REVISITING THE STUDENT OUTCOME "ETHICAL, ENVIRONMENTAL AND PROFESSIONAL RESPONSIBILITY" WITHIN THE CIVIL ENGINEERING BACHELOR DEGREE

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Conference Key Areas: *Sustainability and ethics, Engineering curriculum design*
Keywords: *generic outcome, ethics, transversal competence, civil engineering*

ABSTRACT

In 2013, an institutional project was launched at Universitat Politècnica de València to ensure that all graduates, in addition to acquiring the specific technological skills of their degrees, would also acquire a series of essential soft skills for developing their profession in an excellent way.

At present, there are already graduates who have completed the degree with the integration of generic outcomes; therefore, it is time to review the success that the project has achieved. One of these generic outcomes is "Ethical, environmental and professional responsibility". In this work, we develop a diagnosis of the current state of this competence in the civil engineering BSc degree programme, and we analyse the level of acquisition of the competence by students.

For this purpose, the subjects in which this generic competence is worked on and evaluated will be analysed, studying how lecturers introduce it within different activities to collect evidences of the competence level of acquisition. We also studied whether the results obtained respond to the expected learning goals.

The diagnosis will be completed by collecting opinions from last year students, as well as by interviewing lecturers responsible for these subjects.

The final objective of the project will be to estimate at what extent the students have acquired this competence upon graduation and to propose improvement measures if necessary.

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1 INTRODUCTION

1.1 The scenario at the Spanish University

At Spanish universities teaching civil engineering bachelor degrees, ethical training has never been of great importance from the point of view of the curriculum design. Traditionally, some of the schools offered elective subjects related to ethics, but in most of them, they were directly ignored [1].

However, with the implementation of the European Higher Education Area (EHEA) based on the Bologna Declaration, degrees offered by Spanish universities were revised and updated. One of the consequences of the adoption of EHEA was the division of students' learning into three categories [2]: knowledge, skills and competences. This new vision came out due to the need to provide students and future professionals with a comprehensive training that would qualify them to be excellent professionals, not only from a technical point of view, but also in a more holistic dimension.

In Spain, this fact was accompanied by the increase of universities teaching the bachelor degree in civil engineering [3]. This fact encouraged academic institutions to obtain national and international accreditations to demonstrate the quality of its graduates in comparison with other schools. The most recognised accreditations are EURACE® and ABET labels, and both mention the ethical behaviour of professionals as learning outcomes that students must obtain [4].

At this time, the need arose to incorporate ethical and professional responsibility into the curriculum. Universitat Politècnica de València (UPV) decided to launch an institutional programme [5] to integrate 13 generic outcomes into all degrees programmes, covering topics such as time management, effective communication, teamwork or ethical, environmental and professional responsibility.

1.2 Context-The UPV's Generic Outcomes project

The UPV's Generic Outcomes (GO) project began in 2013 and its main objective is to certify that all students have achieved them once graduated from any of the UPV bachelor degrees. Towards the end of the 2013-14 academic year, training activities were carried out in all the schools to prepare the project and to inform the management teams of the need to start carrying out pilot activities during the 2014-15 academic year. The project was definitively implemented during the 2015-16 academic year. The strategic plan of the UPV 2020 [6] includes the correct accreditation of the GO defined by the UPV.

In each programme, different subjects were established as control points for each proficiency level of each generic outcome. Two proficiency levels were established for each competence corresponding to bachelor´s studies, and a third proficiency level corresponding to master's studies. The subjects defined as control points must collect evidences of the proficiency level achieved by students in the GO.

The Institute of Education Sciences (ICE) of the UPV published a document entitled Generic Outcomes with support material for teachers [7]. It described the 13 GOs: GO1-Comprehension and Integration, GO2-Application and practical thinking, GO3-

Analysis and problem solving, GO4-Innovation, creativity and entrepreneurship, GO5-Design and project, GO6-Teamwork and leadership, GO7-Ethical, environmental and professional responsibility, GO8-Effective Communication, GO9-Critical thinking, GO10-Knowledge of contemporary problems, GO11-Lifelong Learning, GO12-Time planning and management, and GO13-Specific instruments.
The UPV quantifies the achievement level of the GOs of the graduates, providing a measure of their added value to give them a differentiating attraction compared to their competitors. In addition to describing the content of each competence, this document established the learning outcomes that students should achieve for each proficiency level, provided rubrics for evaluating them, and suggested different activities and techniques for working and evaluating the competence in the classroom. In addition to this document, the ICE offered training workshops, produced videos to disseminate the 13 generic outcomes and provided support to all teachers, especially those who were selected to be control points.
In the 2017-18 academic year, bachelor and master's students began to be certified as having completed all the proficiency levels corresponding to their studies and therefore UPV is now ready to check the state of achievement of the different GOs.
The generic outcomes at the UPV cover several aspects. Many of these aspects were already worked in the pre-Bologna curriculum, even though they were not specifically called "generic outcomes". Indeed, it seems impossible that engineers graduated before the implementation of the institutional project would be able to finish their studies without having competences in "comprehension and integration", "analysis and problem solving", or "design and project", for example. These outcomes are worked on in many subjects present in the civil engineering bachelor degree curriculum.
However, other learning outcomes are difficult to include in the curriculum in a transversal way. They need theoretical foundations that can hardly be contained in other specific subjects. This is the case of GO-7 Ethical, environmental and professional responsibility.And yet, as noted above, this competence is explicitly cited in the learning outcomes required by the most prestigious quality labels, which may account for its importance. It is therefore time to study and evaluate how this competence has been developed within the curriculum and whether the required learning outcomes are achieved.

2 METHODOLOGY

2.1 Objectives

The general objective of the work developed at the School of Civil Engineering is to study and carry out a diagnosis of the state of achievement of the generic outcome GO-7 "Ethical, environmental and professional responsibility", at each of the proficiency levels foreseen in the civil engineering bachelor degree studies at the UPV.

This diagnosis includes the review of the methodologies, activities, evidences and rubrics used, as well as the study of the suitability of the subjects selected as control points.
Based on this diagnosis, improvement actions will be studied that may range from improving institutional rubrics to adapt them to the context and to the development of training actions consistent with GO7. "Pilot" subjects will be established as control points, and in the 2020-21 academic year new activities will be introduced with new evidences and, if necessary, new rubrics to ensure the acquisition of this generic outcome by students at the end of their studies.
From the diagnosis, we can highlight the following aspects:

- The subjects in which students work on the generic outcome GO7 will be known, specifying whether they are compulsory (they must be taken by all the students).
- Evidence and evaluation methods for each proficiency level will be reviewed.
- The degree of complexity of the tasks will be analysed regarding the corresponding proficiency level.
- Activities will be designed and the institutional rubrics of each proficiency level of the competence will be reviewed.
- A vertical coordination will be established for all the control point subjects of GO7. In this way, activities to be carried out by students for the achievement of the learning outcome will be organized throughout the programme.
- Pilot subjects will be selected as control points.
- New activities and rubrics will be implemented.
- And finally, the action will be evaluated.

2.2 Method, tools and work plan

To obtain information about the activities and the evaluation method of this transversal competence, we have studied and analysed the course syllabus of the control point subjects and the competence report. This analysis was completed with personal interviews with lecturers responsible for these subjects. In addition, a performance of group dynamics with students in the last year of the degree was developed to collect their opinion and perceptions about the achievement of this competence.
In the future, we would like to extend the study to graduates with professional experience to collect their opinions about the training obtained during their degree studies in this field and their usefulness or perception of lack of training and need in the field of ethical and professional responsibility.
The work plan for the diagnosis of the state of GO7 "ethical, environmental and professional responsibility" in the civil engineering bachelor degree covers the duration of an academic year. Based on this diagnosis, some improvement actions are proposed to be implemented in the curriculum and later to evaluate the effectiveness of the proposals. The tasks of the work plan are:
Task 1: Review of the subjects that are currently control points of GO7, and collection of evidence of the achievement level.

Task 2: Analysis of the evidences and suitability to the proficiency levels of the competence achievement.
Task 3: Selection of the most appropriate subjects in the curriculum to be a control point for GO7.
Task 4: Design of new activities and suitability of rubrics for the control point subjects.
Task 5: Use of the new activities and rubrics in the control point Pilot subjects.
Task 6: Collection of evidence of competence achievement and analysis of assessment.
Task 7: Monitoring the evolution of the student achievement of the two proficiency levels required in the bachelor´s degree.

3 RESULTS

3.1 Analysis of syllabus

At the moment, there are five subjects defined in the curriculum as control point subjects of GO7 (see table 1).

Table 1. Control point subjects

Subject	Type	Year	ECTS	Proficiency level
Topography	Compulsory	2	4,5	1
Science and Environmental Impact of Civil Engineering	Compulsory	2	4,5	1
Industrialised construction	Compulsory	3	4,5	2
Construction Management and Organization	Elective	4	4,5	2
Ethics in Civil Engineering	Elective	4	4,5	2

By analysing their content, it can be concluded:

- All subjects adapt the difficulty of the GO7 activity to the difficulty of the course.
- No subject uses institutional rubrics to carry out the assessment.
- Among the assessment methods presented, simplified rubrics and Likert scale questionnaires are used.
- Most of the activities are contextualised into the specific subject.
- It is not evident that the proposed activities in each subject will let students to achieve the proficiency level desired for the generic outcome.
- The fourth-year subjects in which this GO is introduced are elective, so it is not certain that all students will take them.

3.2 Group dynamics with final year students

A group dynamic was proposed with final year students who had already taken all the control point subjects of the GO7, to find out their opinion on how they achieved the competence and they were evaluated. A 90-minute session was conducted, in which the students were very proactive and enthusiastic to communicate their impressions.

In this session, future engineers were also asked about which curriculum subjects they consider most appropriate to incorporate this transversal competence.
The students were quite dissatisfied with the way this learning outcome was introduced and among the criticisms expressed, we highlight the following:

- In some of the control point subjects, they do not remember doing any activity related to GO7.
- They think that the activities are not well related to the proficiency level to be achieved, and show disagreement with being assessed for a competence for which they have not been trained.
- They are dissatisfied with being, in some cases, evaluated for a GO, in this case ethical, environmental and professional responsibility, of which they are not aware that they are working and being evaluated.
- Less than 2% of the students believe that they have fully achieved the competence with the activities carried out in the control point subjects.

A part of the group dynamic was reserved to ask the students their opinion about the best way to introduce this learning outcome in the classroom, and among the most frequent proposals, we can mention:

- Spending time in classroom to reflect on the GOs, discussing how to teach and evaluate these competences. They want to be active actors and to express their opinion about their needs as professionals.
- Providing students material related to the generic outcome and applications to real cases.
- Involving the academic staff (their attitude is not always optimal) in order they feel motivated to work and evaluate this competence.
- To train lecturers who will be in charge of working and evaluating this generic outcome.

Finally, the most frequent request of the students was to turn the competence into a compulsory subject "Ethics in Civil Engineering".
As for the compulsory subjects that students consider more appropriate to introduce this learning outcome in a transverse way, “Science and Environmental Impact of Civil Engineering” and “Construction Procedures” are the more suitable for proficiency level 1. In proficiency level 2, the only compulsory subject they consider able to work the topic is “Prevention of Occupational Risks and Work Organization”.

3.3 Interviews with academic staff

From the interviews conducted with academic staff, we would like to emphasize that all the lecturers interviewed think that this GO is essential for the complete professional development of civil engineers.
Another aspect to be highlighted is the different perception among students and lecturers of how the learning outcome is introduced in the classroom. For half of the lecturers it has been very easy to introduce the competence as a transversal content

for their specific subject, but the students have not noticed that this competence is worked on.
On the other hand, they have mainly answered that they have never been trained to teach GOs. Indeed, the training offered by the ICE is not compulsory, so they would not have been able to attend or would have considered it unnecessary.
It is interesting to note that even among lecturers responsible for integrating and evaluating this generic outcome in their specific subjects (all engineers), there is a small part who consider that they do not need training (because we all have our ethics, right, or we are engineers then we are virtuous). These opinions clash head-on with the fact that ethics is a type of knowledge that seeks to guide human action in a racial sense [8] and, being a type of knowledge, it can be taught, beyond knowing the deontological codes of a profession. Fortunately, most of the lecturers interviewed call for training or think that this type of content should be given by people trained for it, recognizing and manifesting their limitations in order to carry out the task that has been entrusted to them.

4 CONCLUSION

Let's remember that the general objective of this work is to study and carry out a diagnosis of the state of achievement of the generic outcome GO7 "Ethical, environmental and professional responsibility", at each of the proficiency levels foreseen in the civil engineering bachelor degree at the UPV.
After the review of all the material, the group dynamics with students and the interviews with professors, it can be concluded:

- In general, not enough evidences have been collected to fully certify that the students of the Civil Engineering bachelor degree have achieved the required proficiency level in this GO, at the end of their studies.
- The institutional rubrics for evaluating GO7 may be too complex and even confusing. This may have contributed to the fact that they are not used in the subjects analysed so far.
- It is necessary to correctly explain to students the purpose of the GOs, to name those that are worked on in each of the specific subjects (especially if they are to be evaluated), and to give competency-related training before assessing whether the students have reached the desired level of domain. Students want to learn.
- For the success of the project, the collaboration of the academic staff responsible for the control point subjects is essential.
- This generic outcome is difficult to work with and evaluate, so all possible help and collaboration must be provided to lecturers involved.
- And, maybe, this is not the best way (like generic competence) to introduce ethical and professional responsibility into the Civil Engineering bachelor degree.

We think that this is an essential learning outcome to be able to develop any profession in an excellent way. This opinion is supported by the fact that international agencies that accredit the quality of different university studies, such as ABET, have among the seven learning outcomes that students should have at the end of their university studies "the ability to recognize ethical and professional responsibilities in engineering situations and to make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental and social contexts".
After the discussions with the agents involved, the results obtained and the social demand, there are strong reasons to consider a compulsory subject in the curriculum oriented to help future engineers to develop their professional activity with the necessary responsibility and ethics.

5 ACKNOWLEDGMENTS

We would like to express our special thanks to the academic staff responsible for the control point subjects for their full cooperation, as well as, our colleagues in the REMYP 07 working group, for their contributions and comments and of course, we are thankful to all the students that accepted to let us share their reflections.

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