

## Flipping the classroom in courses of statistics: analysing the feedback from students

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### **Abstract**

*The implementation of the flipped classroom strategy in two subjects of the degree in Statistics (University of Barcelona-Polytechnic University of Catalonia) and the opinion of students about the experience are analysed. The objective is to improve the learning process of statistics by promoting a more active attitude of students in the classroom. The new strategy has been welcomed by students, as most of them are satisfied with the experience. Many of them would like that the strategy would be applied to a significant number of lessons in the subject, or even in other subjects of the degree. Moreover, students think that it helped them to develop their capacity to organize their study time and their self-learning competence. They also think that with the flipped classroom strategy they learn more than with the traditional classes, but they remark the importance of including a session where the teacher answers the questions and solves the doubts of students to ensure a successful implementation.*

**Keywords:** *Teaching innovation, flipped classroom, statistics, active learning.*

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## **1. Introduction**

For many years, it has been observed that the grades of university students in courses of statistics are low. The dropout rate in the degree of Statistics of the University of Barcelona-Polytechnic University of Catalonia (UB-UPC) is close to 40%. Moreover, a quite significant number of students dropped out some university degree before starting the degree in Statistics (usually the degree of Mathematics or some Engineering), so many of them are not really motivated to study statistics. On the other hand, the grade necessary to be accepted as student in the degree of Statistics in UB-UPC has traditionally been just a little bit higher than 5 (thus, very close to the minimum possible grade for admission), therefore many students who start the degree do not have a good background, especially in mathematics.

In general, students of statistics are used to attend the classes, listen to the lecturer's speech and try to understand the theory and exercises that are solved during the classes. It is then when they feel themselves prepared to study thoroughly the subject and solve new exercises proposed by the lecturer, or even a test. In general, the attitude of students in the classroom is too much passive, as most of them do not make any question and just take some notes, in the best case scenario. The doubts and questions appear when they start to study by themselves the subject, which we guess that most of them leave for the last weeks before the exam.

In that context, the application of the flipped classroom methodology could contribute to increase students' motivation and to take advantage of the time spent in the classroom through an active learning approach. There are evidences in the literature of the larger gains in student learning when using more interactive class formats than when using the traditional lectures (Deslauriers *et al.*, 2011, Baepler, 2014).

The flipped classroom strategy consists basically on reversing the traditional learning method. The implementation will be described in detail in the next section, but, essentially, the student starts studying by himself the lesson. Then he solves some test/exercise (which is also discussed in the classroom) and finally, the lecturer teaches the lesson.

Reversing all the process helps the student to develop their self-learning capacity. Moreover, the student comes to the class with doubts and with interest in solving them. In that way, the class time is more effective in order to consolidate their learning process. Specifically, the flipped classroom strategy focuses on the importance of the use of the class time for the construction of knowledge rather than the transmission of the information, and there are many authors who have described positive experiences derived from its implementation (Missildine *et al.*, 2013; McLaughlin, 2013; Wilson, 2013 and Abió *et al.*, 2016). Studies highlight the improvement of students' achievements and

attitudes toward learning, as well as a greater satisfaction of the teachers involved in the experience (Lage *et al.*, 2000; Strayer, 2012 and Prieto *et al.*, 2014).

The flipped classroom methodology has been implemented in two subjects of the Degree in Statistics, namely Descriptive Statistics (first semester, first course) and Survey Design (first semester, second course). The experience took place during the first semester of the course 2017-18. The objective of this paper is to describe the implementation of the strategy and also to analyse the feed-back from students after the experience.

The paper is organized as follows. In section 2 the methodology for the implementation of the flipped classroom strategy is described. In section 3 the feed-back from students after the experience is discussed by analysing the results of a survey. Finally, section 4 concludes with some final remarks.

## **2. The methodology**

It is necessary to remark that the flipped classroom strategy has been implemented in two subjects (Descriptive Statistics and Survey Design) where other teaching strategies are used as well. The most important is teamwork, which is especially relevant in the case of Survey Design. In Survey Design there are traditional classes where the lecturer teaches the theory of survey design, but additionally students carry out a real survey working in groups. Each group has freedom to choose the topic of the survey, which it is also a motivation for them. In Descriptive Statistics, there are also traditional classes where the theory of statistics is presented, but additionally students work in groups in different activities during the course. In these activities they analyse real demographic data collected in the classroom (about themselves), which motivates them and gets statistics closer to their real life. The final grade in these two subjects are obtained as the weighted average between the grades obtained in the final exam and those obtained in the different activities carried out during the course.

In that context, the implementation of the flipped classroom method consisted of the following stages. Firstly, the student has to study by himself the lesson, by using some materials provided in advance by the teacher. The materials are basically books, practical notes or slides prepared by the teacher. Then, he has to attend the class and solve a short test individually. The test consists on ten multiple-choice questions. Then, they have to solve again the same test but working in couples. Then, some students solve the test in the blackboard and there is an open discussion in the classroom on the solution. Finally, the lecturer solves all doubts and questions and finally teaches the lesson. For the moment, the method has been applied to a single lesson in the study program of each subject, but the plan is to extend it to more lessons and also to another subjects gradually. The score

obtained by the students in the flipped classroom activity is taken into account in the evaluation system and represents 10% of his final score in the subject.

In that context, the feed-back from students was collected by using a survey which they have to complete after the flipped classroom experience. The survey consisted of three parts: 1) sociodemographic and academic information, 2) study habits and follow-up of the subject, and 3) opinion on the flipped classroom experience. In the next section the results of the survey are discussed.

### **3. Results**

The total number of students who participated was 111 (61% of them were students of Descriptive Statistics and 39% of Survey Design). Their average age was 19 years and 53.1% of them are men.

Table 1 summarizes the answers of students to different questions on their study habits. In each case, the student has to give a score depending on their level of agreement with some sentences. We see that most of them (64.2%) agree or totally agree with the sentence “I keep up to date the subjects in which now I am currently enrolled”. Nevertheless, 79.6% disagree or totally disagree with the sentence “I normally have a look in advance at the materials that are going to be taught in the next session or do the exercises that have been proposed by the teacher”. On the other hand, only 55.1% agree or totally agree with the sentence “I ask the teacher if I do not understand something”. We observe that a very important percentage of students (43.9%) agree or totally agree with the sentence “I only prepare myself for the exams during the last week before the exam”.

The answers to the questions related to the flipped classroom experience are shown in Table 2. It is remarkable that 73.3% of students think that they learn more by using the new teaching strategy compared to the traditional method. Moreover, 61.7% considered that they had to dedicate more time to study the lesson (the one taught by using the flipped classroom strategy) than normally. Most of students (80%) think that the flipped classroom strategy let them to develop their self-learning capacity. Moreover, 62.9% consider that this teaching strategy let him to develop his capacity to organize the time they dedicate to study.

Finally, the general level of satisfaction of students with the experience is high, as 87.2% of them say that are satisfied. Finally, there was students were asked about the percentage of the subject they would like that would be taught by using the flipped classroom strategy (see Table 3), and 49.5% answered “a very significant part of the subject (between 20%-50%)” and 20% of them a percentage even higher (between 50%-80%). This result encourages the teachers to gradually increase the intensity of application of the new method in these subjects.

**Table 1. Study habits and attitude in the classroom.**

Question	Totally agree	Agree	Disagree	Totally disagree
I ask the teacher if I do not understand something	15.0%	40.2%	33.6%	11.2%
I keep up to date the subjects in which now I am currently enrolled	7.3%	56.9%	30.3%	5.5%
I normally have a look in advance at the materials that are going to be taught in the next session or do the exercises that have been proposed by the teacher	2.8%	17.6%	54.6%	25.0%
I only prepare myself for the exams during the last week before the exam	14.9%	29.0%	43.0%	13.1%

Source: Own elaboration.

**Table 2. Feed-back about the flipped classroom experience.**

Question	Totally agree	Agree	Disagree	Totally disagree
I learn more by using the flipped classroom strategy than with the traditional method	16,2%	57,1%	21.9%	4.8%
With the flipped classroom method, I had to dedicate more time to study the lesson than normally	19,6%	42.1%	33.6%	4.7%
The flipped classroom strategy let me to develop my self-learning capacity	27,8%	52.8%	14.8%	4.6%
The flipped classroom strategy let me to develop my capacity to organize my study time	16,2%	46,7%	31.4%	5.7%
In general, I am satisfied with the flipped classroom experience	33.9%	53.2%	10.1%	2.8%

Source: Own elaboration.

**Table 3. Opinions on the application of the flipped classroom strategy in the subject.**

<b>Question</b>	<b>All/almost all (80% - 100%)</b>	<b>Between 50% and 80%</b>	<b>A significant part (20% - 50%)</b>	<b>Only some lessons (0% - 20%)</b>
Which percentage of the subject they would you like that would be taught by using the flipped classroom strategy?	7.2%	19.8%	49.6%	23.4%

Source: Own elaboration.

Finally, the questionnaire also included an open question where students could express their opinion about the experience with their own words. A detailed analysis of the answers showed that 53.6% consider that the experience has been useful for them, but 9.1% remark that it is necessary to ensure that the flipped classroom strategy includes a session where the teacher answers the questions and solves the doubts of students. Moreover, 13.6% of them think that the strategy could (in some cases) be applied in other subjects of the Degree in Statistics, but depending on the characteristics of the subject.

#### **4. Conclusions**

The results confirm that the attitude of the students of the Degree in Statistics with respect to the class time is not appropriate. Most of them do not prepare the lesson in advance, and an important part of them show a passive attitude in the classroom, even not asking to the teacher when they have some doubts.

These are important problems that must be addressed. In that sense, the flipped classroom strategy could be useful in order to promote a change in their attitude towards the class time and study habits. If they realized that class time is more profitable when they prepare in advance the lesson and read the materials proposed by the teacher, probably they will start to do it in all subjects. The same survey could be completed again by students after implementing the flipped classroom strategy gradually in several subjects, to see if there is a significant change in study habits.

On the other hand, regarding the low percentage of students who ask the teacher when they have doubts, the teacher could ask more frequently students if they have any question during the class, or to give them the possibility to do it later, even by using the forum of the

virtual campus. It would be interesting to ask students the reason why they do not ask the teacher when they have questions in order to find a more precise solution.

It is clear that the application of the flipped classroom strategy has been welcomed by students, as most of them are satisfied with the experience. Many of them would like that the strategy would be applied to a higher number of lessons in the subject, or even in other subjects in the degree, depending on their characteristics. Moreover, the strategy seems to help them to develop their capacity to organize their study time and their self-learning competence, but this should be analysed more in detail.

The results of the experience provide an orientation towards the implementation of the strategy in the Degree of Statistics in the future. The flipped classroom strategy should be applied more intensively in the Degree in Statistics, but gradually. New materials, including audios and videos, could be incorporated to support self-learning in the first stage of the implementation of the flipped classroom strategy. At the same time, as the teaching strategy would be consolidated in the degree, it would be possible to measure to what extent the academic performance of students improved since the application of the new teaching strategy.

## References

- Abío, G., Alcañiz, M., Gómez-Puig, M., Rubert, G., Serrano, M., Stoyanova, A. & Vilalta-Bufí, M. (2016). Retaking a course in Economics: Innovative methodologies to simulate academic performance in large groups. *Research Institute of Applied Economics, Working Paper*, 2016/01, 1-25.
- Baepler, P. (2014). It's not about seat time: Blending, flipping, and efficiency in active learning classrooms. *Computers and Education*, 78, 227-236.
- Deslauriers, L., Schelew, E., & Wieman, C. (2011). Improved Learning in a Large-Enrollment Physics Class. *Science*, 332, 862-864.
- Lage, M.J., Platt, G.J., & Treglia, M. (2000). Inverting the classroom: A gateway to creating an inclusive learning environment. *The Journal of Economic Education*, 31, 30-43.
- McLaughlin, J.C. (2013). Pharmacy student engagement, performance, and perception in a flipped satellite classroom. *American Journal of Pharmaceutical Education*, 77, 1-8.
- Missildine, K., Fountain, R., Summers, L., & Gosselin, K. (2013). Flipping the classroom to improve student performance and satisfaction. *Journal of Nursing Education*, 52, 597- 599.
- Prieto, A., Díaz, D., Montserrat, J. & Reyes, E. (2014). Experiencias de aplicación de estrategias de gamificación a entornos de aprendizaje universitario. *ReVisión*, 7.
- Strayer, J. (2012). How learning in an inverted classroom influences cooperation, innovation and task orientation. *Learning Environments*, 15, 171-193.

Wilson, S.G. (2013). The flipped classroom: A method to address the challenges of an undergraduate statistics course. *Teaching of Psychology*, 40, 193-199.