

Use of Flipped Classroom on High School's Education

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ABSTRACT

This study aims to measure the effectiveness of the Flipped Classroom (FC) in biology classes for high school students. The FC was compared to the "conventional" teaching (lectures), in order to determine the effect of it in the students' learning. Each of the five classes evaluated was randomly selected to participate in one of these teaching methods and each student answered a questionnaire in order to measure the learning of the contents, and to evaluate the activities performed with a satisfaction index. A non-parametric analysis of variance (Kruskal-wallis) was used to determine if there were significant differences in the correctness and satisfaction index between both groups. Although the FC participants obtained a higher average, there was no significant difference ($p = 0.19$) between the scores of both groups. However, a significant difference ($p = 0.04$) in the satisfaction index between the groups was observed, with FC participants more satisfied. We could verify that the students are more interested in the FC model, but this tendency was not reflected in a better fixation of contents. We suggest that longer studies should be carried out in order to elucidate the relationship between students' interest and their performance in evaluation tests.

RESUMO

O presente estudo procura majorar a eficácia da Sala de Aula Invertida (SAI) em aulas de Biologia para o Ensino Médio. A SAI foi comparada ao modelo "tradicional" de ensino, (aulas expositivas), a fim de determinar seu efeito no aprendizado dos alunos. Cada uma das cinco turmas avaliadas foi sorteada para participar de um destes métodos de ensino, e cada aluno respondeu a um questionário a fim de mensurar a fixação dos conteúdos abordados, além de avaliar as atividades realizadas com um índice de satisfação. Utilizou-se uma análise de variância não paramétrica (Kruskal-wallis) para determinar se há diferenças significativas nos acertos e no índice de satisfação entre os dois grupos. Apesar de os participantes da SAI obterem uma maior média, não houve diferença significativa ($p=0.19$) entre os acertos dos dois grupos. Entretanto, foi observada uma diferença significativa ($p=0.04$) no índice de satisfação entre os grupos, com os participantes da SAI mais satisfeitos. Pudemos aferir que os alunos participantes têm maior interesse no modelo de SAI, mas essa tendência não se refletiu numa melhor fixação de conteúdos. Sugerimos que estudos mais longos sejam realizados a fim de elucidar a relação entre interesse dos alunos e sua performance em testes avaliativos.

Keywords

Information and Communication Technologies, ICT, Learning analytics, Biology.

1. INTRODUCTION

The new generation, known as Millennial (born in the late twentieth and early twenty-first century) was born with access to the internet and personal computers. These young people can no longer be educated in the same way that today's teachers were, 20-30 years ago. The "conventional" method of teaching, with the teacher in front of a blackboard, being the sole holder of knowledge, with students sitting in rows following the class in textbooks, no longer attracts their attention. Any teacher of basic education knows that, because he identifies in his own students the lack of interest in this teaching method. Morán [10], says that conventional methods, which privilege the transmission of information by teachers, made sense when access to information was difficult. What technology brings today is the integration of all spaces and times. Education occurs not only in the physical space of the classroom, but in the multiple spaces of daily life, which include digital ones.

In this context, Balanskat et al. [2] point out that the use of Information and Communication Technologies (ICT) has a strong motivational effect, especially in basic education, since students pay more attention during class, taking greater responsibility for their own learning. One of the most interesting models of teaching nowadays is to concentrate basic information on the virtual environment, leaving the most creative and supervised activities to be done at the classroom[10]. This is called Flipped Classroom (FC).

Flipping the classroom means that events that "conventionally" occur within the classroom, occur outside it, and vice versa [8], i.e. students should use online platforms (personal computers, notebooks, smartphones, tablets, etc.) to watch video classes with basic content outside the classroom and then ask questions, solve problems and exercises, collaborate with colleagues mediated by the teacher, during the class. This method tends to maximize the teacher's time in the classroom, since he is present during the resolution of exercises and activities that demand more help. While in "conventional" method, those tasks are done at home without mediation. The content has already been studied previously by the students through the video class and they can write down questions and solve them during the class time.

Thus, the objective of the present work was to apply the FC method in biology classes for high school students and, based on results from multiple choice tests answered by the students, assess their effectiveness in learning and satisfaction of the students involved.

2. MATERIALS AND METHODS

2.1 Description of study environment

The present work was carried out at Edgar Barbosa State School, located in the city of Natal, Rio Grande do Norte State, Brazil. The school's Principal and the students involved were previously warned about the research content and were free to participate, or to stop participating at any time, without any harm to them. Student identification is confidential. These students were divided into five classes, all of them in the second year of high school, with an average of 40 students per class, ranging in age from 16 to 18 years.

The school has a library, computer room and open Wi-Fi connection to students nearby Principal's office. A previous explanation about video classes and the Flipped Classroom concept were made to all the participating students. These students were able to watch video classes outside the school, through various technologies such as: smartphone of his/her own with internet or bluetooth access, personal computer with internet access in their residence, or public libraries with computers and open internet available.

Of these five classes, three were randomly chosen to the Flipped Classroom method and two to be control groups, where "conventional" method of lecture classes were applied.

2.2 Flipped Classroom (FC)

In these classes, there were a time for sensitization (Figure 1), so that the students understood how to access the video class directly through the internet, in addition to send it via bluetooth to those who had a smartphone. After this moment, the students had a week to watch the video class and write down any questions (outside the school time).

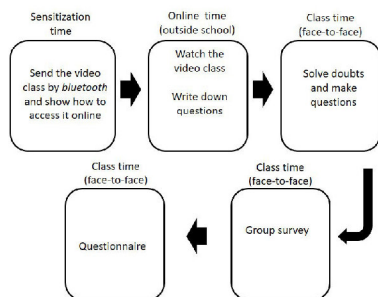


Figure 1. Flowchart of Flipped Classroom

At the class time (face-to-face), the students had the opportunity to make questions and solve any doubts, and then conducted a group survey. In the final 15 minutes of the class the students answered the questionnaire. For these classes, two in-class activities (50 minutes each) and an extra class time were used.

2.3 "Conventional" method, control group

In these classes, the order of application of the activities was as follows (Figure 2): in the first moment there were an expository class (conventional lecture method), using previously prepared slides. At that time, students should make questions and solve their doubts about the lecture's content.

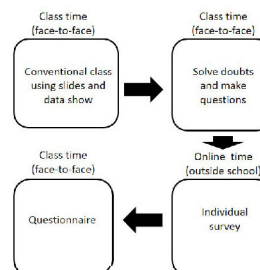


Figure 2: Flowchart of "Conventional" Method

Outside the school, each student should conduct an individual survey, using the internet or searching in libraries. The application of the questionnaire occurred during the second class (face-to-face) and lasted 15 minutes.

2.4 Video class and "conventional" lecture

For the video class recording, was used the software Active Presenter (Copyright © Atomi Systems, Inc.), with 15 minutes long. This software records the voice of the speaker and the image being transmitted by the personal computer. In the present work, the video class was performed using the same slides prepared for the "conventional" lecture (face-to-face). For the presentation of the "conventional" class, we used a personal computer and a data show, lasting approximately 20 minutes.

2.5 Group and individual survey

The subject proposed for the survey conducted by the students was: "Research about an economic activity involving commercial use of algae." In classes randomly drawn for the flipped classroom, the research was conducted in groups of 4 students in the school library during the class time. In the classes drawn for the "conventional" class, the research was done individually, in an extra class moment (outside the school).

2.6 Questionnaire

All students who agreed to participate in the present study answered an individual questionnaire with 5 tests containing 5 alternatives each. Only one alternative was correct. The tests were adapted from 2 different books [1,11], none of them available in the school's library.

There were 4 different questionnaires, each containing 5 tests randomly taken from a previous list containing a total of 8 tests. For each questionnaire, the order and choice of the tests, and the order of the alternatives were randomized, so as not to be identical to each other and minimize the possibility that one student copy other's answers. The questionnaires had a timed time of 15 minutes, after which they were summarily collected.

Additionally, in each questionnaire there was a "personal" question, with the intention of evaluating the student's impression about the proposed activities (flipped classroom or "conventional" class). To answer it, the student should give a score of 1 to 10 for the performed activities, and write comments if he/she wanted to. That is how a satisfaction index was generated, on a scale of 1 to 10, with 1 being totally dissatisfied and 10 being totally satisfied.

2.7 Statistical analysis

A data normality test (Shapiro-wilks) and a non-parametric analysis of variance (Kruskal-wallis) were performed to identify significant differences between the group of students who participated in the FC and those who participated in the "conventional" classes activities. The software used to perform them was RStudio (available for free at www.rstudio.com).

3. RESULTS

A total of 89 students agreed to answer the questionnaires, being 44 in the flipped classroom group (FC) and 45 in the "conventional" classes group. The average score in the FC group was 1.98 (out of a maximum of 5), while in the "traditional" group it was 1.63.

Data on the number of correct answers for both groups cannot be considered as a normal distribution (Shapiro-wilks normality test: $p < 0.01$). Thus, it was necessary to use a non-parametric analysis of variance (Kruskal-wallis test: $\chi^2 = 1.67$, $df = 1$, $p = 0.19$, Figure 3). The result of the analysis of variance shows that the number of correct answers, even if slightly higher in the FC group, are not statistically different between groups.

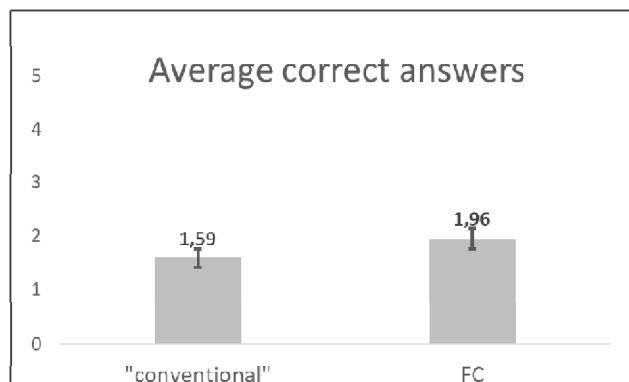


Figure 3: Average number of correct answers for the students in the "conventional" class and in the Flipped Classroom (FC)

Regarding the students' evaluation of the proposed activities, the data are also not normally distributed (Shapiro-wilks normality test: $p < 0.01$). Therefore, it was necessary to use the same non-parametric statistical analysis (Kruskal-wallis test: $\chi^2 = 4.15$, $df = 1$, $p = 0.04$, Figure 4). According to the results of the analysis of variance, students who participated in the flipped classroom tend to evaluate activities differently (mean = 8.53) of students who participated in the "conventional" class (mean = 7.81).

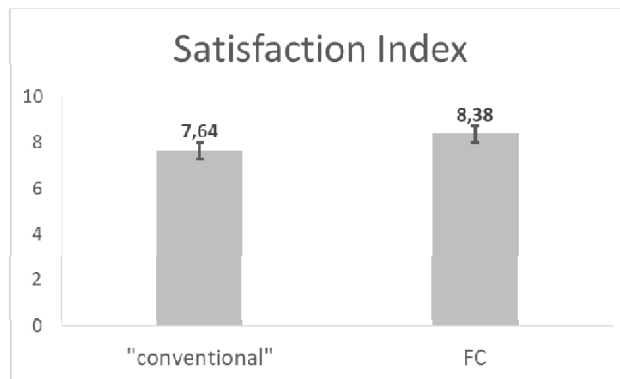


Figure 4: Average score of the satisfaction index, students attending the "conventional" class and Flipped Classroom (FC)

35 students wrote comments on the developed activities (Table 1). Of these, 25 came from students who participated in the flipped classroom, with 21 positive comments (84%). The most popular keywords were: good (10 times, e.g., good for learning); very (seven times, e.g. very productive); interesting (five times, e.g. very interesting). Of the 10 comments from participants in the "conventional" class, five were positive (50%). The most popular keywords in this group were: no (three times, e.g. no preparation); good (three times, e.g. good and interesting); very (two times, e.g., I liked very much).

Table 1: Summary of students' comments on the activities developed

	comments	positive comments	most popular keywords		
			1°	2°	3°
"conventional"	10	50%	no (3x)	good (3x)	very (2x)
FC	25	84%	good (10x)	very (7x)	interesting (5x)
total	35				

4. DISCUSSIONS AND CONCLUSION

In the present study, we investigated the following question: were students who participated in the flipped classroom (FC) methodology more motivated and more likely to demonstrate their learnings through multiple choice tests than students taking "conventional" classes?

From the results of non-parametric variance tests (Kruskal-wallis test) we can conclude that the students felt more motivated by the FC methodology, increasing the satisfaction index ($\chi^2 = 4.15$, $df = 1$, $p = 0.04$), and by the comments written by the students, the FC also increases their interest and motivation. But could this be measured in the results of the questionnaires?

The scientific literature attests that students' interests are positively related to their achievements because this increase commitment to the discipline they are interested in, and the amount of time they are willing to devote themselves to learning [3,4], however, it has not been possible to affirm that the satisfaction index is linked to a better learning, since that even with a higher average of correct answers (1.98 vs 1.63) the results

of the FC participants do not differ statistically from those who participated in a "conventional" class ($\chi^2 = 1.67$, $df = 1$, $p = 0.19$).

Other authors found a significant increase in the scores of students who participated in classes with the FC methodology, when compared to the scores of students participating in "conventional" classes [5,7,9]. Perhaps the small number of questions, the level of difficulty, or the fact that the participating students are still getting used to the new methodology may explain the lack of significant increase in their grades. The authors recommend that further studies be conducted to elucidate the effect of this methodology on the student's learning.

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