Early Primary Education Students' First Engagement with Basic Physics Concepts and Phenomena through an Interactive Board and Sandbox Physics Software - - Proposal and Application

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Abstract. *The teaching of basic physics concepts and physical phenomena in early stages of primary education is very limited.*

Mainly it is focused in the reference of natural physical phenomena, such as rain, earthquakes etc. but it does not relate with certain physical quantities and concepts.

The use of interactive whiteboard in combination with free (or low cost) software, which can be supplied from the internet, can be a fun and creative way to motivate students and thus could help them in the deeper comprehension of a plethora of physical phenomena.

In this paper we present a teaching plan that shows how certain activities can help students to comprehend better the motion of physical bodies by painting and playing which will naturally lead them to create a positive view of physics in general.

Keywords. Primary education, Physics concepts, Interactive whiteboard, Sandbox game.

1. Introduction

The students of first classes in Primary schools are not taught Physical concepts at all. The teachings of physics phenomena and/or physical quantities are limited in natural phenomena (earthquakes, rain, etc). However it is commonly acceptable that even the younger students in Primary schools have a perception for a series of physical phenomena and situations as they try to comprehend the world that surrounds them. In addition the most common and creative expression procedure for them is to paint.

In our proposal we use the interactive whiteboard and free sandbox physics software to motivate students with physical phenomena, physical concepts and physical quantities through games that promote kinesthetic and tactile learning.

2. Rationale – Research Question

Is it possible for early primary students to create and check their models about basic concepts of kinematics using an interactive whiteboard and physics sandbox software? In order to check such a hypothesis we applied a lesson plan based on certain educational model which is being used to teach physics to the students of primary classes (fifth and sixth grade).

3. Educational Methodology

We selected students from classes "A" and "C" of "Nea Genia Ziridi" private primary school.

Figure 1. A student testing her hypothesis

These ages (6 to 8) seem to be the most suitable for an educational approach with interactive whiteboard and sandbox physics software.

"A" class students were familiarized with the interactive whiteboard but never used a sandbox physics software before. On the other

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hand “C” class students had already used the interactive whiteboard (for three years already) and the certain software but just for creative fun.

Our teaching plan is based on the following steps of scientific / educational model by inquiry, [1]:

1. Trigger of Interest
2. Hypothesis Expression
3. Experimentation
4. Conclusions
5. Generalisation

3.1. Educational aims and objectives

Educational Aims

Students should:

1. Acquire positive attitude for science in general.
2. Use and be familiarized with technology.
3. Consolidate the way a scientist approaches a problem.

Educational Objectives

Students should:

4. Try to build models for a series of physical concepts such as weight, velocity, acceleration rotation, balance, orbit, etc.
5. Create models that explain the world that surrounds them.
6. Experiment in a fan and easy way using technology.
7. Try to explain and the behaviour of materials in general.

3.2. Our Teaching Plan

At the stage of trigger of interest we introduced the concept of the third dimension to both classes. With three-dimensional video from youtube and some three-dimensional pictures from 3D books and 3D glasses (cyan-red) the small students experienced the third dimension.

At the stage of hypothesis expression we asked “first” class students very simple and basic questions. We tried this way to make them to express about a number of physical concepts such as the three dimensions, the trajectory of a moving body, the motion of objects in general, balance, etc.

For “C” class students we add the concepts of rotation, velocity and acceleration.

After that we showed at the interactive whiteboard some print screens from the software that showed possible trajectories of a moving ball in order to hit the star, Fig. 2. We asked them to hypothesize which would be the possible one and students expressed their thoughts in the laboratory. After that they had to test their hypotheses using the interactive whiteboard.

Figure 2. Ball Path

We then asked students to use at their computers their sandbox physics software and check this way their hypothesis (step of experimentation) in different scenarios, Fig. 2.

The students working in groups tried to find ways to successfully move objects by drawing shapes, balance scales, etc, and create this way models for the physical concepts in question.

This process led to the final conclusions by students themselves.

During the whole process students worked in groups, discussed each other, and tested their hypotheses.

We also presented many different scenarios that included more physics concepts (Fig.3 and Fig.4), like balancing, rotation, acceleration, etc. asking students to act the same way as described before for these concepts.

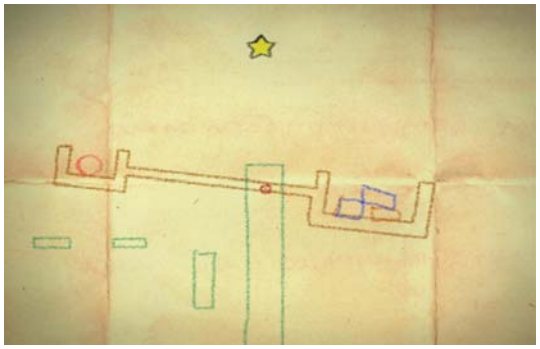

Figure 3. Balancing…

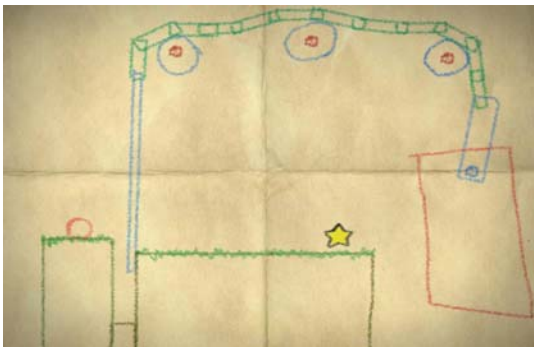

Figure 4. Lifting…

4. The Results

"A" class students that used "crayon physics" software for first time were very excited with the whole process. That way they quickly managed to express their thoughts for a number of physical concepts and physical phenomena by drawing in the interactive whiteboard and discussing about them.

"C" class students were already familiarized with the software as they played its puzzles just for creative (problem solving) fun. They faced for the first time the possibility to talk about physical concepts and phenomena through the software in a fun and easy way.

We observed students to be familiarize with terms and phenomena of physics such as three dimensions, movement, velocity, rotation, etc very quick for both classes. Naturally the students of "C" class seem to be more ready to discuss with us about the phenomena and concepts than the students of "A" class. But even though they could not express their thoughts in a "scientific" way their approach to explain physical phenomena was in the right direction.

It is remarkable that in their effort to explain the phenomena they began to make hypothesis and create models which enhanced their ability in problem solving. Students from other "A" and "C" classes which were used the same software - but just for fun- seems to be less efficient in software's problem solving. The whole process also led the students to use terms of physics in their expressions naturally.

5. Conclusion and Future Work

Through the educational procedure we lead students to make hypotheses, to check them through software and to conclude after team discussion.

Through drawing students create objects and easily test their hypotheses for the movement of the objects they create. In this way students were engaged with a series of physical concepts such as weight, balance, velocity, acceleration, rotation, orbit, etc and the behaviour of materials in general.

The use of interactive whiteboard helped students not only to be focused on the board but also to work in groups in order to present their thoughts about motion, objects, materials, etc in a fun and creative way.

Through these procedures students seem to be helped to have a better understanding of the world that surrounds them.

At this early stage we cannot express general conclusions about their ability to fully use the knowledge they acquired. Although it seems to be possible that the use of interactive whiteboard and sandbox physics software under certain circumstances and with the appropriate educational methodology, could help them to understand some physical phenomena.

For the nearby future we can say that we have already create new lesson plans for the older students of primary school with more (complicated) physical concepts and we will use them with the beginning of the next school year.

We will also try scenarios using the "Level Editor" function of the software as seen in Fig. 5, which can give the opportunity to students to create and test their own levels / "physical" worlds.

Figure 5. Level editor function

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