

Online Flipped Classroom In Higher Education: A Case Of Study

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Abstract: As a way to control the spread of the COVID-19 virus, the global education system—including higher education—switched to digital education. Most of face-to-face educational strategies can be used in a virtual teaching, with slight adaptations. In the case of flipped classroom, the students are provided with learning resources before the class and online classroom time is used to deepen understanding through discussion with faculty and peers' different problems. In this study, an optional experience of using flipped classroom, with first year students of Agricultural Engineering Grade in the subject Mathematics I, during online teaching period due to COVID-19 pandemic is described. Thirty-two of 76 students took part in this experience. More than 50% of them attended to 8 out of 10 seminars. Both the percentage of students who took the final exam and the qualifications, especially those above 6, were better for students involved in flipped classrooms. However, there was not a clear relationship between the marks obtained and the number of seminars received. Therefore, all the results show that this methodology is highly effective and has a great deal of take up among students.

Index Terms: Education technology, Flipped classroom, Online teaching, Motivation, Higher education, Agricultural Engineering, Achievement and Mathematics.

1 INTRODUCTION

AS a way to control the spread of the COVID-19 virus, citizens all over the world were asked or ordered to stay at home by their governments. Obviously, these instructions applied to all educational institutions, including universities, so that it was necessary to implement new modes of teaching and learning compatibles with virtual classes. According to Wiryanto et al. [1], online learning activities are not easy to implement, because the transition period from direct learning to online learning presents many obstacles, especially in learning mathematics, commonly taught through direct explanations. However, most of face-to-face educational strategies can be used in a virtual teaching, with just slight adaptations, as the case of flipped classroom. The key point of this methodology is to provide students with learning resources before the class and use classroom time to deepen understanding through discussion with faculty and peers. In this article, an experience of using flipped classroom during online teaching period due to COVID-19 pandemic is described. The experience took place with first year students of Agricultural Engineering Grade in the subject Mathematics I. Since the 2018/19 academic year, flipped classroom methodology has been used in different subjects in the grades taught in the School of Agricultural Engineering at the University of Extremadura. The aim of this paper is to test the usefulness of this methodology when it is used in virtual classes.

2 LITERATURE REVIEW

Self-reliance in learning is a character that students must develop, because allows proactive students to manage their learning activities [2]. Moreover, in subjects such as Mathematics, a field of science which has an important role in the progress of science and technology, so students need learn them having an active role [3]. However, students are used to only receiving material and doing exercises according to the sample given by the educator [4]. The lack of time prevents them from going into the subject in depth and reasoning, which leads to a poorer understanding and general demotivation. To improve the learning process, a learning model based on Flipped Classroom could be used. First popularized in secondary education in the United States [5], the flipped classroom paradigm reverses organization and time management: before the class, students are provided

with materials about the contents and required to work on asynchronously before the session; and then, within the classroom setting, they are required to do interactive activities with both the guidance of their teachers and the support of their peers. In words of Strayer [6], it 'moves the lectures outside the classrooms and uses learning activities to move practice with concepts inside the classroom'. As a result, this methodological proposal focuses on making the student the protagonist of their learning. In higher education courses this methodology, which takes what was previously class content (teacher led instruction) and replace it with what was previously homework (assigned activities to complete) now taking place within the class [7], can be particularly interesting. As it has been widely suggested, at the university levels, class time should focus on knowledge application [8]. In addition, flipped classroom may also allow the teacher a better opportunity to detect errors in thinking. An interesting scoping review of relevant research regarding the emergence of the flipped classroom has been done by O'Flaherty and Phillips [9]. Their results indicate that the flipped model enables teachers to cultivate critical and independent thought in their students, building the capacity for lifelong learning and thus preparing future graduates for their workplace contexts. However, there appears to be some misunderstanding of the key elements necessary for successful flipping and linking between the pre- and face to face sessions.

3 METHODOLOGY

The experience was conducted in the School of Agricultural Engineering at the University of Extremadura. It was implemented during the second semester of the 2019/20 academic year, partly coinciding with the COVID-19 confinement period, in a group of 76 students registered in Mathematics I—a first semester subject—who had not been passed the ordinary exam in January 2020 and were preparing for the extraordinary one in July. As had been done for the past several years, students were offered optional and weekly seminars to prepare the extraordinary exam in July. Thirty-two students registered for the seminars and attended at least one of them. It was originally planned that the seminars were in person, but it could not be possible. On 14th March 2020, Spanish government declared a state of alarm to manage the health crisis caused by the epidemic outbreak of COVID-19

and confinement was the first measure adopted, i.e., the entire Spanish population remained confined to their homes during the time the state of alarm was in force. At academic level, these restrictions forced a rapid switch to online teaching, and it was necessary to make significant adjustments. Until the beginning of confinement three in person seminars had been held, after this moment the rest others were online (Table 1). All of them were taught using the flipped classroom methodology. In particular, the following distinctive elements of flipped classroom methodology were used:

- Before seminar: students were provided with selected material to prepare the seminar, in particular videos and readings.
- During seminar: questionnaires and exercises related to the topic were solved by students and corrected by teacher.

In this way, through flipping, students were faced with previous interactive learning experiences that were implemented during seminar activities. Time distribution was done according to the following criteria:

- Sufficiently in advance, students were informed about the topic to be worked on in the next seminar and the tasks (watching video, reading...) to be done before it. This communication was carried out through virtual campus.
- Tasks to be done during virtual seminar were published at the corresponding date, giving a 24-hour reply to deadline. These responses were made through virtual campus.
- Once the deadline for the submission of responses had passed, full resolution step by step of exercises was posted on virtual campus.
- Students received their own corrected exercises with relevant clarifications.

Finally, the qualifications of the final exam in July, both students who followed the flipped classroom methodology and those who did not, were recorded in order to compare the results.

4 RESULTS AND DISCUSSION

This study examined the effect of the flipped classroom approach to the motivation, as measured on the one hand by the rate of students' participation in the seminars, and on the other hand by the number of students who did not realize the final exam. Moreover, the effectiveness of the flipped classroom methodology was measured by the final qualifications obtained for all students. Ten seminars were held over the course of the semester. Table 1 shows students' attendance at seminars and points out its virtual or in-person character.

TABLE 1

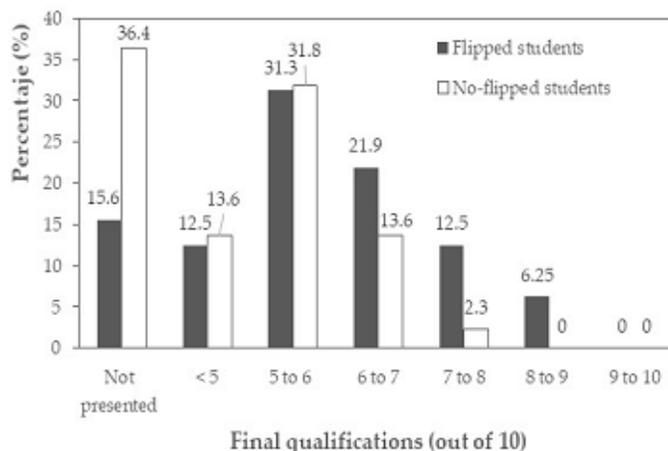
Character, Date, and Student Attendance of the Ten Seminars

Seminar	Character	Date	Students
1. Complex numbers	in-person	Feb. 27 th	23 (72%)
2. Complex numbers	in-person	Mar. 4 th	17 (53%)
3. Functions and graphs	in-person	Mar. 11 th	21 (66%)
4. Limits of functions	virtual	Mar. 18 th	27 (84%)
5. Asymptotes	virtual	Mar 25 th	27 (84%)
6. Differentiation. Growth and decay	virtual	Apr. 1 st	23 (72%)
7. Optimization problems	virtual	Apr. 15 th	20 (63%)
8. Rolle's and Bolzano's Theorems	virtual	Apr. 22 nd	15 (47%)
9. Geometrical applications of integration	virtual	Apr. 29 th	16 (50%)
10. Differential Equations	virtual	May. 6 th	10 (31%)

The acceptance of these seminars was ~42%, which is not very high. Possibly, considering the optional nature of these seminars and the fact that they do not contribute to the qualification of the course it can be said that the participation rate was satisfactory. The demotivation of Mathematics students is a fact that has been highlighted by many authors, being anxiety and pressure triggered by previous failures in its learning one of the main reasons [10]. Also, that students have not previously received classes following this methodology may have caused this initial rejection. Of the enrolled students, more than 50% of them attended 8 out of 10 seminars (Table 1). The decrease in the attendance on the last three seminars might relate to the proximity with the 2nd semester final exams dates.

Fig. 1.

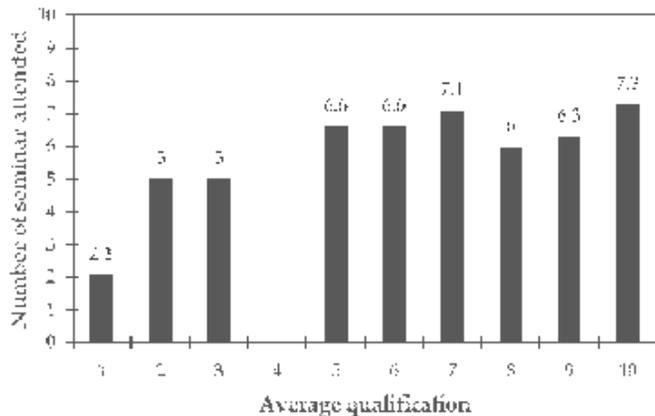
Distribution of the students who did not realized the final exam as well as of the qualifications obtained, both for students who attended the flipped classroom sessions and those who did not.



According to Fig. 1, the percentage of students who did the final exam was much higher in those who did at least one flipped classroom seminar, concretely 5 vs. 16 students. Regarding the final marks, also the attendance had a positive impact on student learning, increasing the pass rate (> 5) from 47.7% to 72%. Particularly striking is the percentage of students who obtained the best marks (> 7), 18.75% (6 students) compared to 2.3% (1 student) of those who did not participate.

Fig. 2.

Distribution of the students who did not realized the final exam as well as of the qualifications obtained, both for students who attended the flipped classroom sessions and those who did not.



Finally, Fig. 2 shows how, after attending 50% of the seminars, the average marks obtained, higher than 6, with no difference between an attendance between 5 to 9 seminars. Only total assistance rated higher, with a qualification of 7.3, but it was obtained by a unique student, so, this fact should be considered with great caution. These results are in line with those found by Fornons and Palau [11], who have recently published a review related to the effect of flipped classroom implementation on academic performance in the subject of Mathematics. They found that in the 78% of the research analysed, academic results improved, attributing these improvements to increased confidence, satisfaction, interest, and motivation of students in Mathematics [12-13] and taking a more active role in their learning [14-15].

5 CONCLUSIONS AND FUTURE WORK

This experience shows that flipped classroom methodology is a good alternative for online teaching. The key point of flipped model is to reverse the sequence of learning process moving the lectures outside the classrooms and learning activities inside it. In online teaching, not only resources provided in advance to students are digital but those activities to be done during class time. In a context conditioned by COVID-19 pandemic, these online flipped seminars have facilitated student learning and provided a safe and effective alternative to the face-to-face instruction. Furthermore, voluntary seminars appear to be an efficient tool for students to prepare final exam. Future experiences will be aimed at analysing the opinion of the students as well as the pros and cons through different surveys in order to be able to improve the material to be made available in each of the seminars. Increasing participation is another key point to improve.

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