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UP-TO-DATE OPINION OF STUDENTS IN THE SUBJECT OF ENGINEERING GRAPHICS

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Abstract

During their first year, students of different Engineering degrees—Industrial, Mechanical, Electrical, Chemical, and Agrifood Engineering—study the core subject of Graphic Engineering. The main objective of the subject is to train the capacity of spatial vision and develop the knowledge of graphic representation techniques, both by traditional methods of descriptive geometry and by computer-aided design (CAD) applications. Nevertheless, the problem is that not all students start this subject with the same level of previous knowledge.

To solve this issue, reinforcement courses were established, in order to improve the background knowledge of first-year students who have not previously studied technical drawing, or those students who have been repeating the subject for several years. Nevertheless, we observed that attendance during the classes tends to decline throughout both in the Graphic Engineering course and in the reinforcement course. To assess the effectiveness of this reinforcement course, two surveys were conducted on a group of 16 students belonging to degrees of Industrial, Mechanical, Chemical, Electrical and Agrifood Engineering; one of them at the beginning of the course and the other at the end. In this way, we try to find the impression of the students during this course in order to observe its effectiveness. To approach the causes of the general sharp decrease in attendance, another survey was carried out, asking about the reasons as well as their general impression regarding the learning and usefulness of the subject.

Generally speaking, we observed that the majority of students value positively the class attendance, their learning during the course and the usefulness of the subject for their professional future. However, the non-attendance is clearly observed by teachers, especially during the theory classes, which seems to be caused by an incompatibility of schedules and the belief that attending theory classes do not contribute too much to their learning.

Keywords: Teaching, Graphic Engineering, Survey.

1 INTRODUCTION

Students of technical studies generally have to imagine objects in different positions and manipulate or generate graphic information, either on paper or on computer, both with 2D or with 3D CAD tools. As McGrath & Brown outlined in their White Paper [1], to develop appropriate skills in the fields of science and engineering visual learning is necessary. These skills facilitate the collaborative learning and develop the students' creativity. Different authors also relate a high level in these skills with the success in technical careers. Spatial thinking is essential for scientific thinking and is used to represent and manipulate information in learning and problem solving [2-4].

Graphic Engineering is a core subject that encompasses the students of different Engineering degrees, namely, Industrial, Mechanical, Electrical, Chemical, and Agrifood Engineering degrees. Its main objective is to train the capacity of spatial vision and develop the knowledge of graphic representation techniques, both by traditional methods of descriptive geometry, and by computer aided design (CAD) applications. The subject is offered in the second semester of the first course and consists of 5 theory groups and 16 laboratory groups in the computer room. The average number of students enrolled every year is approximately 320.

The first problem faced by teachers is that students start their engineering studies with different levels of previous knowledge in technical drawing. This statement is the result of a study conducted in the course 2017/2018 with students of the same subject [5]. In that work, a gamification experience conducted to obtain an initial evaluation of students is described. Results showed that half of students from Chemical and Agrifood Engineering had never received any training in technical drawing, in fact up to 38.5% of Agrifood students were aware of their general lack of previous knowledge, nevertheless this did not discourage them to be curious about the subject. In the light of the results, some actions

were proposed for the future, specifically the application of reinforcement classes for those students who do not reach the minimum previous knowledge for the subject.

During course 2018/2019, teachers decided to implement that proposal and offer the students a reinforcement course with 20 places. It was developed in parallel with the academic classes, and consisted of 10 sessions of 2 hours a week. The sessions were held in computer rooms, and consisted of performing sketching and computer delineation exercises in addition to those proposed in the academic classes. The theoretical and practical contents of the subject were worked at a slower pace. During the classes, the subject's own material was used: class notes [6], paper (cartesian and isometric), pencils, rubber, computer, projector and delineation program (AutoCAD/SolidWorks), as well as online resources [7], [8], additional publications [9], etc.

Nevertheless, we observed that attendance during the classes tends to decline throughout both in the Graphic Engineering course and in the reinforcement course. This is the second problem faced by teachers who, in recent years, have noted with concern a high dropout rate at theoretical classes as the course progresses. This reduction does not occur in the same way in the practical classes in which student attendance is more constant throughout the course and higher than in theoretical ones.

To assess the effectiveness of this reinforcement course, two surveys were conducted on a group of 16 students belonging to degrees of Industrial, Mechanical, Chemical, Electrical and Agrifood Engineering; one at the beginning of the reinforcement course and the other at the end. In this way, we try to find the impression of the students during this course in order to observe its effectiveness. To approach the reasons of the general sharp decrease in attendance, another survey was carried out, asking about the reasons as well as their general impression regarding the learning and usefulness of the Graphic Engineering subject.

This paper is structured in the next sections: Section 2 describes the methodology used to carry out the surveys in order to obtain the students' opinions about the effectiveness of the reinforcement course and the reasons for dropping out of classes. Section 3 presents the analysis of the results and section 4 sums up the main conclusions obtained.

2 METHODOLOGY

To collect students' opinion, we applied online questionnaires. Namely, we used Socrative tool for the first study, which was focused on collecting the students' opinion of the Graphic Engineering subject, to know if their participation in the reinforcement course influences the results of the initial queries.. For the second study, we used the Kahoot tool in order to discover the reasons for the students' demotivation of attending classes. Both of these tools are free digital applications, created as a play-based mixed learning platform, which encourage student attention and participation through questions and answers raised by the teachers and answered by students with their own devices [10].

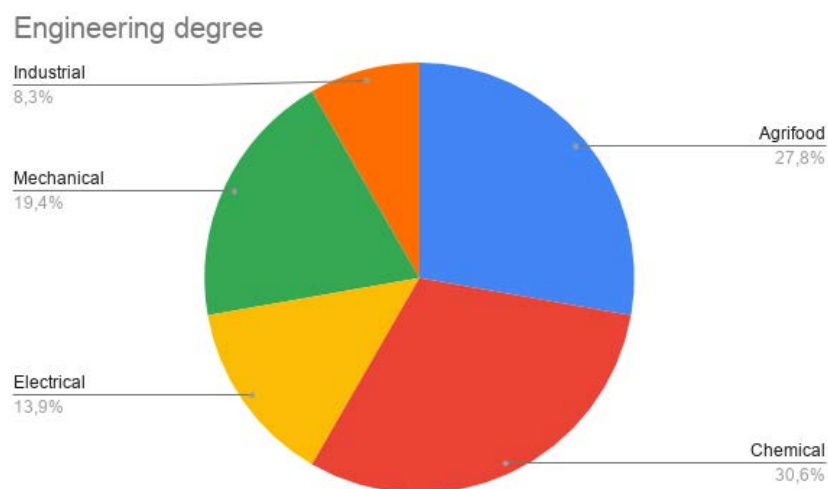


Figure 1. Degree of the 16 students that conducted the survey

A total of 16 students took part in the experience (which suppose 80% of the students that participated in the reinforcement course), all of them enrolled in the first-year subject of Graphic Engineering and

participating in the reinforcement course. Students belonged to different Engineering degrees as it is shown in Fig. 1. Of the total participants, 45% were women and 55% were men. 62.5% of the polled students have no previous knowledge in technical drawing, only 12.5% had studied the subject in the high school and 25% of them had coursed some extracurricular subject related with the subject.

The first survey consisted of an online questionnaire that the students answered at the beginning and again at the end of the reinforcement course. The questions were designed to obtain not only general information (gender, engineering degree, level of previous knowledge, etc.), but also information about their impression of the subject.

- 1 Do you think it is important to attend classes to pass the course?
- 2 Do you like the subject of Graphic Engineering?
- 3 Do you think Graphic Engineering is an important subject for your professional future?
- 4 Do you think Graphic Engineering is an easy subject to pass?

As explained above, we observed that attendance during the classes tends to decline throughout both in the Graphic Engineering course and in the reinforcement course. To approach the reasons of the general sharp decrease in attendance, a second survey was carried out, asking about the reasons as well as their general impression regarding the learning and usefulness of the subject:

- 1 This course, what has been your attendance to theory classes?
- 2 This course, what has been your attendance to laboratory classes?
- 3 For what reasons have you stopped attending classes?
- 4 What is your overall impression of the learning achieved with the reinforcement course?
- 5 Which resources outside the university did you use?

3 RESULTS

After downloading the worksheets with the answers given by the students, we present a summary of the questions and the answers obtained. The results are presented in terms of bar plots, differentiating between questions. Question 1 to 4 are compared between the initial and final surveys. Questions 5-9 show the results of the second survey, in order to approach the reasons of the general sharp decrease in attendance, their general impression regarding the learning and the usefulness of the subject.

The participating students signed electronically a data protection agreement. This document showed the questionnaire's purpose and explained that teachers assure confidentiality and protect the personal data handled.

3.1 Do you think it is important to attend classes to pass the course?

Most of the students consider that is important to attend class, either at the beginning or at the end of the course (the 87.5% of students in the initial survey and the 83.3% in the final survey (Fig. 2)).

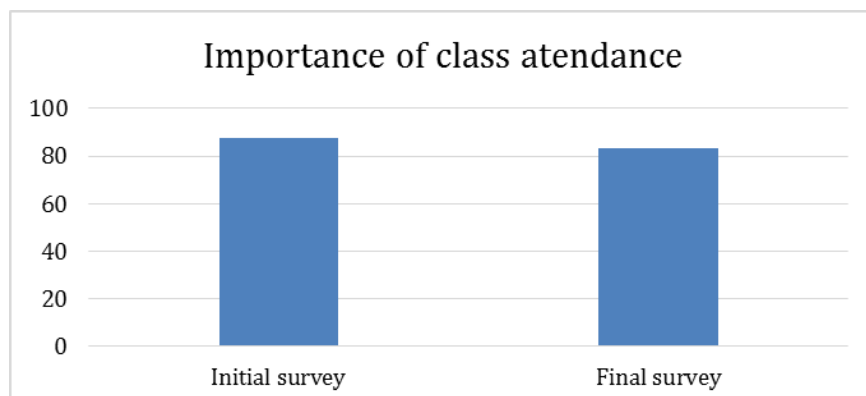


Figure 2: Survey answers to the question "Do you think it is important to attend classes to pass the course?"

3.2 Do you like the subject of Graphic Engineering?

Most students like the subject before starting the course (62.5%) and none of them dislike it. At the end of the course, 47.2% still like the course and the dislike increases to 20% (Fig. 3).

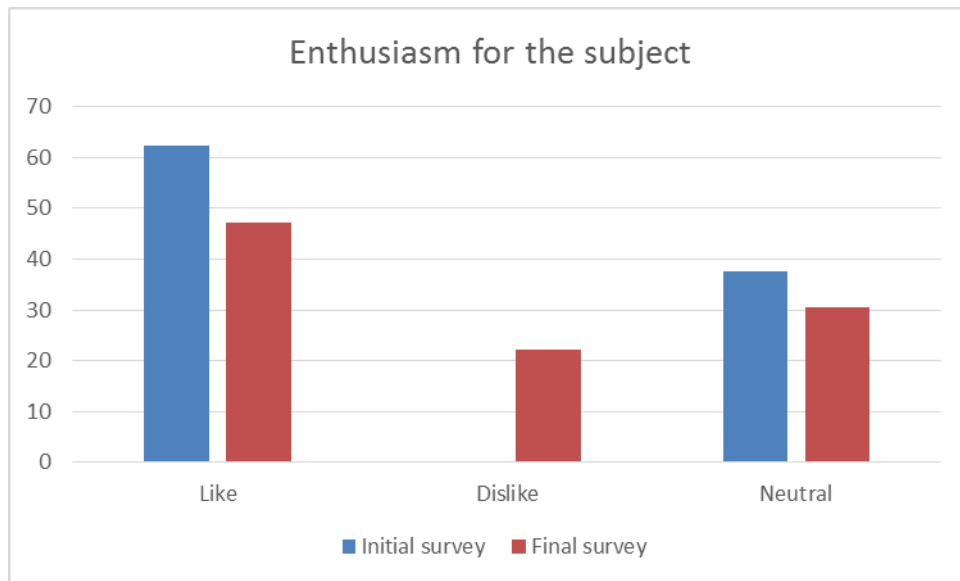


Figure 3. Survey answers to the question “Do you like the subject of Graphic Engineering?”

3.3 Do you think Graphic Engineering is an important subject for your professional future?

Most students consider the subject important in both moments, before starting the course (87.5%) and at the end of the course (55.5%). None of them dislikes it at the beginning and the 20% consider it not important at the end of the course (Fig. 4).

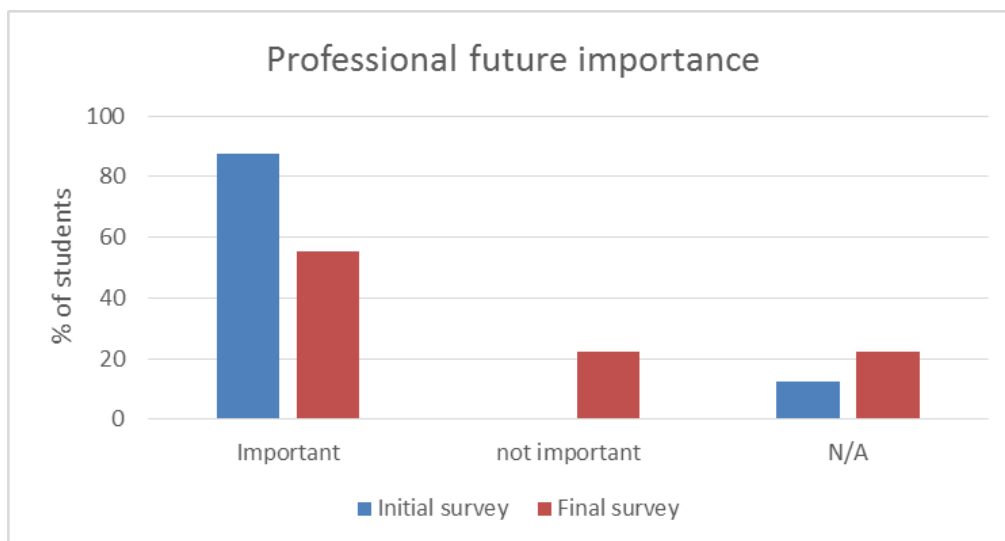


Figure 4. Survey answers to the question “Do you think Graphic Engineering is an important subject for your professional future?”

3.4 Do you think Graphic Engineering is an easy subject to pass?

Initially, 37.5% of the students considered that Graphic Engineering was an easy subject to pass, while 62.5% considered it difficult. At the end of the course, 44.4% considered the subject as an easy subject, while only 5% of the students considered it a difficult subject (Fig. 5).

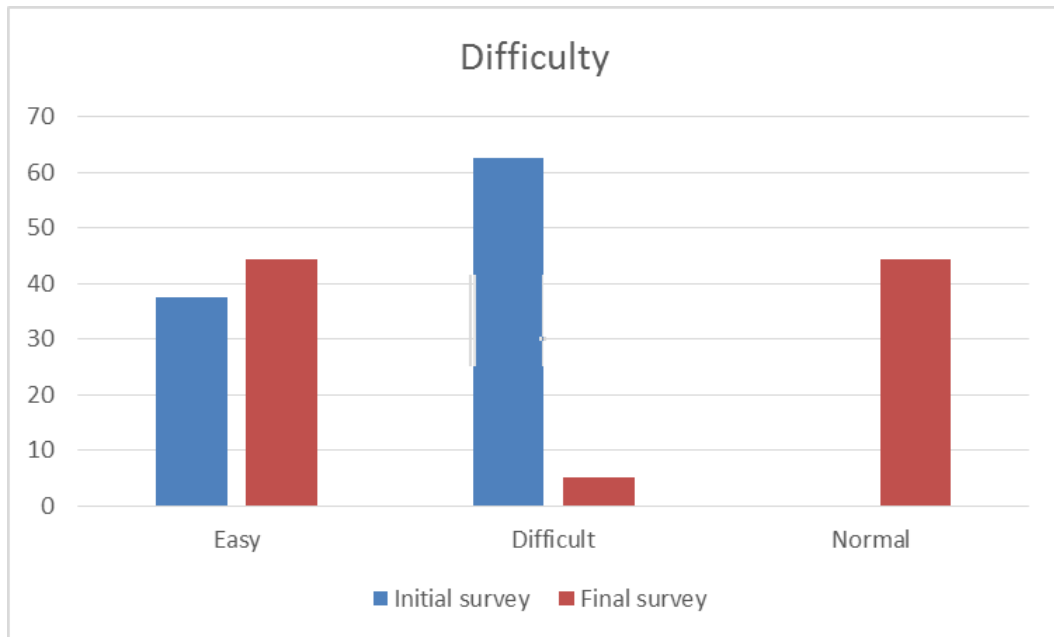


Figure 5. Survey answers to the question “Do you think Graphic Engineering is an easy subject to pass?”

3.5 This course, what has been your attendance to theory classes?

53% of the students only attended between 1-5 classes during the course, 23% between 6-10 classes, 11% more than 10 classes and 11% any class (Fig. 6).

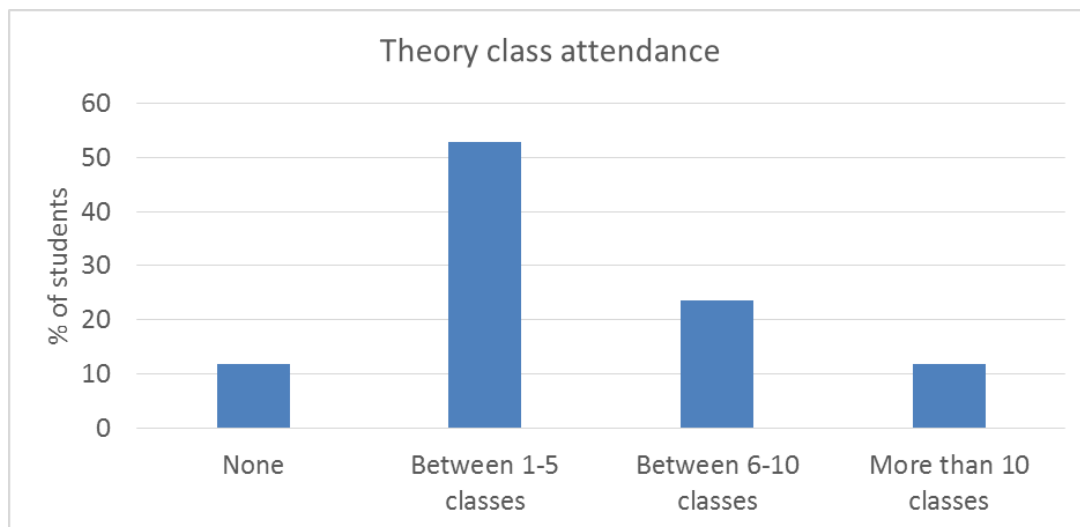


Figure 6. Survey answers to the question “This course, what has been your attendance to theory classes?”

3.6 This course, what has been your attendance to laboratory classes?

6% of the students only attended between 1-5 classes during the course, 6% between 6-10 classes, and 82% more than 10 classes (Fig. 7).

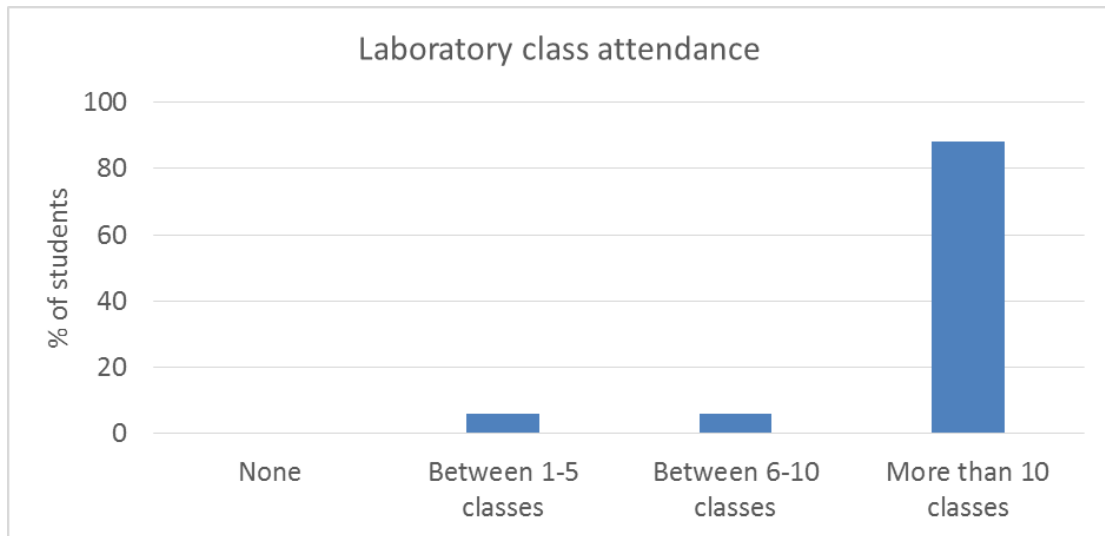


Figure 7. Survey answers to the question “This course, what has been your attendance to laboratory classes?”

3.7 For what reasons have you stopped attending theory class?

Fig. 8 shows the causes of the non-attendance. It is caused by an incompatibility of schedules (35%), the belief that attending theory classes does not contribute too much to their learning (35%) and the lack of interest (5%).

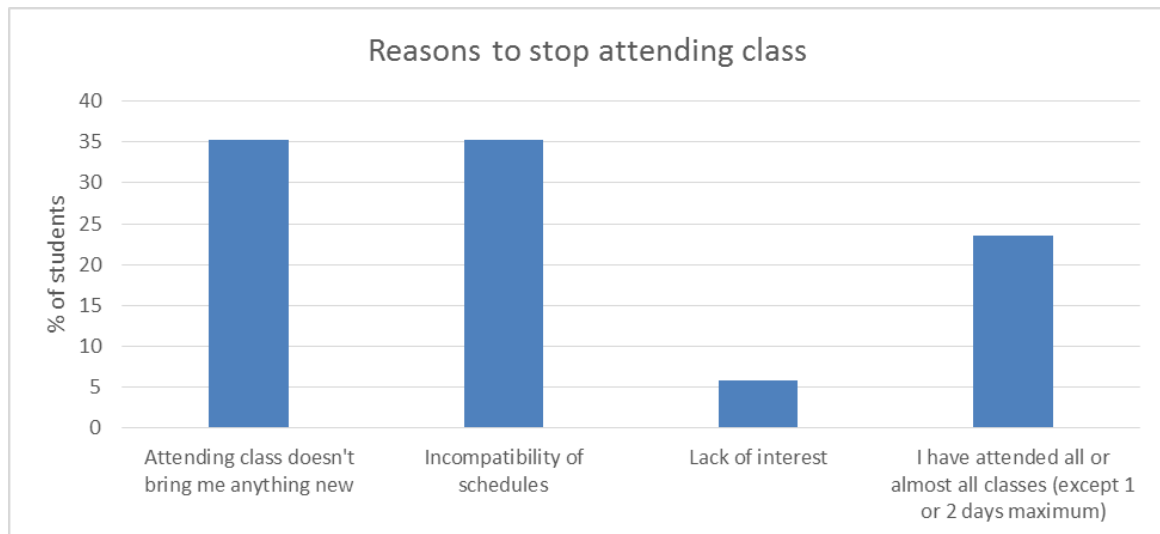


Figure 8. Survey answers to the question “For what reasons have you stopped attending theory classes?”

3.8 What is your overall impression of the learning achieved with the reinforcement course?

52.5% of students value as good their learning during the reinforcement course and the 35.5% of them as very good, while only the 6% value bad or normal their learning (Fig.9).



Figure 9. Survey answers to the question “What is your overall impresion of having learned?”

3.9 Which resources outside the university did you use?

65% of the students affirm that they did not use any external resources to pass the subject. 29% of them confirm that they used video tutorials and other 6% claim to participate in the Formula Student team at the UJI [11], this is an international project which main goal is to design and build a car to compete against other universities that also participate in it. None of the students chose the answer of attending an extern academy. (Fig.10).

RESOURCES OUTSIDE UNIVERSITY

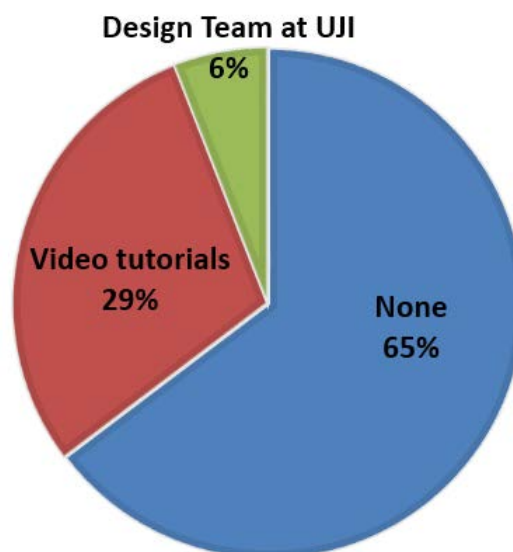


Figure 10. Survey answers to the question “Which resources outside the university did you use?”

4 CONCLUSIONS

This work is focused on those students who attended the reinforcement course of Graphic Engineering. Although they represent only the 5% of the students enrolled in the academic subject of Graphic Engineering, they are considered to need some academic help because of their lack of previous knowledge in the subject. In general, the response of students towards the reinforcement course has been positive; in fact 88% of students assess the learning achieved as good or very good. It also seem to increase the students’ confidence in the face of new content, since the perception of the difficulty of the subject, has drastically decreased from 62.5% to 5%.

Analysing the results in detail, we observed that the majority of students value as positive and important the class attendance, before and after the course. Nevertheless, although students seem to begin the course with enthusiasm, it seems that the course do not meet their expectations and the dissatisfaction and demotivation earn points at the end of the course. This may be the main reason why teachers have noticed a high dropout rate during the course development. Still, we must clarify that attendance to practical classes (at computer classrooms) do not follow the same tendency, since it keep quite high and constant during the entire course. This lead us to conclude that students give more importance to learning the CAD tool than to the theoretical contents of the course.

Therefore, the reinforcement course has been proved to cause positive influence in the students and for future courses it would be necessary to encourage the participation of the students in theory classes, either through an active participation in class or through the proposal of new work material applying new teaching methodologies.

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