Films and Newtonian laws. A brain tool for learning Physics.

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Abstract. 69 undergraduate students who learnt with a Brain-Based Teaching Approach (BBTA) methodology, versus a master class teaching method, has shown some advantages in reasoning processes and higher motivations. We want to show an example of application of this method.

1 Introduction

If we understand how the brain works we can improve the teaching methods. Some authors have proposed a theoretical brain based framework for research in Physics education [1]. The Brain-Based Teaching Approach (BBTA) developed by Reyes [2] is based on similar principles.

2 Methods

By using a BBTA method, we preprared 5 sessions to teach Newtonian laws to 15-16 years old students. The motivation was measured with AMS test, specially the dimension *intrinsic motivation to know* (IMTK) [3], witch indicates the pleasure of learning.

Session 1: We start the session talking about motion and its causes. Easily the students go up to the force, even though they cannot define it. Precise words at this point are not necessary.

We try to get a relationship between forces and kinetics (position, velocity, acceleration). First experiment consists of pushing a chair and seeing what happens. They tend to say no force, no motion.

Then we see the scene from the film Mission to Mars (https://youtu.be/Gaev_Jo6fRs) (00:49:30 to 00:53:30 approx). A man in space is accelerating by using a sort of a rocket, trying to catch a lost device, but he goes too fast and keeps on moving even though he is not using the rocket any more. New questions are suggested. Why cannot this man stop? Is there any force applied? What kind of motion can we see in the different parts of the scene? Is there a different motion law out there? (Aristotle principle)... They find out the inertia principle.

The conversation usually grows up under the teacher´s leading in a maieutic dialogue. How the astronauts start moving? And how do they stop their motion? With apparenty no intention, the students go to the relation between force and acceleration, the second principle.

Analyzing the role of the gas and motion they go up to the principle of action-reaction. At this point, the scene is linked with other new scenes under the guidance of the teacher.

In order to reinforce what they have discovered, the students watch more scenes, but now they explain what is happening.

Session 2: The students try to solve some classical problems. Then, they go through a CSI contextualized problem (a crime, robbery or other challenging situation to solve).

Session 3: A guided lab session is introduced. By using different forces (masses) the measure velocity and acceleration of an object in order to prove the principles. They have to design the procedure.

Session 4: To test if the students have learnt the principles, they complete a google form in which they check their answers without the pressure of the result of a test, because is not taken into account for a final assessment.

Students can search for new scenes. They can show and explain their findings in class and can create their own problems by using a movie scene or inventing fictionalized situations.

Session 5: We go to skate on ice and test the principles already found.

3 Results

Table 1. Kurtosis-Symmetry (K-S) and Shapiro-Wilk (S-W) normality tests (p-values) of women samples, T-test (parametric) / U Mann-Whitney test (non parametric)

	BBTA method		**Classic method**		**T test**	**U Mann-Whitney test**
	K-S	S-W	K-S	S-W		
IMTK	.142	.092	.077	.368	.032	

4 Conclusion

In light of the results obtained, the BBTA seems to be a very efficient way of teaching and learning Physics. Among the profits, the students have more interest in learning, specially women, and higher reasoning skills.

References

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