

IMPROVING LEARNING OUTCOMES IN AN OBJECT-ORIENTED PROGRAMMING COURSE, USING A FLIPPED CLASSROOM

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Abstract

Object Oriented Programming has been a core discipline in Computer Science studies. However, students often have difficulties in learning subjects related to programming. The reasons for these difficulties are well described in the literature and are mainly related to the abstract nature of the subject.

To improve the learning process, different teachers are using different active learning methodologies, such as flipped classroom, project-based learning, and peer instruction.

This paper describes an experiment conducted to improve the learning experiences of the students attending an Object-Oriented Programming course, from the first year of an Informatics B.Sc. curriculum, using a flipped classroom methodology.

One of the learning outcomes in this course aims that students understand the concepts and constructs intrinsic to the object-oriented programming paradigm. Two fundamental concepts arise, the concept of class and the concept of an object. From experience, it is notorious the difficulty students have in learning those.

The experiment took place during a class, divided into two moments: at moment one, students were expected to explore the topics, which were then discussed and worked on at moment two. As a final objective the students, who were organized in groups, produced a poster, summarizing the two concepts. The posters were posted on the classroom board.

As in the gallery walking strategy, students in groups move through the posters and interact and share knowledge.

After the class students were asked to answer an anonymous questionnaire aiming to know their opinion on the use of these pedagogical strategies.

Two kinds of results were observed: first, the posters and knowledge sharing moment allowed to recognize that students achieve the desired learning outcome. Second, from the questionnaire answers, it was evident that the use of this methodology was well accepted by the students improving their engagement.

Keywords: Flipped Classroom, Active Learning, Object Oriented Programming, Students engagement.

1 INTRODUCTION

Learning how to program is not an easy task for students. The reasons for these difficulties are well described in the literature and point to problems ranging from the difficulty in understanding the programming concepts to the lack of motivation and engagement, being mainly related to the abstract nature of the subject.

Souza et. al [1] conducted a literature review to collect and evaluate evidence-problems and difficulties in teaching and learning of programming. In this work, the authors classified the articles considering the problems and difficulties addressed, having found 6 categories. One of these categories focused on the difficulties related to the learning of programming concepts, such as recursion, pointers, classes, and objects.

From experience, it is notorious the difficulty students have to understand the concepts and constructs intrinsic to the object-oriented programming paradigm and in particular the concepts of class and object.

Knowing the potential of active learning strategies, teachers are changing the way they teach, using different teaching and learning methodologies, such as flipped classroom, problem-based, and project-based learning and peer instruction [2], [3] [4]–[10]. These strategies share the common goal of

increasing student engagement by getting them to do things, to participate actively, and to think about the things they do. Teachers in ICT have also been adopting different strategies [11][12] [13]–[15].

This article describes an experience using flipped-classroom, carried out to improve the learning experiences of students enrolled in an Informatics B.Sc. degree course, in 2019/2020, attending a curricular unit in the second semester of the first curricular year, namely, Object Oriented Programming (OOP). In this course, students also learn the Java object oriented (OO) programming language. Java is celebrating its 24th birthday this year and has been one of the most popular programming languages [16].

The article is structured as follows: section II briefly presents the main concepts underlying the flipped-classroom methodology; section III describes the experiment and finally, in section IV the main conclusions are set out.

2 THE FLIPPED CLASSROOM METHODOLOGY

Flipped Classroom is an active-learning strategy, which refers to readjusting the time in and out of class. This means inverting the typical lecture-based style where in-class and out-class learning activities are flipped: students make their previous work at home, seeing videos, searching information and other materials, and class time is spent on working on homework and solving problem activities [17]. The research found that students have positive attitudes toward using this approach. One of the main challenges is how to encourage them to study the subject in advance and come to class prepared [13], [15]. It is necessary to previously train students in this strategy, to achieve a greater commitment.

Another point deserves attention in this strategy: teaching can be more exhaustive and time-consuming. Teachers may have to spend much time preparing materials for out-class activities and activities for the class, and may not have the necessary skill to produce some material, for instance, to produce videos. They need to give instant feedback and be prepared to circulate around the class to interact with students.

3 THE FLIPPED CLASSROOM EXPERIENCE

The experience was done in a class of the 1st year with 45 students. For this B.Sc., OOP is not the first programming language course offered, and students have already studied C programming language in the first semester. However, they never used an object-oriented paradigm. The experiment took place during a 2 hours class, in which the expected learning outcomes were to understand the concepts of class and object.

This was the first experience students were having with flipped classroom, so it was necessary to train them. Considering this fact and the referred difficulty of having students come to class prepared, the teacher chooses to adapt the strategy and the out-class learning activities were developed in the class.

The class was divided into two moments: at moment one (50 minutes), students were expected to explore the topics, which were then discussed and worked on at moment two, in-class (another 50 minutes).

Students were randomly divided into groups of 5; each group receive a written description of the “out-class” learning activities, that included: seeing the videos and reading the documentation that the teacher made available in MOODLE, doing some Internet searches and discuss the concepts, guided by the specific learning outcomes also presented by the teacher.

To guide the students a model sheet was distributed to each group where they could record the keywords and main ideas, they learned from each material provided. At the end of the sheet, there was a space to make a summary, thinking about how they would explain the concepts covered to someone.

As an output they should produce a poster, summarizing the two concepts. Figure 1 presents two of the poster’s students draw. The posters were posted on the classroom board.

In moment two, as in the gallery walking strategy, students in groups move through the posters and interact and share knowledge.

After visiting the posters, students sit in their places and discuss with the teacher; the discussion allowed to recognize that students achieve the desired learning outcome.

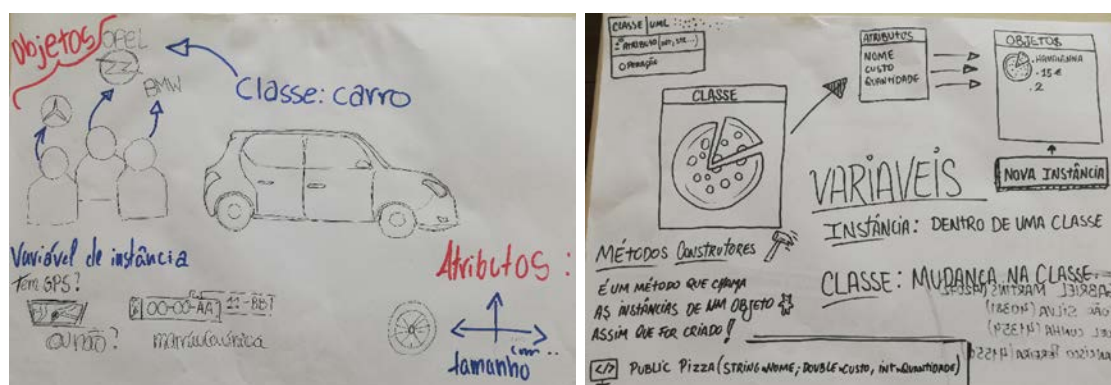


Figure 1. Two posters produced by the students.

After class students were asked to complete a short questionnaire that was made available via GoogleForms. The questionnaire aims to know the students' opinions on the use of different pedagogical strategies.

80% of the students answer the questionnaire. From those, 83% liked the way the class was organized; 78% considered that it was easier to learn the concepts of class and object with this type of class; there were still 8% that did not perceive the concepts.

What they most like: the opportunity to work in groups, the interaction between colleagues that provided a better understanding of the concepts, the final part where they all share their posters, and when the teacher summarized the lesson and the concepts and the dynamics of the class.

Most of them said that there was nothing they did not like; some refer that they prefer being able to choose groups and that the quality of the videos was not good.

4 CONCLUSIONS

This experience showed that students have positive attitudes toward using different approaches, such as flipped classroom. Two main challenges need attention, as found in the literature review: how to encourage students to study the subject in advance and come to class prepared and the need for teachers to have support in the preparation of materials, especially videos. In this experience the videos presented were found on the Internet and were Spanish; the choice of Spanish had to do with the difficulty that some students have in understanding English; the quality was not so good and added to the difficulty of hearing, because the students preferred to stay inside the room to listen, despite having been told that they could go anywhere.

In summary, the Flipped Classroom has its strengths for engaging students despite requiring a greater effort on the part of teachers.

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