UNBIASED EVALUATION OF WORKGROUPS MEMBERS IN THE FIELD OF CIVIL ENGINEERING

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Abstract

Over the last years, there has been a tendency to evaluate the students of technical subjects based on workgroups methodologies. These methods allow the students to acquire skills needed for their future professional development, such as interpersonal communication, group problem resolution, leadership skills and time management. However, in undergraduate degrees (and even master), the high number of enrolled students (up to 100-150 students per subject) makes both the division of work in groups and the fair an objective evaluation complex tasks with unresolved challenges. This situation prevents both the individual follow-up and the personal evaluation of the workgroup members, since the relation of tutoring hours-class hours is unfeasible.

This paper presents a proposal for an objective evaluation methodology based on: (1) the elaboration of workgroups based on an initial questionnaire, so that the groups are organized according to the students’ preference in each theme taking into account their previous knowledge and skills; (2) the continuous evaluation and monitoring of work by teachers by means of qualitative and quantitative milestones or meetings, and (3) the oral presentation of each work evaluated by both students and teachers through a rubric method with an individual redistribution of rating by the members of the group.

Therewith, the intention is to carry out a monitoring of the students to detect the lackadaisical behaviour in time, as well as to reward the effort made. In addition, this evaluation method seeks the heterogeneous formation of workgroups to simulate the reality that students will face in their professional careers. On the other hand, it is also intended to promote aspects of self-evaluation and peer-evaluation, promoting honesty in the collaborative work and helping teachers with the final evaluation process.

Early results at degree and master levels highlight the bad habits acquired since the beginning of the studies, such as the creation of the same workgroups for different subjects, the distribution of the same tasks for each member or even the distribution of tasks of same groups for different subjects. This reinforces the need to delve into these methodologies from the beginning of the degree studies.

Keywords: workgroups, personal evaluation, oral presentation, rubric method.

1 INTRODUCTION

Teaching activities in engineering disciplines face important challenges for training future professionals. Society demands engineers and technicians with transversal competences and able to integrate in multidisciplinary workgroups. Thus, communication skills and critical abilities are essential competencies for engineers. However, those skills are not sufficiently well acquired by means of standard educational approaches [1, 2] and the most widely used teaching practices do not guarantee the development of a proper engineering epistemology [3, 4].

A key factor in the learning process concerns the assessment methods. They are commonly based on a final exam, which totally or partially provides a final mark on the subject. With exam-based assessments, which are often unfair and ineffective, students do not focus on acquiring the necessary background and competencies but only on passing the final exam. In addition, a unique test does not guarantee the efficient acquisition of the required skills [5, 6].

In the framework of the European Higher Education Area, the Bologna process pursues the improvement of some of the aforementioned shortcomings, among others [7, 8]. Its implementation forced the redesign of curricula, subject contents and teaching practices in both bachelor and master programs [9, 10, 11].
In this context, workgroup is a very complete learning method that allows students to acquire different competences in each subject. However, it is common to repeat their participation in the same group over time, with a constant division of tasks across different subjects. This greatly limits the learning process to be achieved. Other disadvantages are related to cases of inequalities on developing the work as well as the difficulties for an objective personal evaluation by teachers.

In this work, our goal is to achieve an objective evaluation methodology based on: (1) the elaboration of workgroups by means of an initial questionnaire, so that the groups are organized according to the students’ preference in each theme taking into account their previous knowledge and skills; (2) the continuous evaluation and monitoring of work by teachers through qualitative and quantitative milestones or meetings, and (3) the oral presentation of each work evaluated by both students and teachers by means of a rubric method with an individual redistribution of rating by the members of the group.

Up to this point, the methodology has been conducted and implemented in both the Bachelor’s Degree Program in Civil Engineering and the Master Program in Environmental Hydraulics at the University of Granada. In particular, the methodology has been applied in these subjects: (1) “Integrated Management of Ports and Coasts” (Degree Program); (2) “Dynamics of the environment, atmosphere, ocean and coast” (Master Program), and (3) “Design and construction of maritime works” (Degree Program). This evaluation methodology, which is feasibly extensible to other branches of the engineering education, is also a bridge between the academic background and the labor market [12].

This work is structured as follows. Sections 2 and 3 describe the evaluation methodology and the results observed over the first year, respectively. Finally, Section 4 details the conclusion drawn based on early results; whereas some future research lines are presented in Section 5.

## 2 METHODOLOGY

The methodological approach of this work is summarized in Fig. 1. As shown, three main lines are proposed: 1) initial formation of balanced groups, 2) continuous evaluation by professors and 3) objective evaluation of oral presentations.

![Methodological approach](image)
2.1 Formation of balanced workgroups

Considering the academic education framework, it is necessary to form workgroups in order to evaluate efficiently all students of the same subject [13, 14, 15]. The formation of workgroups is based on an online questionnaire, which must be performed by all students during the first week of the course. This questionnaire is made by the professors in a virtual platform, such as “prado/moodle”, “google forms”, etc. [16]. The questionnaire contains items which examine the previous knowledge related to the subject matter, as well as the necessary tools for the subject development, such as programming knowledge (Matlab or Python), design software (AutoCAD, CivilCAD, etc.), geographic information systems (ArcGIS, QGIS, etc.), writing and graphics programs.

The answers to the online questionnaire are mostly score, i.e., knowledge level (1) to (5), where (1) is the basic level and (5) is the advanced level. Some standard questions related to the subject matter of “Integrated Management of Ports and Coasts” and “Design and construction of maritime works”, and their corresponding answers, are shown in Fig. 2:

(a)  
(b)  
(c)  

Figure 2.a) Student responses on knowledge of Port: five students have a basic level and others five have a medium level. b) Student response on knowledge of Coastal Engineering: eleven students have a basic level and no student has a prior knowledge. c) Student response on management of geographic information systems: four students have an advance level and five students have a medium level.
This measure not only improves the evaluation system and the student's learning of the subject, but also prepares the students for their subsequent job career, since they have to organize and collaborate into multidisciplinary groups with different professional profiles.

### 2.2 Continuous evaluation by professors

A key factor in the workgroup learning process concerns the evaluation method. As stated before, teacher monitoring during the workgroup activities is essential for an objective score of each component of the group and also to avoid imbalances in the development of tasks [17].

These tasks have been developed during tutorials hours with the different groups which have been asked by members to assess the degree of personal involvement.

### 2.3 Oral presentations

An objective evaluation method for the oral presentations has been implemented in the subjects of “Dynamics of the environment, atmosphere, ocean and coast” and “Integrated Management of Ports and Coasts” (it is expected to implement in others subjects of both the Degree and Master Programs next year). This objective evaluation by teachers is based on: (1) the public presentation of each workgroup and (2) the rubric method by means of qualitative and quantitative milestones. A rubric model has been elaborated by the professors of the subject in order to evaluate the public presentation of each workgroup. The criteria presented in the rubric model (Fig.3) are detailed below:

- Qualitative presentations milestones
  - Clarity and correctness of the expression
  - Language resources
  - Organization of the presentation
  - Design of the presentation
- Quantitative milestones:
  - Work defense.
  - Knowledge of the subject contents
  - Grade of involvement in the workgroup
  - Applications of concepts
  - Responses to the questions

This rubric model is applied to a final presentation of each workgroup. Each member of the group has to expose a part of it. At the end of the presentation, the professors, in addition to the rubric method evaluation, ask each student about the work and not necessarily about their exposed work part. The latter allows professors to confirm cases of parasitism.

The final evaluation is made up of two criteria: (1) the final mark of the rubric method (80%), and (2) the monitoring of each workgroup throughout the course, both in class and in tutoring hours (20%).
Table 1.

<table>
<thead>
<tr>
<th>Work group members</th>
<th>Work title</th>
<th>Observations</th>
<th>TOTAL MARK</th>
</tr>
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<tbody>
<tr>
<td></td>
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<td></td>
<td>0</td>
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<tr>
<td>Appearance</td>
<td>Body language</td>
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<td>Material organization</td>
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<td>Language resources</td>
<td>Correct use of language</td>
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<td>Rhythm and intonation</td>
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<td></td>
<td>Technical vocabulary</td>
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<tr>
<td>Presentation organization</td>
<td>Objectives clarity</td>
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<td></td>
<td>Structure</td>
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<td>Emphasis on the remarkable</td>
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<tr>
<td>Presentation design</td>
<td>Figures and text</td>
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<td></td>
<td>Simplicity</td>
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<td></td>
<td>Clarity</td>
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<td>Work defense</td>
<td>Knowledge of the contents of the subject</td>
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<td></td>
<td>Applications of concepts</td>
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<td></td>
<td>Grade of involvement in the work group</td>
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</table>

Figure 3. Example of a rubric model applied to the subjects: “Dynamics of the environment, atmosphere, ocean and coast” (Master Program) and “Integrated Management of Ports and Coasts” (Degree Program).

3 RESULTS

The organization of workgroups was carried out adequately in the two subjects in whom it was implemented. It is remarkable the differences in the assimilation of the methodology by degree and master students. The latter tried to convince teachers for a self-made configuration of workgroups. This reinforces the need to change the practice of grouping by the students from the beginning of the degree studies.

In the degree subject of 'Integrated Management of Ports and Coasts', the capacities of communication, empathy and workgroup have been reinforced since the implementation of this assessment methodology. Two cases of parasitism among a total of 18 students, have been detected during the continuous evaluation, according to complaints expressed by students.

In the master subject of “Dynamics of the environment, atmosphere, ocean and coast”, the proportion of parasitism cases considerably decreased, detecting 2 cases of 75 students. Although some minor problems of imbalances into some workgroups were detected, the students solved their differences between them or with the final distribution of points according to the work done.

The rubric evaluation was adequately accepted by the students and was especially useful during the review of the final grade by the students, during which very few changes were made.

4 CONCLUSIONS

During this first stage of the project, the evaluation of the methodology proposed in two undergraduate and postgraduate subjects shows different results that highlight a certain evolution in maturity of students. However, bad habits acquired since the beginning of studies have been detected, such as the creation of the same working groups for different subjects and the distribution of the same tasks for each member. More worrisome, some students of the same group confess the practice of a distribution of tasks for different subjects to save time. This reinforces the need to delve into these methodologies from the beginning of the degree studies.

The proposed methodology has improved the objectivity of final qualification by teachers and is especially useful as a tool of transparency and proportional distribution to the effort and dedication of students within a workgroup.
5 FUTURE RESEARCH LINES: EVALUATION BY STUDENTS (SELF-EVALUATION AND PEER EVALUATION)

As future lines of research, it is intended to develop for the following academic year (2017/2018) a student evaluation system. By means of this system, the students, according to the general mark placed in the workgroup, have to distribute the mark honestly between the members of the group, so that the individual work done is rewarded or punished. The latter, together with the evaluations by professors, will make up the final mark of each student.

This will allow detecting cases of parasitism in workgroups, as well as to evaluate in an objective way each student of the subject.

ACKNOWLEDGEMENTS

This work was supported by the project “Evaluación objetiva de trabajos colaborativos dentro del marco de la hidráulica ambiental” (PID-16-66). The first author was funded by the Spanish Ministry of Education, Culture and Sports (Research Contract FPU14/03570) and the second author was funded by the Spanish Ministry of Economy and Competitiveness (Research Contract BES-2013-062617).

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