

## COLLABORATIVE WORKSHOP: SUSTAINABLE CIVIL ENGINEERING PROPOSALS FOR REAL SETTINGS

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**Abstract.** The objective is to familiarize students with real civil engineering problems as posed by social agents (e.g. a city council, a neighbourhood association, etc.) and to foster social responsibility, active and cooperative learning, teamwork and sustainability. A multidisciplinary team accompanies students in finding solutions to problems affecting a region, with the goal of training them in how to sensitively deal with complex urban realities and understand the possible impacts and conflicts of their projects for their region and society. Methodologically, this training strategy is based on active teamwork and cooperation applied to a real case. It is also influenced by service learning in that local stakeholders explain their problems to the students and ask for solutions. This initiative is not part of any study plan but is a complementary teaching activity organized by the Civil Engineering School of Barcelona and worth 3 ECTS for participating students. In 2016-2017, the workshop —covering problems related to harbour design, water quality, pedestrian bridges and retaining walls— was conducted in Marina d’Empuriabrava on the Costa Brava, proving to be a very satisfactory experience for students, teachers and local stakeholders in terms of learning and proposals. In 2017-2018 the workshop has been held in El Vendrell (Tarragona). In the next, editions, it is planned to make ongoing improvements in terms of time organization and teamwork evaluation.

### 1 INTRODUCTION AND OBJECTIVES

The engineer working in the field of civil and environmental engineering develops a professional practice related to the construction of new infrastructures. These projects induce a series of socio-economic and territorial impacts, both positive and negative. Facing a social reality with a large number of conflicts linked to these types of projects [1], there is a need to improve the engineer’s awareness of environmental and social issues.

The engineer should be able to work in teams under interdisciplinary conditions with good communication skills to explain the complexities of their works. Thus, one of the teacher's basic responsibilities is, precisely, to provide the student with an analytical capacity and a critical

vision in the process of territorial intervention.

This is the main objective of the educational initiative that is hereby presented, which aims to bring the student closer to real problems in civil engineering and to foster the skills of teamwork, sustainability and social commitment, through active and cooperative learning. Thus, it seeks to train sensitive professionals to deal with complex urban realities and with the social needs and the conflicts that their projects can generate.

The learning objectives involve integrating and applying the knowledge acquired during the Bachelor's Degree in Civil Engineering and in Public Works Engineering in a real context. To this end, a collaborative workshop has been designed, in order to propose solutions to specific stakeholders' demands. Thus, the students are offered a unique opportunity to get in touch with real problems before graduating and entering the professional world.

In this process the values of sustainability and social equity are questions of great complexity and transcendence that must be dealt with both directly and openly (speaking and discussing them in the classroom), as well as indirectly, through teaching methodologies that promote collaboration and teamwork. As pointed out in the precepts of Education for Sustainable Development (EDS from now on), these issues are essential to train competent and capable professionals to build a better future [2, 3]. The EDS demands participatory methods of teaching and learning that motivate students and give them autonomy. It also encourages skills-development such as critical thinking, the development of scenarios for the future and supports collective decision-making. The EDS demands major changes in the pedagogical methods that are currently applied.

## **2 DESCRIPTION OF THE INITIATIVE**

The learning process is based on active and participatory methodologies, encouraging collaboration and permitting students to get in contact with multiple disciplines and stakeholders, in order to generate creative solutions to the problems raised [4]. In active methodologies, the common denominator is to transform the student from a mere spectator into an active subject. The approach of this initiative seeks to simulate scenarios or real life problems, in order to implicate and motivate the students in their learning process, since bringing them closer to real and contemporary problems increases their interest [5].

Methodologically, the learning process is based on the case study approach, which creates an activity around a real case that must be developed in groups, where the theoretical questions studied during the Bachelor's Degree programme are applied to analyse and solve problems related to civil engineering. Likewise, the activity also has an influence from the service learning because the students are immersed in a complex and real situation where social agents will ask them to propose solutions.

This initiative is not part of any study plan but is a complementary teaching activity organized by the Civil Engineering School of Barcelona and worth 3 ECTS for participating students.

It consists of several stages and activities:

- **Diagnosis and organization:** It starts with a technical visit where several actors accompany the students allowing them to get to know first-hand the problems that must be addressed (Figure 1). Later, in a classroom session, the problems and the observed

needs are shared. Students organize themselves to share all available information (plans, documentation, photography, etc.), identify shortcomings and knowledge needed to proceed with the preparation of proposals. Then they look for experts and professors of the Civil Engineering School that will be invited to the next session to obtain advice or interview them. Problems are prioritized and work groups are created to be effective in finding solutions. The main purpose of this stage is to turn the student into an observer and active subject, to be able to assess the problems at stake.

- Elaboration of proposals: It consists of two face-to-face sessions and independent work out of the classroom. If the students consider that they need support, they contact with other experts or professors at the Civil Engineering School. Moreover, guest lecturers are invited to the class to discuss the ideas with the students, in order to confirm or reject proposals to addressed problems.

In the second session, the proposal phase comes to the end and the presentations for giving back the proposals to the municipality are prepared.

- Return: A return session is held at the stakeholder's facilities, those who have made the request (social entity, town hall, etc.), where other agents of the territory can be invited. This activity is very important for both parties, as it makes visible the work done and highlights the effort of the students. At the same time, the students provide their ideas to the stakeholders' demands as if they were engineers, simulating a real situation.
- Assessment and feedback: On the one hand, both the municipal technicians and the teaching staff involved give a qualitative feedback to the work done by the students and on the other hand, a questionnaire of satisfaction is distributed among the students and technicians, in order to collect their feedback of the activity.

### 3 IMPLEMENTATION OF THE INITIATIVE

In the course 2016/17 the experience was carried out in the context of the Costa Brava, specifically in the Marina d'Empuriabrava. The Community of landowners invited a group of students to assess the civil engineering problems that the marina have, coinciding with the 50<sup>th</sup> anniversary of its construction (Figure 1).



Figure 1: Field trip to Empuriabriava



Figure 2: Return session in El Vendrell

The participating students (twelve) worked in 4 groups, in a cooperative way to make proposals applicable in the field of structures (walls and bridges), water quality, urban planning

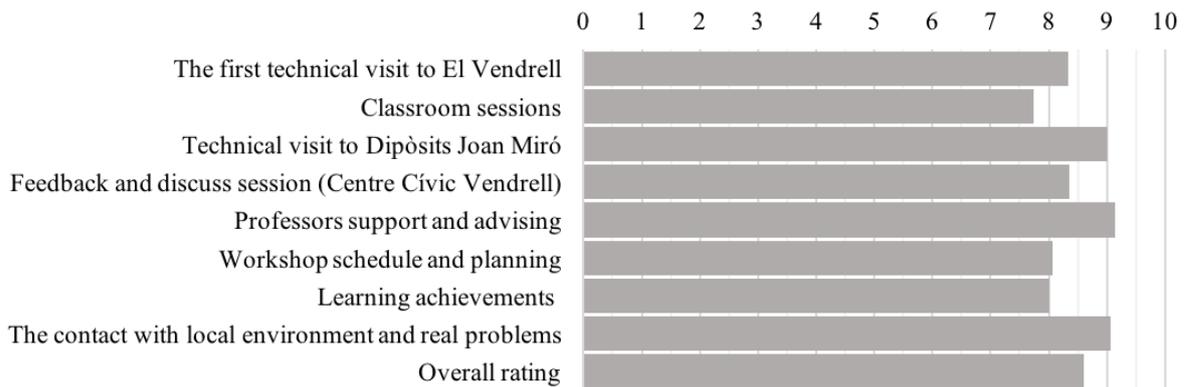
and port engineering. These proposals were elaborated in collaboration with the stakeholders, professors of the Civil Engineering School and other experts of the corresponding topics. It was publicly presented at a round table organized by the same Community of Landowners on June 17.

During the course 2017/18 the initiative has been replicated in another territorial context and with different stakeholders and problems. The scenario this year has been in El Vendrell (south of Barcelona) and the interests have focused on urban planning conflicts, rainwater management, mobility and the protection of coastal areas without urbanization. In this case, the city council consisting of 8 technicians (3 architects, 2 engineers, 1 assistant and 1 environmental scientist) accompanied 15 students, proposing problems and commenting on the proposals (figure 2).

#### 4 ASSESSMENT OF THE INITIATIVE

The expected results have different dimensions, one more technical and easily evaluable, as a result of applying theoretical knowledge obtained during the studies in real situations, and another one more social, which involves acquiring transversal skills such as teamwork, sustainability and social responsibility. The latter is more difficult to evaluate as it requires an holistic appraisal and time.

In this initiative, the evaluation is based on attendance to the activities (which has always been above 80%) and the assessment of the reports and proposals presented by students. There is a wide variability in the quality of the proposals, the final ideas are creative and applicable to the problem studied, but there are groups that clearly have taken the activity more seriously than others have, which reflect a lesser effort and dedication. An indicator of this has been the little time dedicated to autonomous work that has an average of 11 hours (question asked in the satisfactory questionnaire). One of the main problems is that this is a complementary activity and therefore, the level of engagement is lower which, especially, decreases during the exam periods. Therefore, for future editions, the planning and schedule of the workshop should be improved.



**Figure 3:** Evaluation of the initiative by the students.

In this year's edition, on the last day of the workshop a satisfaction survey created ad-hoc for the occasion was designed to collect the satisfaction of the participants. The survey was

short and direct. The students were asked to evaluate the different activities carried out (Figure 3) and indicate what they liked most and what they would improve.

The scores obtained from the student are high in general - from 7.7 to 9.5 - and the overall mark is 8.6. They highlight the support and advice of professors and the contact with the local world and the real problems. The least valued would be the sessions in the classroom with a 7.7, which shows the need and the good reception of this type of initiative based on bring the student closer to the real problems. Table 1 shows the positive comments and suggestions of improvement that the student has considered about the Workshop of El Vendrell:

**Table 1:** Positive comments and improvement suggestions mentioned in the survey

<b>Positive Aspects</b>	<b>Improvement Suggestions</b>
Immersion in the future of work environment	Conciliation with other exams and tasks
It helps to conceive ideas to solve real problems of a municipality	Focusing directly in the solutions in the classroom sessions
Exposure of ideas and solutions in front of professionals and members of the city council	More interaction with the City Council; to know how they work, internal organization and how to carry out a project
Effective search for solutions to real problems	To understand clearly what should be the result of the workshop and the scope of the work to do since the beginning
Access and contact to Public Administration	Proximity of the municipality
The possibility of working on issues at municipal scale relate to urban planning	Creation of more debate in the classroom sessions instead of formal presentations
To apply the knowledge acquired during years to solve a real problem, with the advice of teachers.	

The main positive aspects are the contact to the local environment and the real problems solving as well as the seeking for solutions and advice of professionals in the sector. Regarding the suggestions for improvement, it is varied but there is general concern for the conciliation of the workshop with the study plan.

To receive feedback from experts and stakeholders, they were also asked to indicate what they liked most and suggestions for improvement. In general, getting closer to the academic world is highly valued: "the interaction with students" and the "fact of exploring ways of doing and seeing things in a more open-minded way", while also proposing that the initiative could be exported to main courses to improve depth and reflection on proposals, which are sometimes too superficial.

## 5 CONCLUSION

This type of initiatives induces the synthesis, integration and implementation of the knowledge acquired during the degree in real situations. The initiative combines students and stakeholders as co-producers of knowledge to improve the built environment, infrastructures, technologies and offer holistic solutions to the challenges of society. Starting from a real demand of the society specially motivates and stimulates students. In addition, teamwork, in a multidisciplinary and cooperative way, promotes values that are necessary in the professional world.

Both editions, the case of Empuriabrava and El Vendrell, were very satisfactory to all the participants, including the stakeholders, the students and the professors. Participatory learning, peer learning and collaborative methods make it easier for the student to be in contact with multiple perspectives and generate creative responses to the problems posed. Critical reflection on the values and assumptions in some cases can rise to what is known as 'transformative learning', that is necessary to deal with complex problems and conflicts of values in our society. In addition, the disclosure of this type of initiatives contributes to enhance the role of the Civil Engineer and the Civil Works Engineer in our society at a time that, for contextual reasons of economic crisis and social change, its image has been affected.

However, in future editions, improvements must be made in the field of the evaluation of results and the transversal competences achieved, the time-planning and its coordination with the academic calendar.

These methodologies specially those related with service learning are not enough extended in the university, despite its recognition. We are aware that service learning requires an institutional involvement which may represent a challenge. However, we are convinced that it is worth the effort to integrate these pedagogical frameworks as they contribute to increase environmental awareness and social responsibility among participants.

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