

EDULEARN¹⁸

10TH INTERNATIONAL CONFERENCE
ON EDUCATION AND NEW LEARNING
TECHNOLOGIES

PALMA (SPAIN)
2ND - 4TH OF JULY, 2018



CONFERENCE PROCEEDINGS



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ACTIVE METHODOLOGY IN MECHANICAL TECHNOLOGY

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Abstract

Challenged with the existence of increasingly heterogeneous classes in higher education, it is imperative that the teacher reflects on his practice and worries about the learning environment of the curricular units that he/she teaches. This paper describes a teaching experience developed in the Mechanical Technology II course unit, of the degree in Mechanical Engineering, in the 2016/2017 and 2017/2018 academic years. The main objective of the experiment was to achieve a greater involvement of students in the theoretical component of the course unit. Thus, the students were assigned the responsibility of presenting the theoretical subjects in the classes instead of being presented by the teacher as was usual in other years. In addition, in each class, a debate was held on the presentations and the students made a brief written evaluation of the subject. Evaluating the experience, through a questionnaire, the students generally agreed that it was positive for their learning. This is corroborated by the results of the evaluation, since, compared to previous years, there was a significant improvement in the students' classifications in the theoretical component of the course unit.

Keywords: Mechanical technology, presentation of themes, bibliographic research, active participation.

1 INTRODUCTION

Giving students the role of protagonists in the process of teaching-learning and promoting their autonomy with the planned monitoring of teachers was the central focus of the academic policies and discourses that underpinned the implementation of the Bologna process in European higher education [1]. However, this change of paradigm cannot be only by decree, but has to be a project felt by the teachers involved. It should be remembered that in higher education, teaching is often understood as a way of transmitting knowledge, being the lecture classes, in which students are mere receivers of information, the most commonly used method ([2], [3]).

Thus, to have a real shift from lecture teaching to methodologies which consider the student as a constructor of their own knowledge, it is important that teachers reflect on their practices and launch themselves into the challenge of trying new teaching approaches to be a powerful helper in this process.

Some teaching methodology like the Project-Based Learning [4] and the method of Flipped Classroom [5], already experienced by some teachers in higher education ([6], [7], [8], [9], [10]), meet the objective of giving students a more active role in their learning process. The first method is based on the development of a project (goal) in which the knowledge to develop it is acquired by the students, with the support of the teacher, as they need it [11]. In the Flipped Classroom, students use the non-classroom timetable to watch "virtual lectures" available on the internet, or provided by the teacher [12], thus freeing the classroom time to occupy students with other activities. As refer Talbert [9] "to put students in a better position to succeed, it would seem that the contexts of the traditional classroom need to be reversed: information transfer should be done outside of class using media that give students more control, and high-level tasks should be done inside of class where the instructor is present to guide students in efficient and effective work" (p. 362).

In this way, the teacher leaves the role of "sage on stage" [13], in which the main function is to provide information to the class and instead he can use the time available to guide students in solving tasks that promote interest, without the pressure with the end of the program of the course unit.

The degree course in Mechanical Engineering of the Higher School of Technology and Management of the Polytechnic Institute of Bragança integrates in its study plan the course unit of Mechanical Technology II, which works in the 1st semester of the 3rd year. The programmatic contents are

organized into fifteen major themes that can be grouped according to two classifications: manufacturing processes and metal joining processes (welding and structural adhesives).

The curricular classes are divided into theoretical and practical, each lasting two hours per week. In theoretical classes the usual methodology is the lecture of contents by the teacher. The practical classes, usually more participate by the students, having experimental and laboratory components, in which are designed and manufactured metal parts.

Considering that the approval rate for the course unit is usually over 75%, it could be concluded that students perform well in the course unit. However, if the theoretical component was separated from the practical component, it is observed that in the first component the students have much lower classification, for example, the percentage of positive classifications in the theoretical part ranged from 19% to 42% in the three academic years before 2016/2017. In this context, there is a need to rethink alternative approaches to theoretical classes that, in addition to motivating students, contribute to a more effective learning of the contents inherent to this component. With this in mind, the teacher of the course unit (one of the authors of this article) decided, in the 2016/2017 and 2017/2018 academic years, to adopt a teaching methodology in the theoretical classes, partially following some of the ideas involved in the Flipped Classroom methodology.

2 METHODOLOGY

The experiment carried out had a target group of 15 students and another with 50 students, who were attending the course of Mechanical Technology II in the academic years 2016/2017 and 2017/2018, respectively. Both classes consisted mainly of male students. In addition to Portuguese students, classes also included international students of Spanish and Brazilian nationality, and this heterogeneity was most evident in the 2017/2018 school year. That is, in 2016/2017, the class consisted of 4 Spanish students and 11 Portuguese students and in 2017/2018 by 14 Brazilian, 10 Spanish and 26 Portuguese.

During these academic years, in the theoretical classes of the course unit, the content was carried out by the students rather than by the teacher. In this way, each student (in 2016/2017), or group of two students (in 2017/2018), was responsible for presenting a theoretical theme. In this sense, was proposed to students a search about the subjects, using specialized bibliography or the internet (websites, videos, etc.). Subsequently, on a previously agreed date, they would make the presentation to their colleagues. At the end of this presentation there was a large group debate in the classroom where the other students of class could request clarifications about the theme content to the colleague who presented the topic, furthermore was discussed the application of theoretical contents to practical cases. Since all the students also had as a task the previous reading of the topic to be presented, their participation in this discussion could be more active. In order to encourage the students' involvement in the debate and the previous study of contents, at the end of each class, a "classroom question" was also proposed. This was organized differently in the two school years, due to the high number of students in the class of the second academic year in which the experience was implemented. Thus, in 2016/2017, the "lesson question" consisted of a written test of one or two development questions about the topic presented. On the other hand, in 2017/2018, was implemented an online test where ten multiple-choice questions were randomly generated for each student, based on a set of 20 questions made by the teacher.

Taking into account the work developed, the evaluation of the students to the course unit was made using three different components:

- Presentation of the theoretical part by the students: 10%.
- Written evaluation (weighted average of the classification of classroom questions): 60%.
- Technical report and practical performance in laboratory: 30%.

At the end of the experiment, the students answered a questionnaire whose main purpose was to gather their opinion about the contribution of the methodology applied to their learning, as well as, their opinions about the changes to be implemented in future years. It was not possible to have all students who participated in the experiment respond to the questionnaire, so the number of responses was 12 and 36 students, in the 2016/2017 and 2017/2018 school years, respectively. Thus, the data obtained through the questionnaire, the lecture notes collected by the teacher as a participant observer, his own reflection on the classes, and the students' performance in the classroom questions were used to analyze the impact of the approach methodology described in the two years at the same

time and to investigate how the significant increase in the number of students in the class influences the process.

3 RESULTS

Almost the students who answered the questionnaire attended more than 75% of the classes and participated in the evaluation components (presentation of the subject, practical work and class questions), although around 25% of students in 2016/2017 and 27.8% in 2017/2018 has not performed the written evaluation of all topics.

Overall, the students considered that they had no difficulty in "following up" the curricular unit, since only 16.7% and 8.3% of the students in the 2016/2017 and 2017/2018 classes, respectively, either agree or fully agree that they experienced difficulties.

Regarding the opinion about the presentation of the theme and the work developed in its preparation (Fig. 1), although in 2016/2017 no student stated that they had difficulties in preparing the presentation or in understanding the contents, however, in 2017/2018 some students (22.2% and 33.3% respectively) agree or fully agree to have had difficulties in these aspects. It should be noted that most students agree or fully agree that this process has increased their confidence in their abilities (91.7% in 2016/2017 and 66.7% in 2017/2018) and improved their argumentation skills (91.7% in 2016/2017 and 69.4% in 2017/2018). Even so, only half of the students in both years think they have learned more than if they had been the teacher exposing the content.

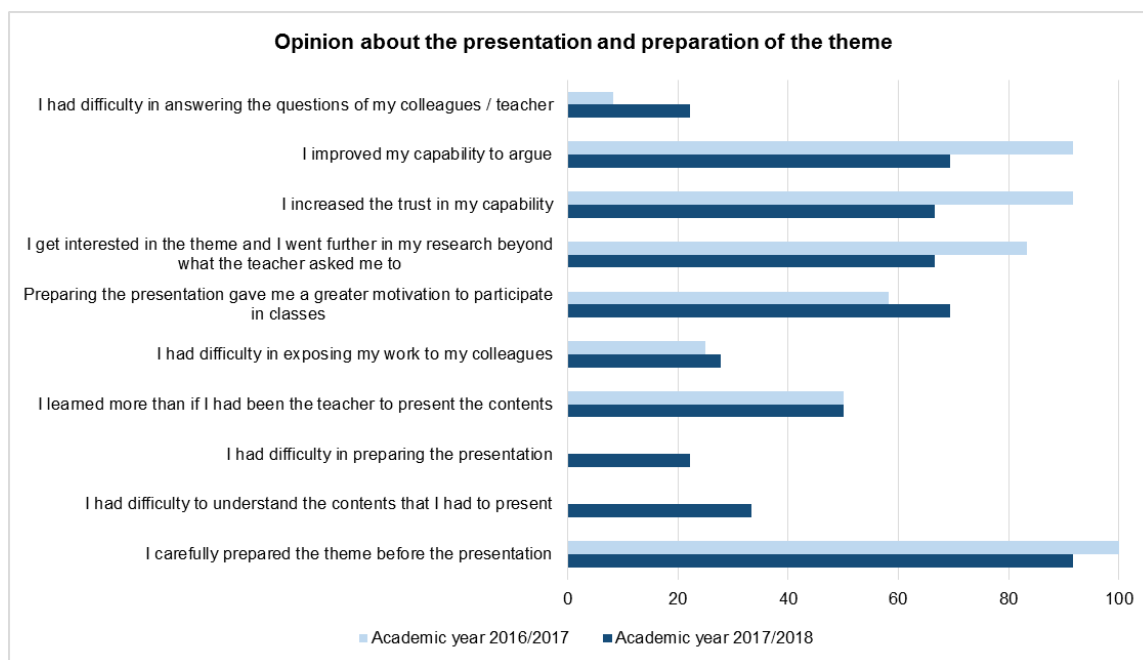


Figure 1. The students' opinion about the presentation and preparation of the theme.

In the 2016/2017 school year, 58.3% of the students agree or fully agree that they felt more motivated to participate in the classes because of presentations, in 2017/2018, had an increase of that percentage to 69.4%. However, when analyzing the presentation impact of the topics by colleagues, this motivation for the course unit increases to 83.3% in the 2016/2017 (Fig. 2) and decreases slightly to 63.9% in 2017/2018.

The active participation in classroom is still an attitude that has to be developed with the students, because although this voluntary participation is already significant in 2016/2017, since 41.7% agree or fully agree that it did in 2017/2018 this percentage is only 8.3%, falling far short of what would be desirable.

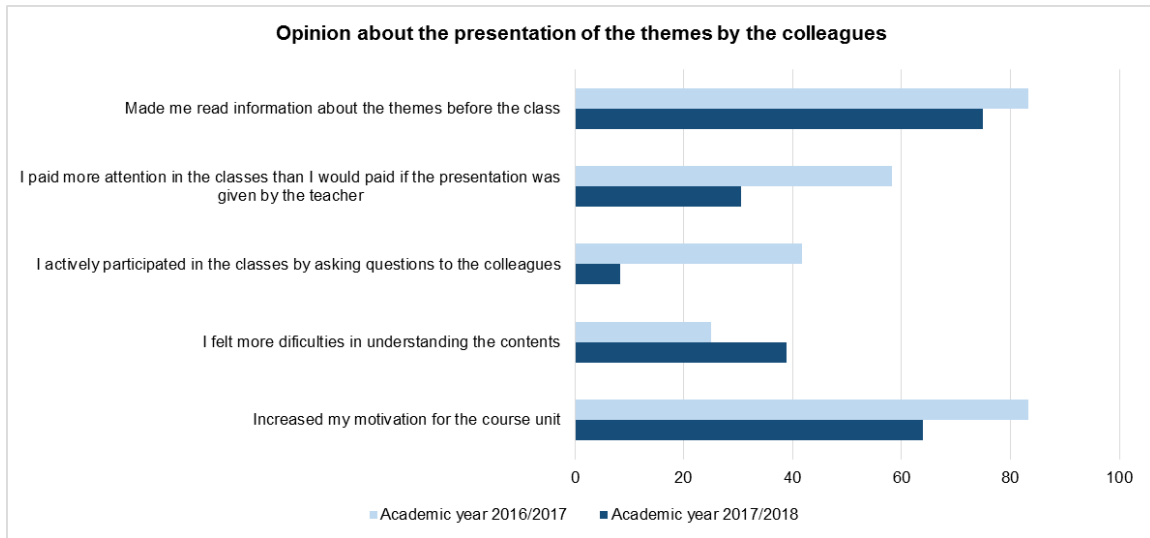


Figure 2. The students' opinion about the impact of the themes presentation by the colleagues.

The existence of the classroom question for student evaluation after the presentation of each theme contributed to the fact that the majority of the students became more involved in the classes, this is, they were more focused and studied the subjects before the presentation of the colleagues, although the verification of a smaller percentage in 2017/2018 than in 2016/2017 (Fig. 3). It is worth noting that while in 2016/2017 all the students agree or fully agree that they tried to clarify the doubts after presentation of the colleagues, that percentage does not reach the 50% in 2017/2018.

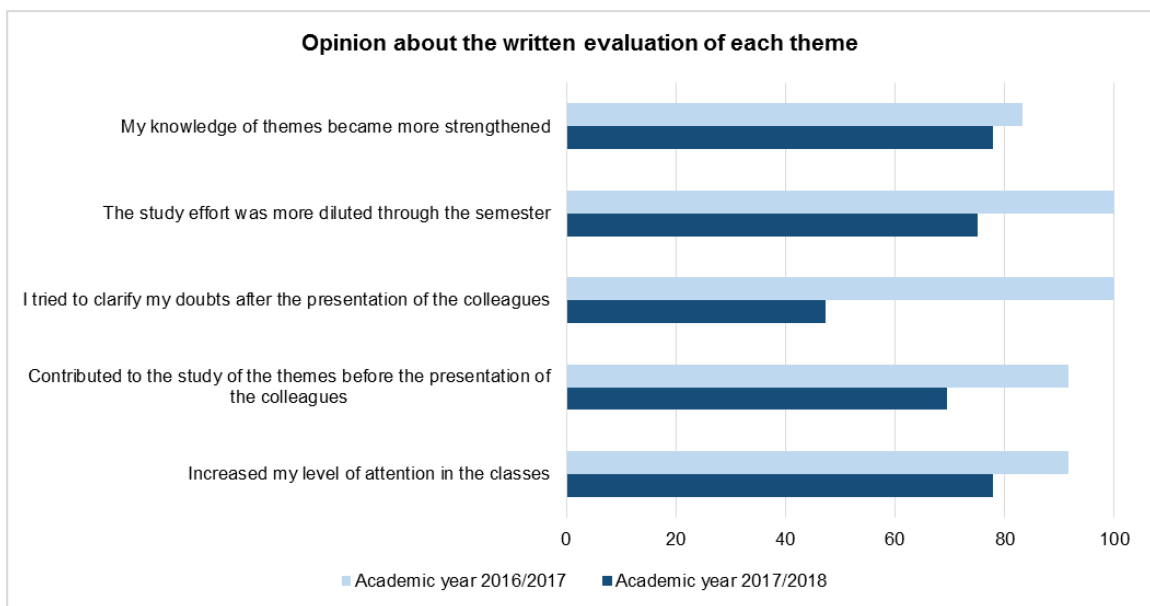


Figure 3. The students' opinion about the impact of written evaluation of each theme.

If they attended the course unit again, most of the students would like, except for the final exam, all other strategies used in the classroom must be maintained (Fig. 4). It should be noted that the most significant difference between the two school years is in the written evaluation of the subjects, in which in 2016/2017, the totality of students has the opinion that it should be maintained and in 2017/2018, only 69.4% agree with this perspective.

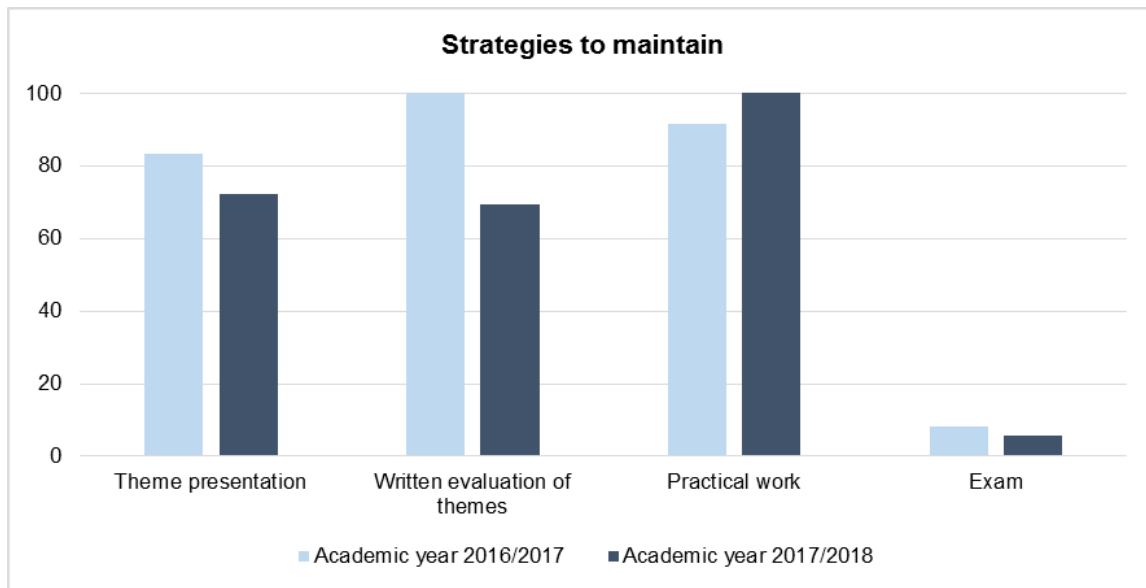


Figure 4. The students' opinion about the strategies to maintain.

4 CONCLUSIONS

Even though there were some less favorable aspects, in global terms, it can be considered that the methodology applied in the theoretical classes had positive effects on students' learning. As the teacher found, in both school years there was a greater involvement of students in classes compared to previous years when the theoretical exposition was only carried out by the teacher. This is corroborated by the opinions of the students in which most agree or fully agree that the presentation of the subjects by the colleagues increased their motivation for the course unit and made them to read information about the subjects before the lesson. In addition, most also consider that having to present the topic has increased the confidence in their capabilities and improved their ability to argue.

The evaluation of the theoretical component in each class, instead of concentrating only on a test, was one of the factors that contributed to the success of the experiment. According to the words of some students, "The evaluation was motivating" (2016/2017), "Obligation to study every week improves achievement and is a fairer evaluation of student performance" (2017/2018), "Distribution of more attractive course unit, better learning performance" (2017/2018). These ideas are in line with the views expressed in the questionnaire, as more than 75% of students in both years agree or fully agree with the fact that they have to do the "lesson question" at the end of each class improve their level of attention in class and allowed the knowledge in the subjects to be more strengthened. To corroborate the mentioned advantages, it is verified that the overall classification of the students in the theoretical part was greater than the previous years, since 78% of the 16 students in 2016/2017 and 75% of the 50 students in 2017/2018 obtained a positive classification in the theoretical component.

Relatively to disadvantages of the experience, they were more visible in the 2017/2018 school year, when the class was larger. This significant increase of the class for 50 students led to the organization of the logistics of assigning the topics to be presented and the management of class time itself to carry out the tasks envisaged would be more difficult for the teacher. In addition, the class was more heterogeneous in terms of knowledge and attitudes. Thus, there were more problems with student attendance, they were less able to be attentive to peer presentations, and not all of them took full responsibility for the task assigned to them when presenting the theme, as evidenced by the opinion of colleagues when referring to the aspects they liked least: "Many presentations were a copy of the teacher's notes, showing disinterest in learning and teaching other students", "Lack of dedication in the presentations". Although this aspect may also be due to difficulties inherent to the task itself, since, unlike the 2016/2017 academic year in which the students did not present difficulties related to the preparation of the presentation, in 2017/2018 there are students who agree or agree fully to have had difficulty in preparing the presentation (22.2%) or in understanding the content they had to deal with (33.3%). The teacher also found that the discussion generated by the topics presented was a little poorer than in 2016/2017, and that there was constant intervention on his part to make the debate fruitful. However, the difficulty in participating actively in class by asking questions to colleagues is

much more pressing in 2017/2018 (only 8.3% agree or fully agree that they participated) is transversal to the two years since even in 2016/2017 only 41.7% of the students fully agree or agree that they have actively participated, which may denote that students are still unaccustomed to such tasks.

In sum, despite of careful consideration about the adaptations that must be made according to the size and profile of the class, especially when students still need a lot of supervision and support by the teacher, the applied methodology can be considered, as one student says, a "good learning method: more motivating and exciting" (2016/2017).

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