

# Combining strategies to make General Physics lectures more attractive and to improve students' performances

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**Abstract.** Going one step further in looking for new strategies to improve the teaching-learning process in General Physics courses, the current contribution reports on the last results/observations and students' opinions on the combination of simple experiments performed during the lectures with active methodologies, and making use of new technologies (media). Cross-checking multiple choice questions done online during the classes and in mid-term exams has shown that this strategy has, at least partly, a positive effect on clarifying misconceptions. The overall opinion of the students is that this lecturing approach is useful and motivating, making the lectures more attractive and stimulating their eagerness to understand Physics.

## 1 Introduction

For almost a decade the authors of this contribution have been involved in lecturing General Physics courses of the Faculty of Science and Technology at the University of the Basque Country (UPV/EHU). Following new tendencies in science education [1,2], the authors investigated the role of a formative evaluation via mandatory or optional *Moodle* quizzes at the end of every unit of the course. The main conclusions were that those students passing the quizzes increased their probability of passing the course and obtained better final marks, regardless of whether the quizzes were mandatory or optional [3,4]. In the last year, using an alternative and complementary approach to make Physics lectures more attractive, the classical strategy of doing simple demonstrations in the classroom was recovered and combined with new technologies with the aim of detecting and solving wrong preconceptions of the students [5]. By introducing a question related with the experiments in the mid-term exam, it was confirmed that a higher amount of students answered them correctly at the end of the process. Going one step further, the current contribution reports the last results and students' opinions on the combination of simple experiments with active methodologies. The outcome of a flipped classroom (FC) combined with cooperative learning and some demonstrations on electromagnetism is assessed.

## 2 A flipped classroom with simple demonstrations; students' performances and opinions

The activity consisted of a typical FC divided into two lectures. Faraday-Henry's law, motional electromotive force and eddy currents were worked out. The puzzle methodology was applied. In the first lecture, initially the meeting of expert-students took place, and then the topics were explained in their original groups. Simple devices to make demonstrations related to electromagnetic induction were available during the session. In the second lecture the students handed over an exercise integrating all topics treated or alternatively made a summary of the concepts treated. An open discussion took place subsequently. Finally, to check the proper understanding of the concepts by the students, each of them answered an individual 6-question test run online.

Concerning the student's understanding of the Physics concepts, in 5 out of the 6 multiple-choice questions about electromagnetic induction carried out in the final part of the session, more than 64 % of the students answered them correctly, reaching more than 85 % in two of them. However, in one case the percentage of correct answers dropped down to 21 %, which can be related with the intrinsic difficulty of the related concept. This allowed the lecturers to detect the misconception and clarify it. In any case, it is observed that, at least when the students have worked out the concepts recently, their performance is quite good. Cross-checking these multiple-choice questions with 4 similar ones answered by these students in the mid-term exams has shown that this strategy has, at least partly, a positive effect on clarifying misconceptions. More than 83 % gave correct answers to 3-4 questions, 14 % answered correctly 2 questions and only 3 % responded well 1 or no questions. Here it has to be noted that not all of the students that took the mid-term exams had taken part in the FC session. Although no strict correlation can be attributed to not having done the activity, for the questions related with the topic treated in the FC, the students that did not take part showed poorer performances. 39.5 % gave correct answers to 3-4 questions, 28 % answered correctly 2 questions and 32.5 % responded well 1 or no questions. Turning to the students' opinions, after doing these activities, 75 % of them fully agreed, and 25 % agreed to some extent, that "*The real demonstrations/experiments used during the class are very useful for a better understanding of the topics studied*". Asked for an overall opinion on this type of activities 42 % gave a mark between 9 and 10, 55 % a 7-8 one and only 3 % evaluated it within the 5-6 interval. It should be emphasized that these positive opinions can be considered representative and unbiased, since the activities were optional and were not taken into account for final marks.

### 3 Conclusions

Flipped classroom in combination with simple demonstrations and cooperative learning is a very powerful methodology to make Physics more reachable for first-year university students. Even though statistical quantitative evidence hasn't been shown, a direct positive impact on the student performances can be attributed to this lecturing strategy. In general, it can be concluded that the overall opinion of the students is that this lecturing approach is useful and motivating, making the lectures more attractive and stimulating eagerness to understand Physics.

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