



## INTEGRATING SUSTAINABILITY AND SOCIAL COMMITMENT (S&SC) COMPETENCES IN THE CURRICULUM AT THE BARCELONA SCHOOL OF CIVIL ENGINEERING

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### ABSTRACT

The importance of integrating the Sustainable Development Goals (SDG) in the curriculum of all the bachelor and master degrees at UPC has been legally and institutionally recognised. At the Barcelona School of Civil Engineering, issues such as professional ethics, environmental impacts of infrastructures, respect for cultural diversity and gender perspective are currently cross-cutting competences highlighted and stated in the study plans as a transversal competence on Sustainability and Social Commitment (S&SC). However, its effective implementation requires significant teaching efforts in order to adapt academic curricula, so far limited to individual non-coordinated initiatives.

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The launch of the “ODS-Camins Toolkit” project (Toolkit for the Promotion of SDG in the Civil and Environmental Engineering Fields) seeks to encourage the implementation of teaching innovation practices that contribute to the deployment and assessment of S&CS competences. The aim of the project is to exchange experiences, develop new practices, and draft a common pathway for the promotion and implementation of the SDGs in the field of civil and environmental engineering studies.

The paper will explain the experience of this one-year project, highlighting barriers, challenges, and sharing the lessons learned with the final purpose of involving all the community in the years to come. It will also present the Toolkit for the Promotion of SDGs in the Civil and Environmental Engineering Fields

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## 1 INTRODUCTION

Education for Sustainable Development (ESD) facilitates the acquisition of knowledge, skills, attitudes and values needed to forge a sustainable future. It seeks to provide students with professional and personal abilities necessary to work and live in a way that protects environmental, social and economic well-being, for present and future generations. Applying ESD principles to engineering education involves working under an integrated approach, incorporating social and humanities disciplines, encouraging work in multidisciplinary teams, stimulating creativity and critical thinking, and promoting self-learning.

In Higher Education, the pathway to integrate the Sustainable Development Goals (SDGs) in the curriculum has started through a legal recognition that pushes towards this direction. Specifically, in the fields of civil and environmental engineering, issues such as professional ethics, environmental impacts of infrastructures, respect for cultural diversity and gender perspective are currently cross-cutting competencies included in the study plans as a transversal competence on Sustainability and Social Commitment (S&SC). However, its effective implementation requires significant teaching efforts in order to adapt academic curricula. This is not always easy, due to a lack of recognition by academic institutions.

At the Barcelona School of Civil Engineering (BSCE), several projects have recently been carried out on this topic. So far, these were individual initiatives with a certain degree of internal coordination but with low institutional leadership. These previous experiences, the recent legal enforcement and new institutional priorities have led to a change, and facilitated the launch of several initiatives promoted at different UPC levels. On the one hand, a bottom-up initiative called ODS-Camins Toolkit led by the Barcelona School of Civil Engineering, which aims at producing accessible educational resources to help lecturers integrate sustainability in their courses. On the other hand, UPC at higher institutional levels is leading a pilot initiative to guide and give support to different UPC schools on this endeavour. These coordinated actions aim at assessing the current situation and foster a planned deployment of the integration of S&CS competences in the context of the civil and environmental engineering studies.

Conceptually, this experience feeds from the on-going research projects Edinsost I & II [1,2,3] which have created the Engineering Sustainability Map (ESM), a tool that contains the ESD-related learning outcomes that any engineering graduate should have acquired upon completion of the studies.

There are previous academic research works [4] and institutional contributions [5] that identify and describes competences that engineers should acquire to deal with SDG challenges. However, in this paper the classification used is that recommended by the Working Group of the Sectorial Commission CRUE-Sustainability (Conference of Rectors of Spanish Universities) which should be integrated in the curricula of all Spanish university degrees. It establishes four sustainability competencies units:

- CU1: Critical contextualization of knowledge establishing interrelationships with social, economic and environmental issues, local and/or global.”
- C2- Ho: Holistic. Identification and analysis the environmental, social and economic impact of their professional activity and to propose, design, organize and carry out sustainable actions.
- C2-En: Environmental: Identification and analysis the environmental impact of their professional activity and to propose sustainable solutions.”
- CU2- So: Social. Identification and analysis the social impact of their professional activity and to propose sustainable solutions.”
- CU2- Ec: Economic. Ability to manage material, economic and human resources of projects in their professional field, in order to ensure the economic viability while taking into account the sustainability.
- CU3: Participation in community processes that promote sustainability.
- CU4: Application of ethical principles related to the values of sustainability to personal and professional behaviours.

The objective of this paper is to assess to what extent the ESM is fulfilled in the curriculum of Bachelor Degrees at the Barcelona School of Civil Engineering and discuss strategies to improve the level of integration of S&SC competences. This is embedded in a wider project called Toolkit-ODS Camins with the goal of creating an engaged “Civil and Environmental Engineering community” with a high commitment with SDGs.

## 2 METHODOLOGY

The following coordinated tools and activities have been implemented in order to achieve our objectives. Firstly, the ESM was shared among a group of lecturers to identify and assess their learning outcomes, competencies and SDGs integrated in a representative set of courses.

Then, based on this previous experience, an on-line survey adapted from [1] was addressed to all teaching staff to gather information on the SDGs addressed, methodologies used and learning outcomes and competences present in each of the Bachelor Degree in Civil Engineering courses. The survey included a table with the

learning outcomes and competences and the teachers addressed were asked to recognise which were the 5 top ones addressed in their course. A total amount of 40 responses were collected, representing almost 50% of the courses. Based on this initial assessment and together with all involved parties (coordinators, lecturers, students) learning strategies will be suggested and planned to embed all the SDGs in the curriculum



*Fig. 1 Images of the workshop held in November 2021.*

Finally, parallel activities to promote community involvement were undertaken such as workshops, meetings and a video recording. For instance, the workshop “Team building for SDGs engagement in the Civil and Environmental Engineering Field” was held in November 2021 (Fig. 1). More than 40 participants were informed on the institutional strategies and projects to embed SDGs in the curricula, and invited to discuss teaching and learning activities, their main barriers, challenges and needs. Moreover, a course on “Inclusive non-sexist language in teaching and research” was organized in March 2022, to address the SDG 5 on Gender Equality

### 3 RESULTS

Data from the surveys helped assessing to which extent the SDGs and sustainability competences are addressed in different courses of the Bachelor Degree in Civil Engineering.

Figure 2 shows how this Bachelor currently involves more than half of the SDGs. This is in line with the institutional goal of getting students to know the SDGs and their importance for society. It can be observed how the SDGs related to infrastructures, water, cities, climate and production, are among the most studied, while those related to education, inequalities, peace, hunger and poverty are barely introduced. The

reason for this is the curriculum of the very same Bachelor, where socio-political competencies are barely included as learning outcomes.

The analysis has also shown that lecturers have been introducing the SDGs by their own, as individual actions lacking institutional support and funding. However, an institutional change is currently taking place both at the Barcelona School of Civil Engineering and UPC, who have fostered a coordinated strategy to integrate sustainability competences in the curricula.

### SDGs present in the courses

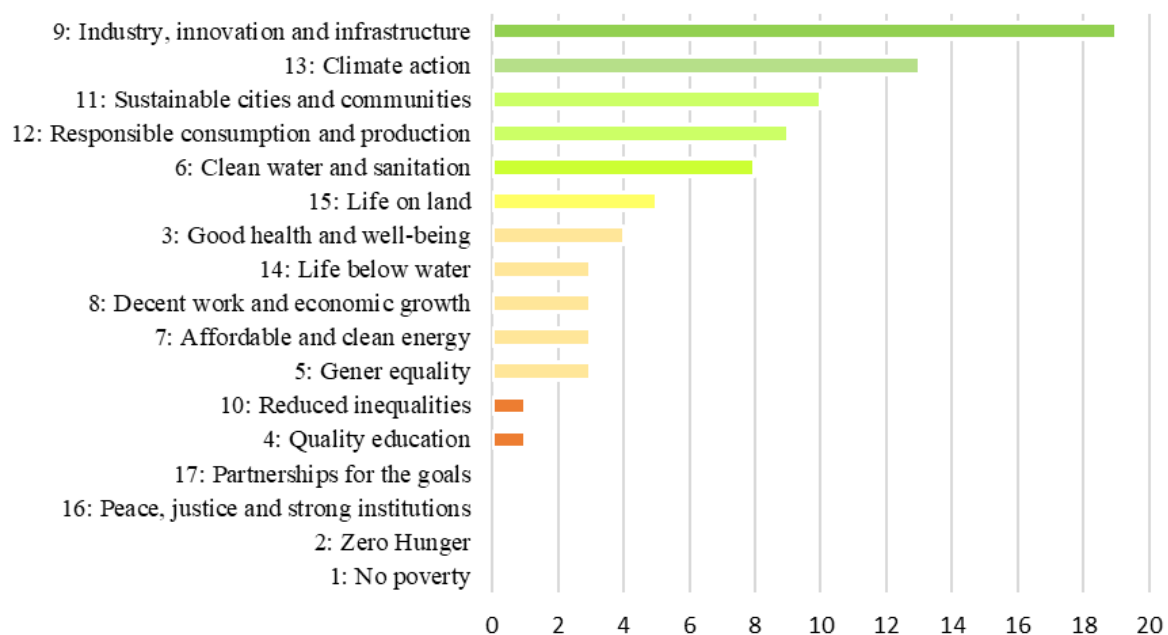


Fig 2. Number of courses that deals with each SDG in the Bachelor Degree in Civil Engineering.

A more detailed analysis on the four sustainability competence units (Figure 3) shows how they are deployed to a different extent. The graph divides the holistic unit (C2), in which the student achieves the capacity to prevent negative impacts, into four dimensions: holistic, environmental, social and economic. Competences related to the sustainable use of natural resources (C2) and critical contextualization (C1), which are the most closely related to technical aspects of civil engineering, are developed to a higher extent in the courses. Among them, social and economic aspects seem to be beyond the scope of many courses, as they are less present. However, civil engineers are responsible for planning, constructing and managing infrastructures that should be aimed at improving human well-being.

Competences dealing with C3 are placed in a medium position, meaning that the participation in community processes that promote sustainability seems to be reasonably accounted for. However, effort should be made to encourage transforming

teaching-learning processes and include active methodologies and service-learning. The students will be better prepared to face complex problems if they learn how to collaborate and understand the local context and society.

Finally, the Bachelor Degree in Civil Engineering appears to invest more time at teaching negative impact assessment than addressing ethical aspects, as shown by the poor presence of C4 competence. Lecturers should discuss the risks, uncertainties and ethical implications that their future projects or professional activities will eventually have.

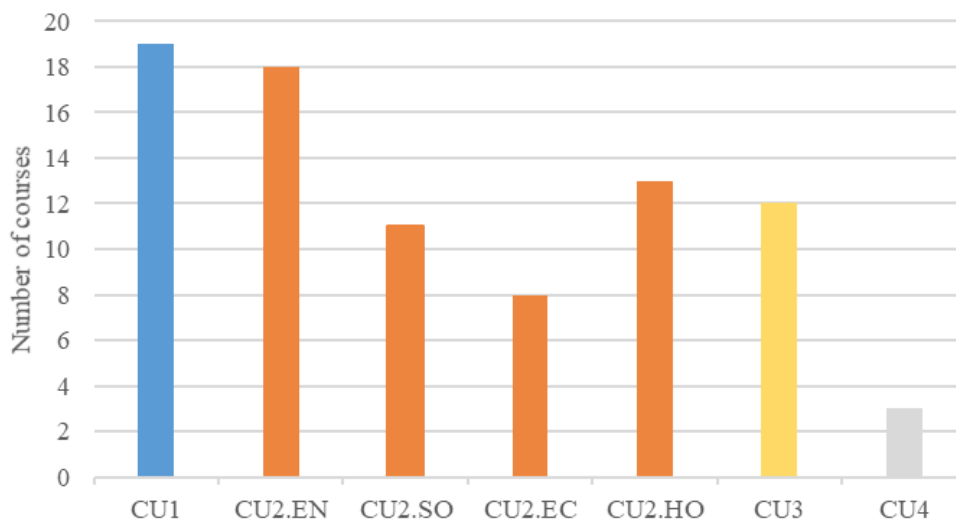


Fig 3. Presence of each competence unit at the Bachelor Degree in Civil Engineering.

Once the SME was completed, lecturers participating in the innovation project Toolkit-ODS Camins were encouraged to prepare a teaching activity to introduce the SDGs in the curriculum. To this end, they were provided with a template and asked to fill in information on their activity, such as the SDG addressed and sustainability competences level acquired by the students.

These activities were included in the web site “Toolkit-ODS Camins”, which proposes a pathway to implement the SDGs in 4 steps:

- 1) Get familiar
- 2) Evaluate yourself
- 3) Prepare your own activity
- 4) More info

It shows a simple, straightforward way to learn and implement the SDGs in our courses. The web site will be launched soon, along with a promotional video.



## 4 CONCLUSIONS

The aim of this paper is to explain to which extent sustainability is present at the Bachelor Degree in Civil Engineering of the Barcelona School of Civil Engineering (UPC). It has been shown how competences dealing with C1 and C2 are present to a higher extent than C3 and particularly C4, which is still missing. These results are consistent with previous analyses of other Bachelor Degrees in Engineering at UPC.

However, some limitations should be considered. The assessment of the sustainability “presence” is based on the information provided by the lecturers’ self-assessment. Considering the qualitative dimension and open-to-interpretation nature of some concepts, an external validation would be required. Thus, a more in-depth analysis should be done, and feedback from students ought to be included to increase the robustness of the results.

This initiative also seeks to encourage the implementation of teaching innovation practices that contribute to the deployment and assessment of S&CS competences and evaluate their learning outcomes. The aim of the project was to exchange experiences, develop new practices, share and disseminate them, learn and draw a common pathway for the promotion of the SDGs in the field of Civil and Environmental Engineering. For this reason, the results of the project will be disseminated in a video and web called Toolkit-ODS Camins, that will be used as guideline to integrate S&CS in other courses.

## 5 ACKNOWLEDGMENTS

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