IMPROVING ORAL COMMUNICATION AND TEAMWORK SKILLS IN THE FIELD OF THERMAL ENGINEERING

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Abstract

Ability for oral communication and teamwork are key skills for any engineer that are not always properly dealt with in conventional teaching-learning processes. For this reason, a pilot experience is being developed in several degree and master subjects related to Thermal Engineering at University of Zaragoza.

The methodology followed in this work includes several sequential activities. First, the experience is planned and practical tasks for students as well as evaluation rules are defined. Then, two workshops of 90 minutes are developed: the first one focused on teamwork and the second dealing with oral communication; and they are applied to both undergraduate and graduate students. Afterwards, students develop their subject tasks in small groups (usually in pairs) under the supervision of lecturers who collect main aspects in observation forms. Next step is the public oral presentation of activities, what allows students to put in practice skills developed in the previous workshops. Evaluation is developed by considering aspects related to teamwork and oral communication skills. Finally, results of the pilot experience are assessed by using the aforementioned observation forms and evaluation results, as well as surveys among students. Results are compared with the same subjects in previous years when no specific training on oral communication and teamwork had been provided.

Results obtained up to know show how, although it is not always easy to enroll students, they evaluate positively the introduction of these transverse skills.

In a more general perspective, the collaboration of lecturers of technical subjects with a psychologist enables to tackle the problem with different and complementary perspectives, which increases the interest of the approach. Finally, beside the improvement of skills of students directly involved, methodology and materials that are being developed (e.g. surveys or evaluation forms) will make it easy to export the experience to other subjects within the same and other Universities.

Keywords: Oral communication, teamwork, engineering, higher education.

1 INTRODUCTION

Skills related to teamwork and to communication ability (especially in oral form) are key aspects for any Graduate or Master in Engineering. Sometimes, a good technical work loses global quality due to bad communication. In a similar way, teamwork can generate dysfunctions such as unequal work distribution, lack of global vision of the work by the students or bad coordination among them. For this reason, effort is being made in Engineering studies for improving these skills.

In [1], how communication skills are evaluated in a laboratory subject of chemical/biochemical engineering students is presented. Feedback from industry regarding English communication in Chemical Engineering studies in Malaysia is presented in [2], where it is concluded that emphasis has to be put on oral rather than written communication. The positive effect of workshops in communication skills in Chemical Engineering is described in [3]. How cooperative learning helps improving not only teamwork skills but also deep learning in a reaction engineering course is presented in [4]. In [5], it is explained how both teamwork and communication skills improve in a multivariable calculus course by applying blended learning (mathematical thinking and creative problem solving). In [6], the development of personal skills in engineering graduates according to the needs of employers is presented.

In this framework, a project is being developed the Faculty of Engineering and Architecture of University of Zaragoza, whose main goal is to improve teamwork and oral communication skills of
Engineering students; in particular, the project will be developed in some subjects related to Energy Engineering, although it is expected that results can be extended to other subjects. To achieve this general goal, the following partial goals are required:

- To provide students training on teamwork techniques.
- To provide students training on oral communication.
- To adapt student’s activities that require teamwork and oral presentation in order to allow the application of techniques and skills presented in the aforementioned training.
- To define evaluation methods for these activities with a double purpose: to reduce subjectivity and to evaluate transverse skills. Among other techniques, co-evaluation and observation cards will be used.
- To assess the success of the experience by observation cards, surveys and comparative analysis of results.
- To obtain general conclusions that can be extrapolated to other subjects.
- To disseminate results.

The aim of this paper is to present this project. First, in the methodology section, the main activities being developed are described. Afterwards, the main results obtained up to now are summarized.

2 METHODOLOGY

In order to achieve the goals presented in the introduction, the work developed includes several tasks that are explained in this section. First of all, the general view is described, whereas afterwards the specific aspects related to the different subjects are detailed.

The first task of the project is aimed at the definition of the work to be done. Activities to be developed by students in each subject are identified and guidelines for improving their skills are defined. Besides, the methodology for the evaluation of both skills and the whole experience is defined.

Afterwards, two workshops with students are developed. The first one is focused on teamwork and its aims are to identify what teamwork is, which are the main difficulties and which are the keys for successful teamwork. The second is aimed at improving the effectiveness of oral communication: to identify errors, to develop strategies both before and during the speech and to tackle the problems related to oral speaking. In order to facilitate the assistance of students and to have small groups, two sessions of each workshop are developed. Students of the selected subjects participate in both workshops; additionally, students developing their Master/Degree Theses are asked to attend the second workshop.

In the third task, students develop the different activities within the subjects under the supervision of the lecturers who collect information about both activities and students’ behaviour. Then, students present results of their work by applying the techniques learnt in the workshops and these aspects are considered in the evaluation; furthermore, tools designed in the first task such as co-evaluation or observation cards are applied.

Finally, results of the project are analysed by the members of the research work taking into account observation cards, surveys and comparison of students’ marks. General conclusions are obtained and guidelines for extending the experience are defined. In parallel, main results are presented in conferences.

Besides the general structure of the project, it is worth to summarize how it is implemented in the different subjects:

**Thermal Engineering. Degree of Chemical Engineering.** Students work in pairs and collect information about a given subject, write a short report and give a short presentation that is open to their classmates. With this work they can reach up to 20% of the subject mark.

**Energy Efficiency in Thermal Systems. Master on Renewable Energy and Energy Efficiency.** The work includes calculations on a thermal system defined by the professor and a short review of a topic of interest, as well as writing of a report and its oral presentation. It accounts for 30% of the mark, it is developed in pairs and co-evaluation is used for defining the students’ mark in the part of oral presentation.
Hydrogen and Fuel Cells. Master on Renewable Energy and Energy Efficiency. The practical work includes writing a report and oral presentation and is developed either individually or in pairs, depending on the number of students.

Energy Efficiency in Buildings. Master on Renewable Energy and Energy Efficiency. Students have to complete three works. In all of them, they have to submit a written report. Additionally, in the last work they make an oral presentation. This last task is the one considered for the project, is developed in pairs and consists on the review of three papers published in indexed scientific journals on a topic freely chosen by the students, although related to the subject. The qualification obtained in this task represents 20% of the final grade of the subject.

3 RESULTS

Since the project is nowadays being developed (it will finish at the end of the semester in June 2019), all final results are not yet available. Main results obtained up to know are related to the first workshop, that was focused of teamwork, and are summarized in this section.

As said before, two sessions of the same workshop were organized: one for degree students (Chemical Engineering) and the other for master students (Renewable Energy and Energy Efficiency). Sessions were organized outside the usual timetable of students, in order to enable them to assist. Participation was not mandatory but strongly recommended by the lecturers of related subjects. However, the number of students attending the workshops was around 20-25% of students invited.

In order to evaluate the perception of students about the activity, a short questionnaire was distributed at the end of the sessions. Four aspects were considered: amenity, contents, duration and usefulness, and students were asked to use an evaluation from 1 to 5. Results are summarized in Table 1, where it is shown not only the distribution of marks (in %) but also the average value. It can be seen that students' perception is quite positive, especially amenity, although contents and usefulness are also considered good. It should be also noted that all students evaluated positively the duration of the activity.

<table>
<thead>
<tr>
<th></th>
<th>Amenity</th>
<th>Contents</th>
<th>Duration</th>
<th>Usefulness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1 no enjoyable, 5 very enjoyable)</td>
<td>(1 no interesting, 5 very interesting)</td>
<td>(1 too short, 5 too long)</td>
<td>(1 no useful, 5 very useful)</td>
</tr>
<tr>
<td>1</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>3</td>
<td>9.1%</td>
<td>27.3%</td>
<td>100%</td>
<td>9.1%</td>
</tr>
<tr>
<td>4</td>
<td>36.4%</td>
<td>54.5%</td>
<td>0%</td>
<td>54.5%</td>
</tr>
<tr>
<td>5</td>
<td>54.5%</td>
<td>18.2%</td>
<td>0%</td>
<td>36.4%</td>
</tr>
<tr>
<td>Average</td>
<td>4.45</td>
<td>3.91</td>
<td>3</td>
<td>4.27</td>
</tr>
</tbody>
</table>

Besides, students were asked to include comments about the workshop. In general, these comments were positive. One student suggested that this kind of training should be integrated in the general courses and not as an optional activity. Another student highlighted that the topic is interesting not only from the academic point of view, but also from the person point of view. The role of the person who developed the workshop was also evaluated very positively. One student explained that he/she had previously attended other workshops, and knew some of the topics presented. Finally, other suggestions were to include more examples and to have a summary with the main points.

As a result, it can be seen that it is not easy to enrol students in this type of activity, but at the end, they evaluate it as positive. Besides, it can be said that the highest rate of assistance corresponded to students that had been developing a job previously, probably because the contact with real world outside University allow them to be more interested on these transverse skills.

The second workshop is focused on oral communication and it will be attended not only by students of selected topics but also by other students that are preparing their Master or Diploma Theses. Although the number of participants is not closed yet, a lot of people have shown their interest on the activity.
4 CONCLUSIONS

A teaching innovation project focused on transverse skills of Engineering Students (mainly in subjects related to Energy Engineering) that is being developed in the Faculty of Engineering and Architecture of Universidad de Zaragoza has been presented. In particular, it is focused on oral communication and teamwork skills and entails the collaboration of professors of the Faculty (most of them Engineers) and a Psychologist.

The project includes the development of workshops, as well as the design and application of tools for assessing the aforementioned skills (e.g. evaluation forms or surveys for students). Results obtained up to now show that the number of students attending the workshops may be higher, but afterwards they appreciate strongly the introduction of communication and teamwork skills. Furthermore, in the first dissemination activities around colleagues of the same Faculty, they show interest about the activity and support it.

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REFERENCES


