IMPROVING THE PERFORMANCE OF SECONDARY SCHOOL STUDENTS IN A PHYSICS COURSE THROUGH VIDEO-BASED LEARNING

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Abstract

Technology is evolving constantly, expanding its fields of application to many areas such as education. When it is intended to introduce technology in education, it is necessary to search for the correct strategy, since there is a close relation between the chosen technique, the students' engagement and the results in evaluations.

This study summarizes the results of the implementation of a video-based strategy for the physics course taken by 25 secondary school students at Monterrey Institute of Technology Campus Morelia, Mexico. The selected topic was mechanical power.

The methodology was validated addressing the topic and solving some exercises in a traditional way; in the next session, the teacher made a first evaluation. Later, a video about the topic was made and provided to the students for review. The activity was concluded with another evaluation where the grades increased in 16% and the rate of failed students was diminished in 25%.

The device used for the video's creation has been named Learning Lightboard, which is based on the learning glass of San Diego State University (USA) and the lightboard of The University of Northwestern (USA). Learning Lightboard allows the recording of sessions to professors who teach courses based on the flipped classroom technique; furthermore, the teacher has the possibility to support the topics with visual and media content that allows to emphasize some aspects and concepts in a very specific way.

The applied methodology with the aid of videos was very helpful for a better comprehension of the concepts through explanations supported by real-life examples in a physics course of secondary school.

Keywords: Video-based learning, Flipped classroom, Science teaching.

1 INTRODUCTION

Learning is a process that is performed according to cognitive abilities, which provide the students the capability of learning in a more focused way in all their aptitudes as it is demonstrated in a study made by Eric M. Anderman [1], where it is described how teachers can create an adequate environment for the students to improve their attitudes and boost their development. Many factors relate cognitive abilities for the achievement of integral development of the students, as it is mentioned in the study performed by Solomon Gunta in 2015 [2], made in Ethiopia through questionnaires, the difficulties for the physics learning in secondary school students were analyzed, ranging from the facilities, the teacher's perspective, the possibilities of performing certain activities, etc. In this study, the existence of more factors involved in the process teaching-learning was verified and proved.

Innovation in science teaching can occur in two ways, changing the pedagogy processes and/or incorporating technology methods.

The first option is demonstrated by Carlos Becerra in 2011 [3], by whom a relevant study is introduced, in which two possibilities are compared; one class following the traditional method of reading-based instructions and other, where an approach based on assimilating the questions through certain didactic materials, was provided to the students; the study demonstrated that the participants that followed the new method, obtained better performance reasoning the problem solving process, and also had, an improvement in the conceptual learning. A study performed in Thailand by Richard Coll [4] for a chemistry course proposes an innovative strategy for some classes that consists of applying a laboratory activity related to a real-life problem, as well as developing collaborative work
and analysis activities. The result of this study was a better comprehension of the students, since they were capable of justifying their numerical results with concepts and valid arguments.

On the other hand, incorporating technology, a compilation of studies obtained from secondary school level by Jennifer Olson in 2011 [5], showed that part of the problem in developing countries is the fact that students don’t have optimal conditions for learning and the updates of their education systems does not allow them to develop a strong interest in science; the study proposes that an important investment in the modernization of education is necessary in order to include the immersion of technology as an educational tool.

It is true that technology can be really helpful in the teaching and learning process; however, it also comes with a lot of challenges, as it is established by the study made by Kulik in 2003 [6], where it is mentioned that the way in which technology is applied as learning tool has a lot of influence on its effectiveness because if not applied with the correct approach, it can cause the opposite effect on the students, such as loss of interest and distractions.

2 METHODOLOGY

2.1 Participants.

The group in which the use of the tool was implemented was integrated by 25 secondary students at Monterrey Institute of Technology Campus Morelia; they were all 17-year-old students of fifth semester. The examined group was formed 56% by women and 44% by men.

2.2 Implementation

The procedure carried out for the implementation of the tool Lightboard was the following:

a) Explanation of the topic, “Mechanical power”, in a traditional way.

b) Evaluation of the topic through a quiz.

c) Generation of a tutorial video.

d) Delivery of the video to the study group.

e) Second evaluation of the group applying the same quiz used in b).

f) Results analysis.

2.3 Description of the equipment.

Videos were generated with the aid of the program ATEM Software Control®, which are professional digital switchers capable of mixing and processing resources in live video. These characteristics make the videos easy to produce without any kind of post-production. The hardware used was: ATEM television studio®, which is the special switcher used for connecting the audiovisual content to the software; Wireless presentation set®, this microphone allows the teacher to record his voice in high quality; to record the videos, it was used a Camcorder Canon XC10®, which record in 4K standard. To illuminate the set 3 lamps were used, 2 of these were LimoStudio®, and the other one was SunBlaze®, these lamps come with advanced reflectors to give the greatest spread of light for a nice even shadow-free lighting fixture. The glass used as the board is made of ultra-clear crystal, it was internally illuminated with leds that give more lighting to the fluorescent markers. The equipment working altogether can be seen in “Figure 1”. As it was mentioned before, Learning Lightboard is based on the learning glass of San Diego State University (USA) and the lightboard of The University of Northwestern (USA) [7].

2.4 Characteristics of the video.

Video length is approximately 7 minutes, and it is divided in two different moments, theoretical introduction and the knowledge application exercise.

The video simulates a personalized tutoring session between teacher and student in which the participants are always face to face; a lot of advantage is taken from the teacher’s abilities for guiding the student with his own hands.
3 RESULTS

3.1 Student survey responses

In a survey administered before the application of the surprise exam and the delivery of the tutorial videos, the first question was: “After your classes, do you watch any YouTube videos about the subject treated?” This question showed that students have a very positive opinion about the usage of videos for fully understanding difficult topics, as 100% of them accepted the fact that they look for extra explanation on online videos, even after the session given by the teacher.

Also, the second question of the survey showed that 64.7% of the students attend tutoring sessions to reinforce the topic addressed in class as shown in “Figure 2”. These data are the basis for the application of a new method that includes both learning tools, videos and tutoring.

3.2 Effectivity results.

Previous to the creation of the video tutorials, approximately 60% of the students seemed to have the knowledge about Mechanical Power as they had an approving grade in the quiz applied. On the other hand, 40% of the students didn’t pass the exam. Then when the method was applied there was an increase in the approving grades of 28%, passing the second quiz 88% of the participants and failing it 12% of them “Figure 3”. It should be emphasized that 60% of the students improved their grade and 40% remained at the same one; nevertheless, it is important to mention that none of the participants decreased their performance in the second chance they had to do the quiz. In the “Figure 4” it can see the improvement of students’ averages pre- and post- application of this method, there was an increase of 14.8 points in the average of the group.
"Figure 5" is the result of a video uploaded to YouTube. In this video, the teacher used animations to make the explanation more dynamic and understandable.

![Individual performance of the group.](image1)

**Figure 3.** Comparison of student performance between pre- and post-Learning Lightboard.

![Average grades of the intervention group](image2)

**Figure 4.** Improvement in the average of the students that were participants in the study.

![Screenshot of a video made with Learning Lightboard by the teacher](image3)

**Figure 5.** Screenshot of a video made with Learning Lightboard by the teacher, who is explaining uniform circular motion

### 4 CONCLUSIONS

The result of this study indicate that the video-based learning technique had a positive impact in the performance of the group in a physics course specifically with the topic of mechanical power. This
strategy is especially beneficial for both the students and the teachers; for the students because they can watch the videos wherever they want and review the topics before a quiz, exam or just for learning completely the content. It has a lot of advantages for the teachers because they can make the class more dynamic and attractive for the students; also, if the teacher has to be absent, he can prepare the session so the students can have the necessary material to do the corresponding activities of that class.

For this project, technology plays an important role in the improvement of the performance of the students; however, the learners have the final decision of taking the most advantage of the technique. From the previous paragraphs, it can be concluded that the applied methodology with the aid of videos is very helpful for a better comprehension of the concepts through explanations supported by real-life examples in a physics course of secondary school. At the same time, it is important to highlight that the generated material can also be used as a study repository, since the students have unlimited access to the generated videos.

5 FUTURE APPLICATIONS

The study was limited by the number of participants and by the fact that the videos made were specifically for physics and for the topic of Mechanical power. Our main goal is here in Monterrey Institute of Technology, to offer the teachers of all subjects a brief course about the Learning Lightboard functioning, mainly to show them how they can record their own videos in a very fast and easy way without others aid.

It is our hope that in the future, Learning Lightboard videos can be improved with ideas thought by students, so they can feel more attracted and motivated by the content of the video. Also, the goal is to apply Learning Lightboard videos starting next semester August-December 2017.

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