

# TEACHING AND EVALUATING GENERIC STUDENT OUTCOMES AT THE SCHOOL OF CIVIL ENGINEERING IN VALENCIA (SPAIN)

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**Abstract.** This paper presents a review of teaching and evaluating methods of generic student outcomes in the Civil Engineering degrees at the School of Civil Engineering in València (Spain). First, the institutional project of Generic Student Outcomes that is being implemented at the Universitat Politècnica de València is described. Second, teaching and evaluation methods of generic student outcomes that are being applied in different Civil Engineering courses are analyzed. Methods more suitable for basic and engineering courses are identified for each generic student outcome. Conclusions regarding advantages and limitations of using each teaching and evaluation method are outlined.

## 1 INTRODUCTION

The project on UPV Generic Student Outcomes [1] (UPVGSOs henceforth) is a Universitat Politècnica de València (UPV from now on) initiative supported by the UPV2020 strategic plan, in which the university assumes its first challenge:

*... the Universitat Politècnica de València aims to progress towards training models which allow its students to acquire the skills needed to become suitably employable. This training should be seen from a wide perspective, linked with the full education cycle of each person, addressing both undergraduate and postgraduate studies.*

To a small and large extent, the specific Student Outcomes are taught, worked on, and acquired by students; they become qualified by passing different subjects in the degree programs. However, other types of skills included in the definition of these degree programs do not receive the same attention. In general, they are assigned to different subjects/courses, but it is difficult to ensure that they will systematically be worked on and evaluated; therefore, it cannot be guaranteed that they will be acquired.

On the basis of the definition of the 13 Generic Student Outcomes, UPV considered that all its graduates should acquire these outcomes having finished their studies. Therefore, the following objectives are addressed:

- Systematize and guarantee the procurement of UPVGSOs in the training of students using different complementary paths or strategies.
- Design systematic UPVGSOs evaluation processes and strategies which consider both the individual results of each student and the aggregate information for analyzing and possibly improving the degree.
- Accredite and make the set of results acquired by students more prominent.

## 2 UPV GENERIC STUDENT OUTCOMES

The UPV Generic Student Outcomes correspond to skills which are key and transferable in relation to the wide variety of personal, social, academic, and employment contexts encountered throughout graduates' lives. In this sense it constitutes a fundamental part of the professional and formative profile of all or the majority of degrees. It deals with the skills which include a set of cognitive and metacognitive skills, and instrumental and attitudinal knowledge which are of great value to the knowledge society (Andrews and Higson, 2008).

UPV Generic Student Outcomes are characterized as being:

- a) Integrative, given that they favor the integral training of our students.
- b) Transferable in the contexts of academia, employment, personal, social, etc.
- c) Interdependent, because when they work on a skill, it is normal for them to develop other related skills.
- d) Multifunctional, meaning students become versatile and capable of tackling different types of problems.
- e) Assessable, because the outcomes should be broken down into learning results allowing the accreditation of the level achieved by each student.

The thirteen UPV Generic Student Outcomes, which encapsulate the competency profile of all UPV graduate students, are as follows (Table 1):

**Table 1. UPV Generic Student Outcomes.**

<p><b>1. Comprehension and integration</b> Demonstrate an understanding and integration of knowledge in both the student's own specialization, and other wider contexts.</p>
<p><b>2. Application and practical thinking</b> An ability to put theoretical knowledge into practice and plan the process to be followed, develop and conduct appropriate experimentation, and analyze and interpret data to draw conclusions.</p>
<p><b>3. Analyzing and solving problems</b> Analyze and solve problems effectively by identifying and defining the significant elements of which they are composed.</p>
<p><b>4. Innovation, creativity, and entrepreneurship</b></p>

Innovation and entrepreneurship in the form of a satisfactory and original response to personal, organizational and social needs and demands.
<b>5. Designs and projects</b> Effective design, control, and evaluation of an idea until it becomes a specific project.
<b>6. Teamwork and leadership</b> Work with and lead a team effectively in order to achieve common objectives while contributing to the personal and professional development of its members.
<b>7. Ethical, environmental, and professional responsibility</b> Show ethical, environmental, and professional responsibility towards oneself and others.
<b>8. Effective communication</b> Effective oral and written communication with proper use of the appropriate means, and bearing in mind the requirements of the situation and the person receiving the message.
<b>9. Critical thinking</b> Develop the ability to think critically and consider the fundamental concepts behind student's and others' ideas, actions, and judgements.
<b>10. Awareness of contemporary issues</b> Identify and interpret contemporary issues both in student's own field, and other fields of knowledge.
<b>11. Life-long learning</b> Strategic, independent and flexible use of knowledge in accordance with the desired objectives throughout student's professional career.
<b>12. Planning and time management</b> Appropriate planning to make the best use of the time available, programming the required activities to reach the desired academic, professional, and personal objectives.
<b>13. Specific tools</b> Select and apply as appropriate the tools, technologies and, in general, the instruments available in any operations related to design and projects in student's professional field.

### 3 CIVIL ENGINEERING DEGREES AT THE SCHOOL OF CIVIL ENGINEERING IN VALÈNCIA

The School of Civil Engineering at the Universitat Politècnica de València offers Bachelor's degrees in Civil Engineering and in Public Works Engineering, and a Master's degree in Civil Engineering (Figure 1). Bachelor's degrees envisage four years with 60.0 ECTS (European Credit Transfer System) credits each, for 240.0 credits. Required courses, where UPVGSOs are included, comprises 208.5 credits, which are classified in Basic Courses (76.0 credits), Common to Civil Engineering courses (63.0 credits), and Civil Constructions Specialization (46.5 credits). Bachelor's Degree in Public Works Engineering program contains 12.0 Basic Credits less than its Civil Engineering counterpart. Bachelor's Degree in Public Works Engineering includes 57.0 ECTS of elective courses in third and fourth year, which permits students to specialize in Civil Constructions, Hydrology or Transport and Urban Services

Once the degree is completed, students will be able to access the Master's degree in Civil Engineering, which is taught in two academic years and 120.0 ECTS Credits. Required courses for those students that access from the Bachelor's degree in Civil Engineering includes 97.5 credits. If the student accesses from Bachelor's Degree in Public Works Engineering, then the number of required credits are 115.5, which include 18.0 additional credits on Selective Elective courses to complement their Civil Engineering specialization.

B.Sc. DEGREE: PUBLIC WORKS ENGINEERING										MASTER'S DEGREE IN CIVIL ENGINEERING														
YEAR	1st		2nd		3rd		4th		1st			2nd												
	BASIC COURSES		COMMON TO CIVIL ENGINEERING		COMMON TO CIVIL ENGINEERING		Techn. Spec. CIVIL CONSTRUCT.	Techn. Spec. CIVIL CONSTRUCT.	Elective CIVIL CONSTR., Foreign Languages & Internship	B.Sc. Thesis		BASIC COMPLEMENTS		BASIC SCIENCE COMPLEMENTS		CIVIL Eng SPEC TECH	Tec.Esp. FOUND. & STRUCT.	CIVIL Eng SPEC TECH		ELECTIVE Intensification	Workshop on Professional Practice	M.Sc. Thesis		
ECTS Credits	54		6		60		6	30	24	6	18	24 (*)	12	18	18	6	18	43.5	4.5	12				
(*) Students must select a minimum of 12 Credits of courses related to the Specialization, and a minimum of 12 Credits of Foreign Languages courses or External Internships (maximum 6 Credits)																								
B.Sc. DEGREE: CIVIL ENGINEERING										MASTER'S DEGREE IN CIVIL ENGINEERING														
YEAR	1st		2nd		3rd		4th		1st			2nd												
	BASIC COURSES		BASIC COURSES		COMMON TO CIVIL ENGINEERING		Techn. Esp. CIVIL CONSTRUCTIONS	COMMON TO CIVIL ENGINEERING		Techn. Esp. CIVIL CONSTRUCTIONS	ELECTIVE Training complements for civil engineering		B.Sc. Thesis		BASIC SCIENCE COMPLEMENTS		CIVIL Eng SPEC TECH		CIVIL Eng SPEC TECH		ELECTIVE Intensification		Workshop on Professional Practice	M.Sc. Thesis
ECTS Credits	54		6		18		37.5	4.5	25.5	34.5	12	4.5	31.5 (*)	12	18	42	25.5	22.5	12					
(*) Maximum of 4.5 Credits of External Internships																								

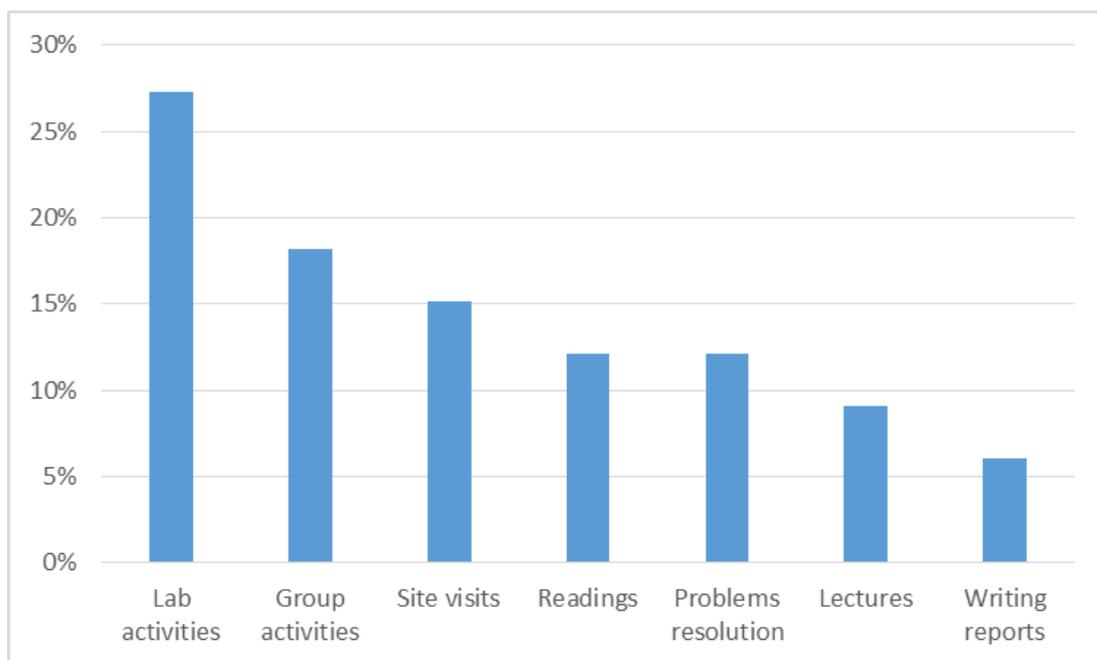
Figure 1: Civil Engineering teaching scheme at Universitat Politècnica de València. Bachelor's degrees in Civil Engineering and Public Works Engineering, and Master's degree in Civil Engineering.

## 4 TEACHING AND EVALUATION METHODS OF UPV GENERIC STUDENT OUTCOMES

A variety of teaching methods and techniques to evaluate the degree of acquisition of generic student outcomes exist [3, 4, 5]. In this section, we review and analyze the teaching and evaluation methods used in Civil Engineering degrees at UPV.

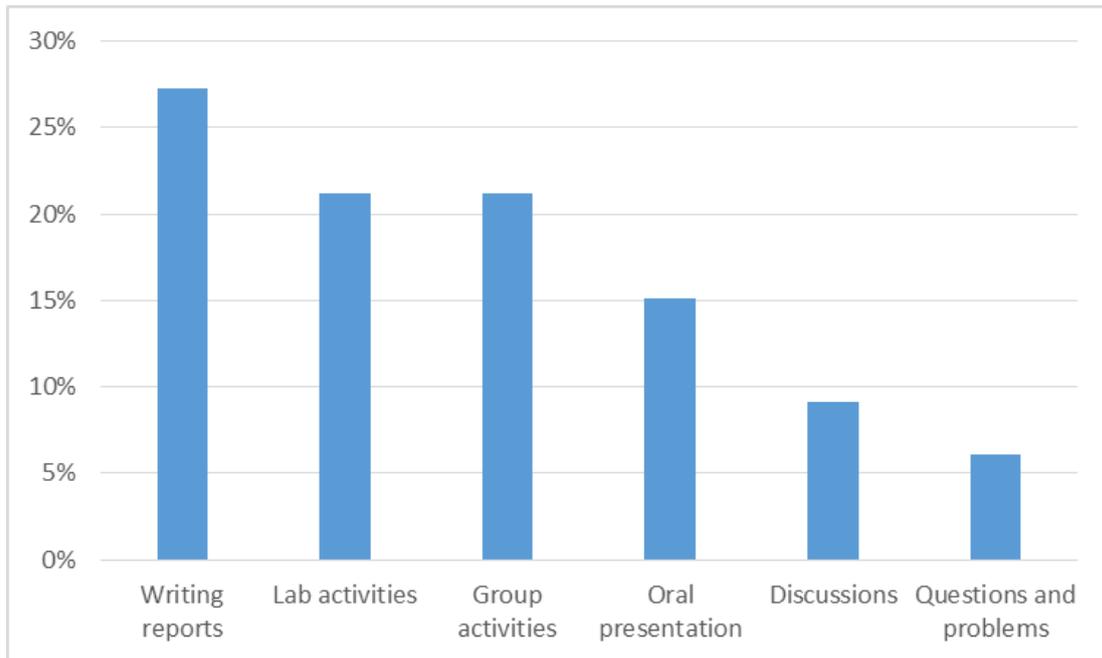
### 4.1 Teaching methods

The teaching method to develop UPVGSOs most frequently used in basic courses of the Civil Engineering degrees at UPV is Laboratory Activities (see Figure 2). Basic courses include many hours of this type of activities, so it is logical to take advantage of them to develop UPVGSOs. Group Activities is the second most utilized teaching method. Other important teaching methods are Site Visits, Readings, Problem Resolutions, Lectures and Writing Reports. There is a great variety on teaching methods, which reflects well the diversity of contents included in basic courses in Civil Engineering degrees.



**Figure 2.** Teaching methods in basic courses of Civil Engineering degrees at UPV

Common to Civil Engineering courses utilized largely Writing Reports to teach UPVGSOs (see Figure 3). Frequently, those reports include the resolution of problems directly related to any of the Civil Engineering field of work. Laboratory and group activities are also important teaching methods in this type of courses. Other methods are oral presentations, discussions and questions and problems.



**Figure 3.** Teaching methods in Common to Civil Engineering courses of Civil Engineering degrees at UPV

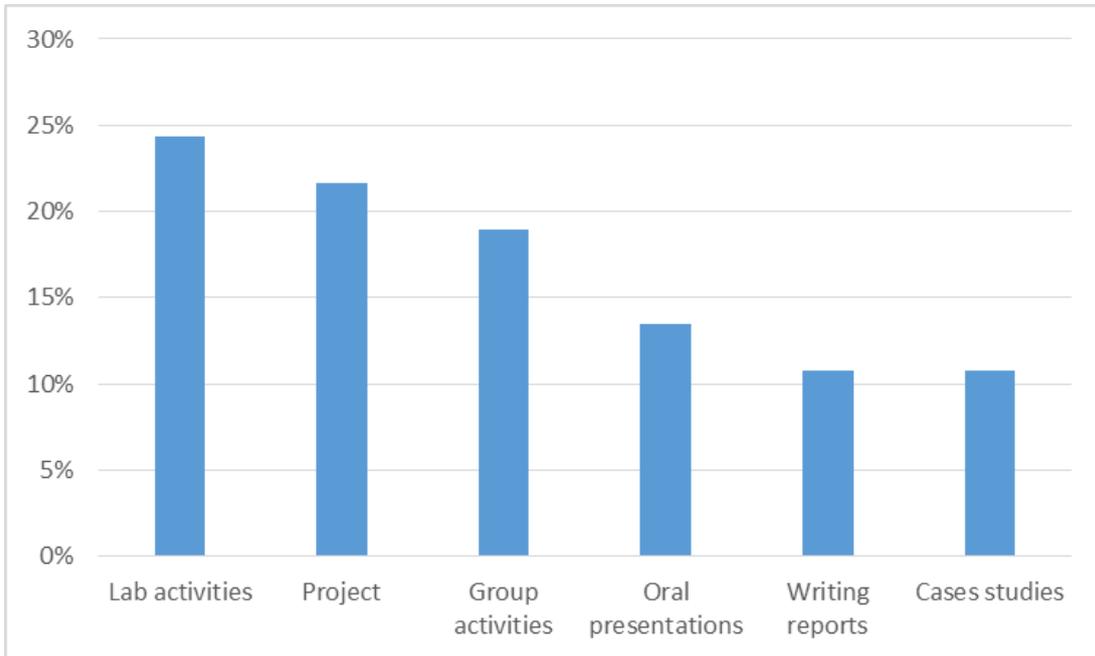
Laboratory Activities is also the main teaching method to develop UPVGSOs in specialization courses (see Figure 4). In this case, Lab Activities are more related to the resolution of practical problems using computer rooms. Projects is an important teaching method in this type of courses. Others teaching methods are Group Activities, Oral Presentation, Writing Reports and Cases Studies.

## 4.2 Evaluation methods

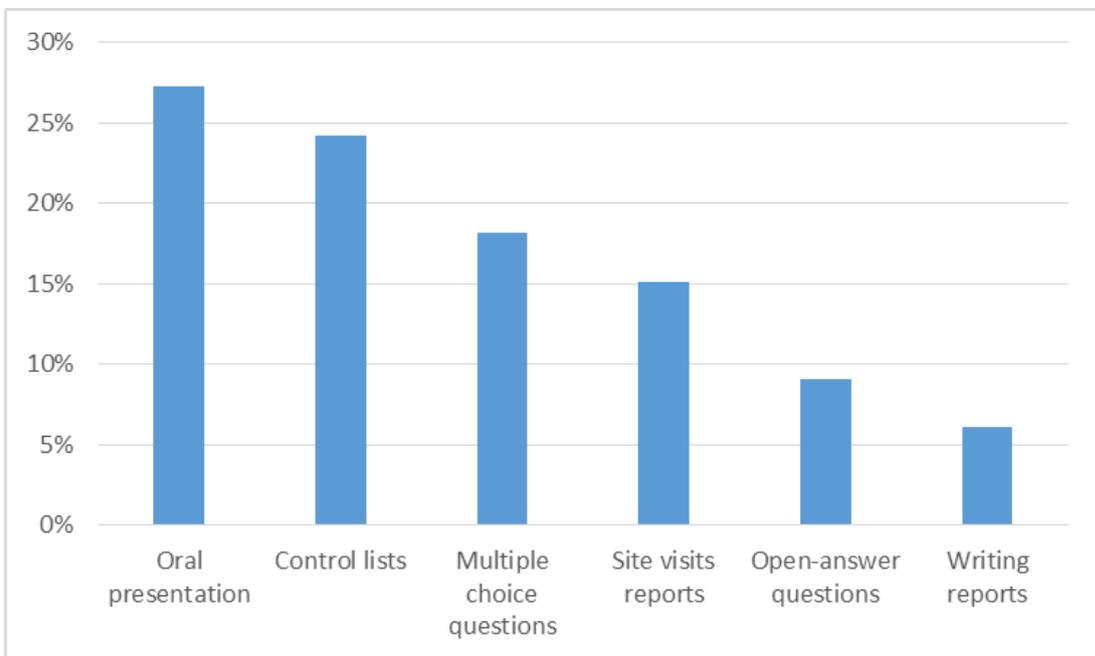
The method to evaluate the degree of acquisition of UPVGSOs most frequently used in basic courses of the Civil Engineering degrees at UPV is Oral Presentations (see Figure 5). Control Lists and Multiple Choice questions are also utilized. Other important evaluation methods are Open-Answer Questions and Writing Reports.

On the other hand, Rubrics is the main evaluation method to develop UPVGSOs in Common to Civil Engineering courses (see Figure 6). Writing Reports and Observation are important evaluation method in this type of courses. Other evaluation methods are Laboratory Activity methods, Cases Studies resolution, and Control Lists.

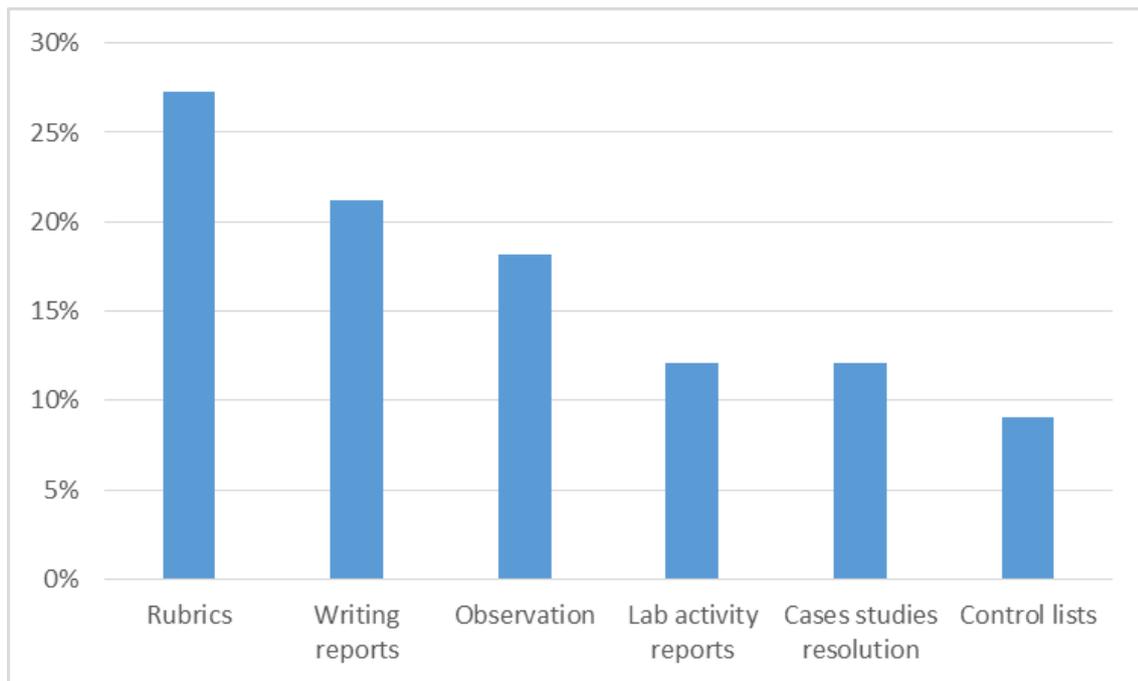
Writing reports is the main method to evaluate the degree of acquisition of UPVGSOs in Specialization courses (see Figure 7). Other evaluation methods are Laboratory Activities, Rubrics, and Oral Presentations.



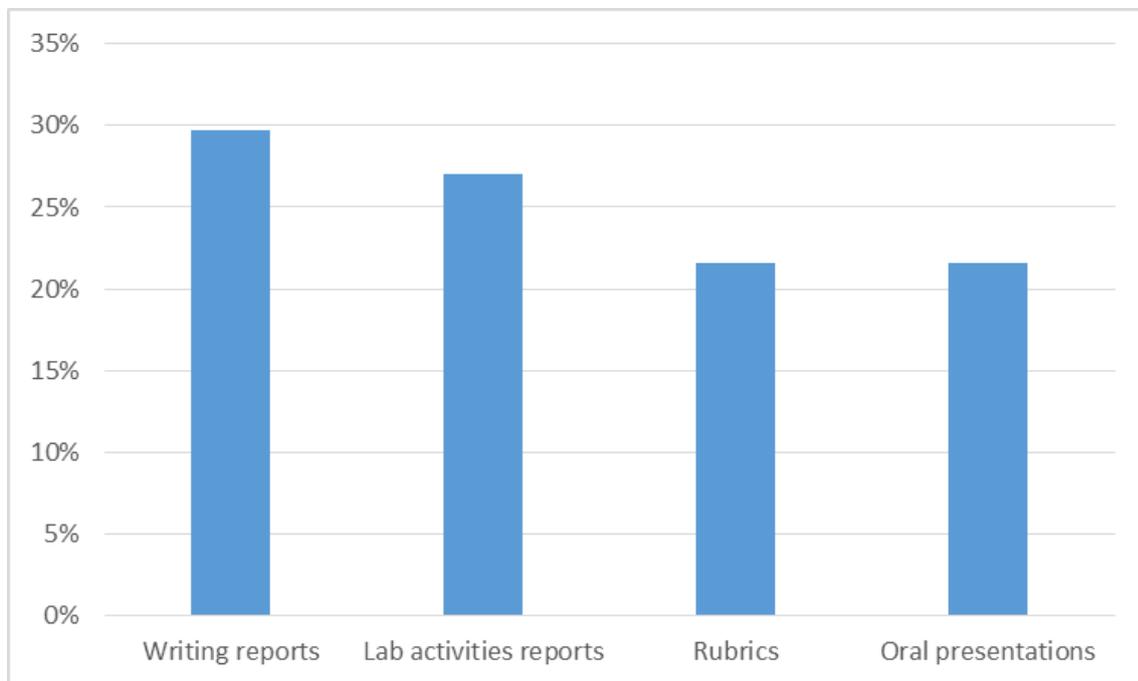
**Figure 4.** Teaching methods in Specialization courses of Civil Engineering degrees at UPV



**Figure 5.** Evaluation methods in basic courses of Civil Engineering degrees at UPV



**Figure 6.** Evaluation methods in Common to Civil Engineering courses of Civil Engineering degrees at UPV



**Figure 7.** Evaluation methods in Specialization courses of Civil Engineering degrees at UPV

## 5 CONCLUSIONS

This paper describes the institutional project on Generic Student Outcomes (UPVGSOs) of Universitat Politècnica de València, and how it is being implemented in the Civil Engineering degrees of the School of Civil Engineering. All UPV students should have acquired 13 UPVGSOs when they finish their degrees.

Two Bachelor's and one Master's degrees in Civil Engineering are offered in the School of Civil Engineering at the UPV. Both Bachelor's degrees comprises courses classified into Basic Sciences, Common to Civil Engineering, Specialization, and Bachelor's Thesis, with a total of 240 ECTS credits. The Master's degree in Civil Engineering includes courses classified into Basic Sciences and Specialization.

More than ten different teaching and evaluation methodologies are used to develop UPVGSOs in all Civil Engineering degrees. Laboratory, Group Activities, Writing Reports and Projects are the most used teaching methods. Oral Presentations, Writing Reports, and Rubrics are the most used evaluating methods.

The School of Civil Engineering is working to improve the adaptation of each teaching and evaluation method to the UPVGSOs and the objectives of each course. In particular, other teaching methods that best suit to particular generic student outcomes will be promoted. Examples are Creativity Techniques, DAFO Analysis, and Learning Agreements.

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