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Flipping a Science Course: Influence in the Students' Cognitive and Affective Performance

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Abstract

One of the main challenges that professors have to face when teaching science is to find teaching strategies able to increase the interest of the students toward scientific contents. Poor cognitive and affective performance are among the main consequences that this lack of interest produces in the students. Following students' centered methodologies have been proved to be an effective strategy to increase students' interest to science, and improve both the results of the cognitive and affective components of learning. In order to follow this teaching methodology, more in-class time is required to perform hands-on activities and to let students apply the theoretical scientific contents delivered in the course. To achieve that, this research explores the application of a flipped-classroom methodology to a science course. In the flipped-classroom methodology, the traditional roles are inverted: the time students spend in their houses is used to work the theoretical contents by means of video-lectures delivered by the instructor, while classroom time is used to complete the students' centered and other collaborative activities to put in practice the scientific contents delivered. This classroom setting aims to engage students more successfully with the course. In order to gauge this relatively new methodology, a comparative study was conducted. Precisely, a traditional classroom was compared with a flipped-classroom setting for the same science course. The study was conducted at the Teaching Training College of the University of Extremadura (Spain). The comparison was carried out in terms of how the instruction methodology had a significant influence in the students' affective dimensions toward the course and the learning outcomes achieved. According to the results, the students had a general positive perception to a flipped classroom setting, showing more positive attitudes toward the course. Besides, the students' emotions analysis revealed that they were more positive and less negative in the flipped classroom compared with the traditional one. Therefore, regarding the course learning outcomes, statistically higher average grades were achieved in the flipped-classroom course, as well as the number of students passing the course.

Keywords: *Science education, training science teachers, learning outcomes, teaching methodology, inverted classroom.*

1. Introduction

To find proper teaching strategies is one of the main challenges that professors should face when teaching science. Through these, it is able to increase the interest of the students toward scientific contents. However, current lack of interest to science produces poor cognitive and affective dimensions as the main consequences in the students. Therefore, students-centered methodologies have been substantiated to be an effective and efficient strategy to increase students' interest and attention to science [1,2]. Also, this methodology improves both the cognitive and affective learning results [3,4]. Particularly, in this active teaching methodology, it is required more in-class time, which can perform hands-on activities and can let students that apply the theoretical scientific contents delivered in the course [1,5].

The flipped-classroom methodology is a somewhat new instruction and teaching methodology [6,7]. In a regular flipped-classroom, lectures and classes are offered to home-based forms of video-lecture resources along with printed deliveries and on-line quizzes and tasks [7,8]. Therefore, more students-centered learning activities will happen in-class time, will create more interactive and cooperative courses and will address specific certain questions, which can deliver just-in-time lectures [1,5]. Also, a flipped-classroom methodology can be deliberated as a combination of both traditional and online education structure by exploiting in- and out-of-class time, which can complete more effective and efficient learning chances and perspectives [2,9]. Consequently, when a flipped-classroom

methodology is esteemed, the cognitive and affective dimensions of students ought to be considered in order to entirely fix this somewhat new instruction and teaching methodology.

This research objective is to explore the application of a flipped-classroom methodology to a science course. This classroom setting along with the proposed methodology aims to involve students more positively to the course. In order to measure this somewhat new instruction methodology, a comparative study and analysis were directed. Specifically, a traditional classroom setting was compared with a flipped-classroom setting for the identical science course. The study was performed at the Teaching Training College of the University of Extremadura (Spain). The comparison study and analysis were carried out in terms of how the instruction methodology had a meaningful influence and effect in the students' affective dimensions toward the course and the learning outcomes accomplished as the students' cognitive dimensions.

2. Materials and Methods

This research assesses the students' cognitive and affective dimensions when a flipped-classroom methodology is respected as an instruction methodology for teacher training students in science education. During two courses of 2014/2015 and 2015/2016, particularly, this research was carried out in a general science subject. With the post-task questionnaires survey, we acquired the information and measurement to measure their cognitive and affective dimensions toward the course.

2.1. Sample explanation

This work was completed in a general science course with a second year of the Primary Education bachelor degree in the Training Teaching School of the University of Extremadura (Spain) during 2014/2015 and 2015/2016 courses. 153 students, 65 and 88 students, respectively, partaken in the study with the particular demographic information (61% male and 39% female in 2014/2015, 65% male and 35% female in 2015/2016, 21 years old average age, 6.81 average GPA in 2014/2015, 6.95 average GPA in 2015/2016, 71% social science background in 2014/2015 and 63% social science background in 2015/2016).

2.2. Flipped-classroom methodology

The flipped-classroom methodology at the beginning of the semester was exhibited to the students together with the class flowchart containing all the important dates and class activities predetermined. Particularly, with theoretical and laboratory contents, the course has 3 sessions (50 minutes) per week and 1 session (50 minutes) per week for all three groups, respectively. It has five chapters in the context of the contents and its difficulties. Herein, all students had utilized a Moodle, university virtual interface, that can distribute the contents of the flipped-classroom. As shown in Figure 1, various software tools were employed for detailing asynchronous and seamless video lectures.

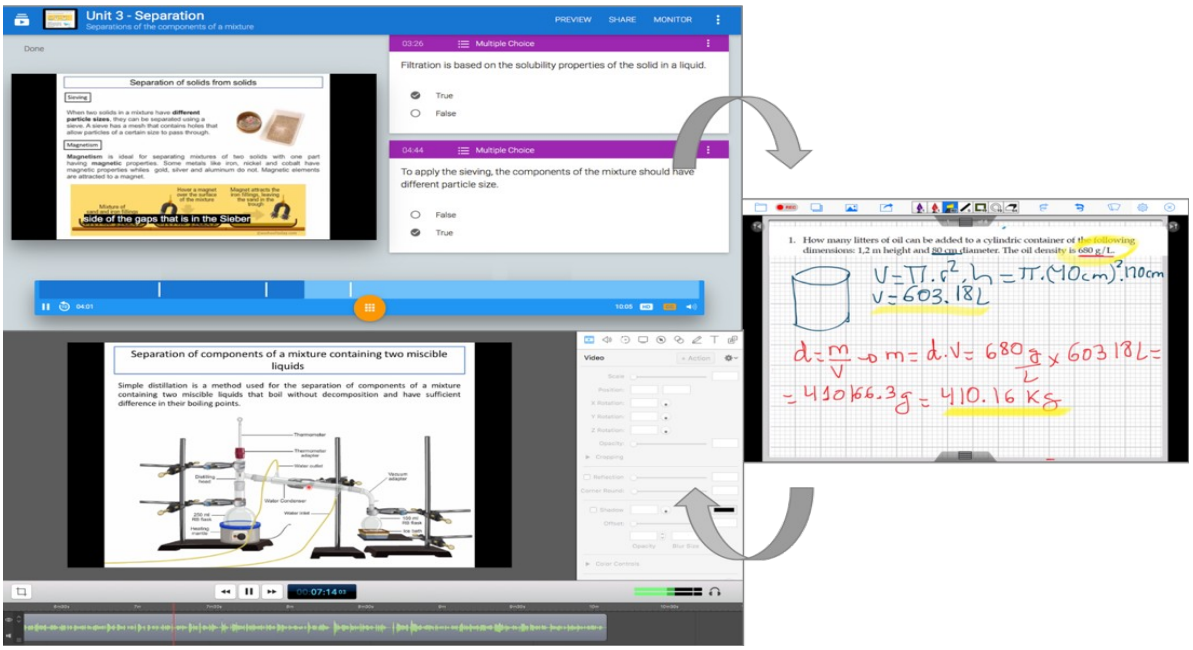

Figure 1. Software to be used for flipped-classroom methodology in this study.

3. Results and Discussion

Based on the data from the University, students continuously have had some difficulties and problems to complete the subject suggested for this study. Particularly, students took 2.5 years in average to finish this subject. Thus, small portion of students even took more than 4 years to pass it. So, we proved students' successful completion percentage in this subject with the flipped-classroom methodology proposed. 2014/2015 course has 56.6% passing rate and 2015/2016 course has 57.2% passing rate, an increasing tendency comparing with the previous years that indicates the flipped-classroom methodology was over the previous years' passing rate. With various tasks and activities created, we also can notice the similar results that the flipped-classroom methodology was over the passing rate of various tasks and activities in previous years. Thus, in the perception analysis, we can find out that the results showed the students inclined to a general positive perception to the flipped-classroom methodology employed.

The mean values of affective dimensions, emotions, were provided and assessed by the whole students based on 0 to 10 scale as shown in Figure 2. The overall scores indicated were very high in positive affective dimensions. Amongst these four positive affective dimensions, the students articulated the highest point to fun and enthusiasm and confidence attained the lowest point amongst the positive affective dimensions. In the context of the negative four affective dimensions, the lower points were consistent to them. Boredom was chronicled with the lowest point and concern was acquired as a highest point of amongst the negative affective dimensions. Herein, we can tell the finding discovered that all positive affective dimensions had a noteworthy positive correlation and connection between them and the negative affective dimensions were positively correlated and connected as well.

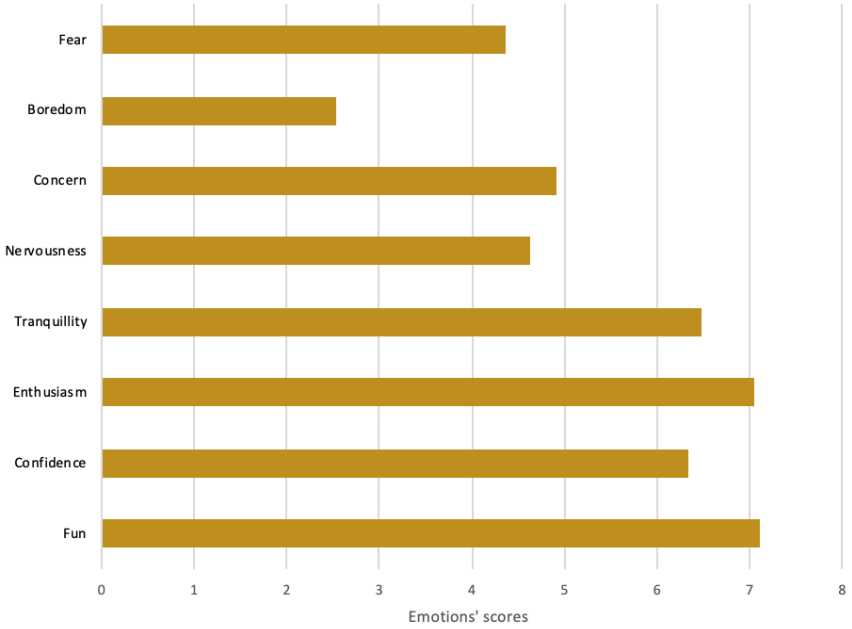

Figure 2. Affective dimensions analysis (0 to 10 scale) of students' answers in particular eight different affective dimensions.

4. Conclusions

The measurements and results of the students' cognitive dimension were determined through the subject passing rate, that is, final exam grades and other exercises grade of students when the flipped-classroom methodology was utilized as instruction and teaching methodology. They confirmed that the flipped-classroom methodology contributed much better outcomes than previous courses not employing the flipped-classroom methodology, viz. traditional instruction setting. For example, the students' passing rate was more than 10% increase in the same year for the first time registered. Also, similar variances we can find were perceived final exam, in-class assessments and the lab activities during the course. For the measurements and results of the students' perception, the students had a general positive opinion and perception to the flipped-classroom methodology pertained for this class designated. The measurements and results of the students' affective dimensions can be detected that the highest scores were specified to the positive affective dimensions, fun and enthusiasm as the most pointed positive affective dimensions. Amongst the negative affective dimensions, boredom was acquired as lowest point. Therefore, the students with a flipped-classroom methodology had a more positive and less negative affective dimensions.

According to the results, the students had a general positive perception to a flipped-classroom methodology and setting, presenting more positive attitudes toward the course. Besides, the analysis of students' affective dimensions, emotions, revealed that they were more positive and less negative in the flipped-classroom methodology compared with the traditional methodology. Therefore, the course learning outcomes are statistically higher in the flipped-classroom course than average grades were achieved in traditional course, as well as the number of students passing the course.

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