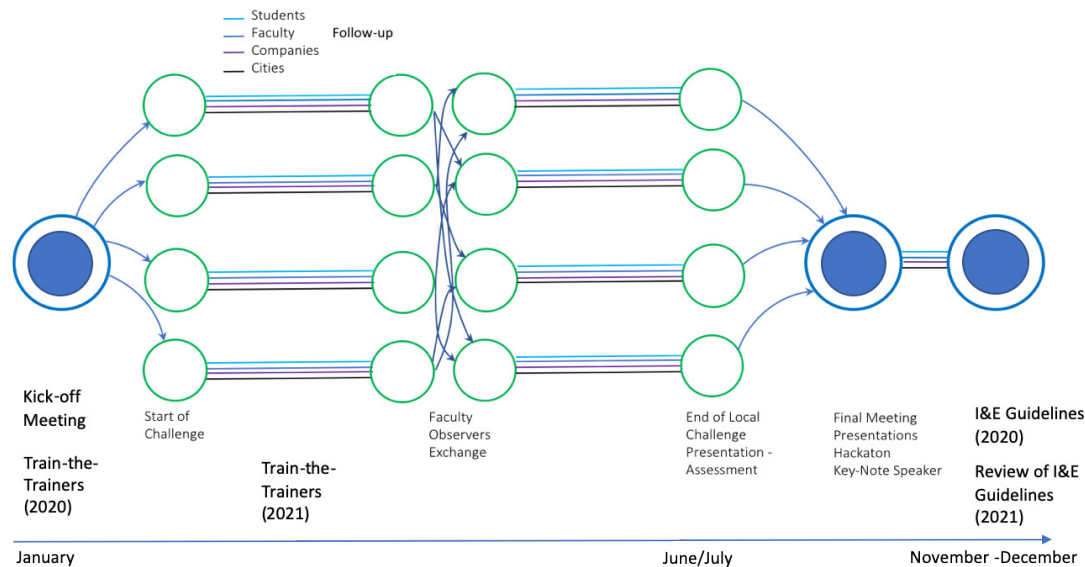


Fig. 1 Implementation Process of Boost I&E. Circles represent milestones, whereas lines development of activities and arrows relationships

At the end of the Local Challenge, students presented their solutions and the evaluation was carried out. At the final presentation of the students' projects, representatives of cities and local businesses were also invited in order to provide first-hand feedback on the innovation potential of the proposed solutions. The learning outcomes were evaluated. The best team from each university was selected to go to the final meeting.

The **final meetings** were held online in 2020 and face-to-face in 2021. The following activities were devised:

- Invitation of relevant keynote speakers.
- Presentation of the results of student teams from each institution. Prizes for the best teams. Invitation of a representative of the cities and representatives of companies.
- Hackaton, named "Urban Mobilithon", where mixed student teams were assembled to work on a challenge to be solved in the host city. Invitation to Representatives of the City and Representatives of Public and Private Stakeholders.
- Academic meeting of representatives to draw final conclusions

Guidelines for the I&E Challenge-Driven Academic Activity for Master Schools. After the activities, the partners worked on defining best practices. Therefore, Guidelines for International Cooperation I&E Challenge-Driven Projects in Urban Mobility were drafted.

2.2 Observed Best Practices

The activities carried out at each institution were assessed by the other partners, with the goal of identifying the most relevant best practices, ranking them by affinity



and included in some way in the general guidelines of Boost I&E. These practices are as follows:

- Planning for a good balance of technical and I&E skills
- Working with strong links to stakeholders
- Creating multidisciplinary teams
- Including sufficiently broad challenge topics to encourage creativity and autonomy
- Breaking up the challenge into sub-challenges, when many students participate in the course and the challenge allows it
- Challenging students to conduct interviews with many users and stakeholders
- Pushing students to get a good understanding of customer needs
- Pushing students to work out a rationale behind each decision
- Inviting relevant guest lecturers
- Performing intermediate checks of the challenges
- Visualising other teams at universities solving similar challenges
- Promote the achievement of a result that is ready to be piloted
- Sharing best practices with other partner universities
- Getting the support and encouragement of the leaders in the academic institution and making the links with other courses and the curriculum in general

3 SUMMARY OF GUIDELINES

The guidelines include features identified on the basis of lessons learned from implementation and exchange of best practice between institutions. It is strongly recommended to follow CBL projects. These features are summarised in the following subsections. For more information, the full version of the guidelines can be downloaded from [8].

3.1 Teaching and learning activities

Challenge-Based Education is mainly based on cooperative and experiential activities. The student teams have to carry out field research and conduct interviews with users, customers and experts. This requires time of autonomous work between sessions and in some phases a period of a week is not enough to collect and process the information.

Regular short presentations in the classroom, to get feedback from the teachers/coaches and from the classmates play a big role in the learning process.

On the other hand, it is also useful to share ideas in a different environment than the classroom and look at different solutions in similar processes. Hackathons and inter-institutional activities offer the chance to get to know different points of view and learn different tools.

3.2 Time distribution of the activities

Courses spread over a full semester are preferred. There is also a trade-off between breadth (scope) and depth. For example, courses of 5 or less ECTS allow for a reasonable range of I&E learning outcomes, but are limited to concept-level developments (need-solution-business idea). For deeper results, larger courses (10-12 ECTS) are a better choice. Combinations between an ideation course and a technical development project course with the same challenge is also an option.

3.3 Multidisciplinary

Multidisciplinary and diversity are essential in CBL and Design Thinking education. The possibility of including truly multidisciplinary students in the teams (i.e. not only



different engineering disciplines but also architecture, business, design, arts or social sciences) adds tremendous value to the innovativeness of the courses, but it is usually not easy to organise because it requires cross-school or cross-university collaboration. It is also about having different ways of thinking. Multidisciplinarity can include diversity (gender, age, culture, nationality, etc.) and organisational complexity.

3.4 Challenge Selection

In urban mobility, many stakeholders are public institutions or public transport operators. Common projects involve a request for a public tender. The I&E possibilities in this framework are therefore limited.

To work on CBL, we need to ask stakeholders to propose more open projects. It is advisable that the challenge belongs to a live or near-future project of the stakeholder. If challenges are generic, they need a lot of time to converge. Therefore, challenges should be open, but not excessive. Another possibility is to work on campus-based challenges with their advantages and limitations.

3.5 Role of the external stakeholders

The role of the representatives of the external companies or institutions is essential. They have less effect if they only act as guest lecturers or external observers. The effect is greater if they behave like clients or contractors. A similar effect is achieved if part of the I&E training workshops is given by staff from the knowledge transfer unit of the university or by external innovation consultants.

3.6 Assessment of CBL Projects

Team rating seems to be the main tool for assessing CBL projects. Several institutions use it without individual assessment, while others include an individual modulation in relation to the team rating. External stakeholders give an opinion but do not participate in the assessment.

The individual modulation can have up to three contributions: Supervisors/coaches collecting evidence (participation, effort, value); assessment by the team leader (if any); and peer assessment, via a rubric. Apply peer assessment only if there is no agreement in a team negotiation.

It is difficult to give an absolute mark to all activities.

3.7 IP, Sponsorship

In most universities, the intellectual property of the project results belongs to the students. Conflicts may arise when an external institution or company sponsors the project. There is a trade-off between giving the student an incentive and getting relevant challenges and implications from the companies. Sponsorship of CBL ensures more involvement on the part of the company. The case for UM may be simpler, as public stakeholders in this field do not ask for IP ownership. Open projects proposed by public institutions may provide more opportunities for students' initiatives. Intellectual property is just one potential benefit for an external partner. The cooperation between sponsors and students during the CBL project is a competitive advantage in talent recruitment. Additionally, sponsorship can also be part of the companies' social corporate responsibility initiatives.

3.8 Sustainability and Engineering Ethics

UM is suitable for training socially oriented engineers. Seminars on sustainability, with specific reference to the UN SDGs, are also recommended. Sustainability analysis of their projects is a must, including social, environmental and economic aspects.



Business and Engineering Ethics should also play a role in I&E courses. Not only for the implications arising from the use of technology, but also for the mission, governance model and value chain of the business models developed by the student teams.

3.9 International Perspective

The possibility of cooperation between universities from different countries makes it possible to observe course development and share best practices. When the challenges are similar, it is easier to compare methodologies and activities and take note for current or future editions. Students observing students from other universities, with the practical solution of sharing this online in the middle of the semester, allows them to observe directly and possibly apply different perspectives to improve their own projects. They also get an idea of cultural issues and different legal structures. Sharing presentations from stakeholders or other invited speakers gives them a chance to broaden their international and triangular exposure. Organising Hackathons (Mobilithon) as a final activity, preferably face-to-face in a particular city and facing different challenges, boosts their motivation and establishes their I&E skills.

3.10 Self-assessment of I&E skills

We delivered surveys for self-assessment of the students' I&E skills, both before and after the courses at some universities. The comparison shows an overall slight improvement in the perceived level of I&E skills of students. For instance, one of the universities surveys results show that the number of students who think they can present creative ideas has increased.

3.11 Additional Features

Learnings from COVID-19 confinement

There were limitations to the lessons from the COVID-19 pandemic restrictions: difficulties in conducting user interviews and testing prototypes in the field and no possibility to visit other courses face-to-face (F2F) to observe practices. However, there were learning points that may be useful even if face-to-face returns: mastery of online meeting platforms (Zoom, Meet, ...); remote user interviews and surveys; prototyping and testing based on multimedia representations of the ideas; etc

Opportunities for Master Students to pursue an Entrepreneurial Career

Challenge solutions are usually not ready to be marketed. Some students have shown interest in going beyond the project. We can offer them support and information: by introducing them to the university's incubators; the cities' incubator programmes; and, in particular, the EIT Urban Mobility Accelerator Programme.

4 CONCLUSIONS AND EVALUATION OF RESULTS

Most emphasis of the project focused on the sharing of activities and looking for best-practices and finding stakeholder implication. Although all elements were discussed, in the future, we have to focus on some issues, as sharing best practices for evaluating I&E skills before and after students have taken the course, sharing how assessment was carried out, or even to increase stakeholder implication and sharing talks by experts.



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