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IS FIELDWORK AN EFFECTIVE TEACHING METHODOLOGY APPLICABLE IN ALL TECHNICAL EDUCATION?

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Abstract

Visits to companies through fieldwork are of great importance in the pedagogical process of students of technical education, since the abandonment of the classroom is an incentive for the student, and the information acquired from visits is always more attractive and valuable to him. Besides, field visits can alleviate the limitations associated with the lack of material, machinery or specific instrumentation of a particular subject. However, there can always be doubts if the student learned something from these visits. Variables such as group size can also influence knowledge acquisition. The present study shows the results of an anonymous opinion survey that has been passed to the students of the last course of Chemical Engineering Degree (whose maximum number of students is 30) and Mechanical Engineering Degree (with students by subjects higher than 70). The results of the surveys show how students positively value the fact of leaving the classroom, but if a subsequent practice related to the activity is not carried out, they do not assimilate the knowledge previously seen in the classroom. Also, in large groups of students (first Mechanical Engineering Degree courses), there are considerable limitations such as transport logistics, company availability, and time invested in conducting fieldwork, which practically discards their application.

Keywords: Fieldwork, Technical Education, Group Size, STEM Education.

1 INTRODUCTION

Following the definition of the Cambridge Dictionary, engineering “*is the study of using scientific principles to design and build machines, structures, and other things, including bridges, roads, vehicles, and buildings.*” For this reason, future engineers must be in contact with the real-world, assuming real problems, applications, economical sources, and relevant solutions. The teaching staff of the technical studies like chemical or mechanical engineering degree considers that, in technical education, field trips are a useful tool to overcome the limitations associated with classroom teaching, as well as to promote the assimilation of experiences by students. The field visit has a teaching focus at all times, where on the same facilities, the teacher remembers those theoretical concepts seen in class. Besides, in this type of facility, they receive the talk and explanation from the plant manager, whose training is often related to their studies, which gives students an example of possible job opportunities [1].

As different authors have studied, as Chanson, H. [2] field works are an exciting activity to improve the interest of the students in a particular aspect and help them in their professional development. Despite this, during the last years, due to the lower economic resources faced by the Spanish university system, the increase in computer-based and simulation classes and the increase in the ratio of student to teacher have implied a reduction of these activities.

In this study, the main issues have been studied to corroborate than field practice are not a teaching methodology applicable to all technical studies. Some of these aspects are the number of students by group, the development of following activities related to the field practice to assimilate the technical concepts, the academic results of the students, and the economic and personal sources needed.

2 METHODOLOGY

From the academic courses of the year 2016 to 2019, students of the last year of the chemical engineering and mechanical engineering degree have carried out fieldwork through visits to specialized companies in some of the subjects they teach. Specifically, in the chemical engineering

degree subjects analyzed are "Solid Waste Treatments" and "Advanced Water Treatment" and in the degree of mechanical engineering "Materials, Selection and Behavior in Service."

These subjects have been the focus of attention because they are very different groups in terms of the number of students. While the four groups analyzed in the chemical engineering degree range between 16 and 26 students, the two mechanical engineering groups range between 69 and 76 students. In this way, the authors, through the passing of anonymous surveys to students, intend to study the influence of group size on the results of activity satisfaction.

In addition to the influence of group size, the authors intend to study the degree of assimilation of content seen during the field viewers. To analyze it, the authors have divided the four chemical engineering groups into two: two of the groups carried out an activity in the classroom relaunched with the technical concepts seen in the field visit, while the other two groups did not perform any activity after the fieldwork.

On the other hand, the authors also wanted to know the opinion of the students' own receiving companies as well as of the professors involved in the tasks of conducting field visits. To do this, after the visits, companies have been asked about the main advantages and disadvantages in their view of carrying out this type of activity. In the same way, the professors involved in these activities also give their opinion in this regard, valuing aspects such as organizational difficulty, the number of resources allocated, and main drawbacks.

3 RESULTS

In the next section, a rigorous analysis of the students, companies, and teachers' opinions are shown.

3.1 Analysis of the students' opinion

Figure 1 shown the students' opinions obtained after the analysis of the anonymous survey in four different groups of chemical engineering and two groups of mechanical engineering. In the surveys, students have been asked about an evaluation of the activity, where 1 is a wrong opinion of the activity, and 10 is a very positive aspect. The number included in the bar is the number of students in these fieldworks.

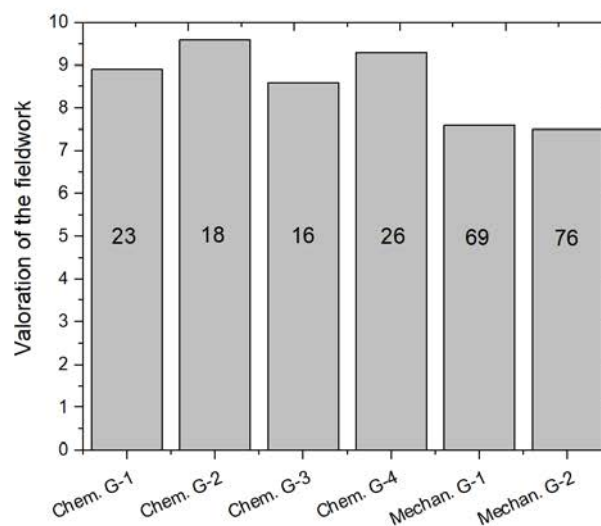


Figure 1. Assessment of fieldwork of different students groups

In general terms, all students considered the fieldwork very positively, with average results higher than 8.5 out of 10. Asked for the main incentive for the students, they assess very positively the fact of moving to a different place, different than the traditional class, seeing with their own eyes industries related to their studies and engineers of the same degree performing their work, which helps them, visualize possible job opportunities. Finally, when students are asked about the degree of the activity to help them to assimilate technical concepts seen in the classroom, the average opinions is higher than 7.8. This result will be analyzed in-depth further in the text.

3.1.1 Influence of the group size

Through the analysis of student satisfaction surveys, the influence of their assessment can be seen depending on the group size. In smaller groups (chemical engineering), the assessment is more positive, with an average value of 9.1 out of 10, while in large groups of mechanical engineering, this satisfaction value does not reach 7.6. Therefore, the group size is a variable that is related to the scores, as the groups become smaller, the evaluation of the activity is better. These findings are consistent with those reported in other countries [3], [4], which makes evident the need to take care of the size of the group in university classrooms.

3.1.2 Assimilation of contents

The authors have studied the assimilation of contents related to the fieldwork in the four different groups of Chemical Engineering. To evaluate this, two of the groups worked on an activity related to the fieldwork in the classroom after the visit. The other two groups did not work on this activity. In the partial examination of the subject, when asked about a technical concept seen both in the classroom and in the fieldwork, the two groups that developed the activity obtained better results in that question. Average results of the marks obtained (out of 10 points) in this question in the partial examination are shown in Figure 2.

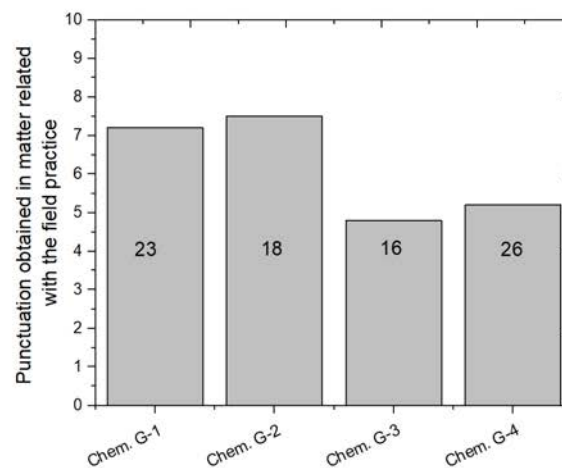


Figure 1. Assimilation of contents related to field practice in different student groups.

Because of the obtained results, the authors consider it necessary to carry out an activity in the classroom to reinforce those technical concepts seen in the field visit. If it is not done, the student perceives the departure from the classroom as a mere recreational excursion or session devoid of the content of interest.

3.2 Analysis of the companies' availability and organizational capacity of teachers

The companies that kindly give up their time and staff to receive the students have been asked about the advantages and disadvantages of this activity. The analysis of the response is summarized below:

- As a positive factor, companies declare that fieldwork is for them a form of dissemination and publicity in the university community. Likewise, they value very positively the fact that students know their field of work in order to have candidates to be able to hire them in the future.
- As a negative aspect, companies are reluctant to receive large groups since they can incur security problems, lack of attention, and a higher expense of personnel and personal protection material for each of the students visiting the company.

Authors consider a handicap the fact occurring in studies like Mechanical Engineering, with very groups large groups, with more than 70 students, where companies are reluctant to receive them, being a disadvantage respect other degrees.

3.2.1 *The organizational capacity of teachers*

For their part, the authors also analyze the negative aspects of the organization of fieldwork in such large groups.

In the first place, there is a need for more resources to be allocated, such as means of transportation or personal protection measures. Secondly, there is a limitation of teachers, since in many cases there is only one teacher assigned to each subject, which makes it very difficult to control a large group and can even cause security problems in companies. Finally, through the study developed has demonstrated that the following activity related to the technical concepts developed in fieldwork is necessary to assimilate concepts by the students.

4 CONCLUSIONS

As conclusions, authors have demonstrated through this study, some main aspects related to the field practice. On the one hand, it is a pedagogical activity very well valued by students, so the abandonment of the classroom is an incentive for the student, and the information acquired from visits is always more attractive and valuable to him. On the other hand, large groups have some inconvenient, like less assimilation of concepts with worst academic results. Moreover, these large groups with more than 70 students need economical and personal sources to be developed by teachers' staff, which sometimes do impossible to be developed. Finally, the companies, which kindly yield their technical personal and installations, there is also a problem with such large groups, since they can lead to a lack of attention, security problems and higher costs in personal safety equipment. For all these reasons, authors consider that fieldwork is not a teaching methodology applicable in all technical education since the students/teacher rate is very high (70/1) in some cases, such as mechanical engineering degree. Besides, to require a high amount of sources to obtain the worst academic results than in smaller groups.

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