Hands-on Experimentation in Educational Physics Laboratory utilizing a Common Mobile Phone – The Case of Decrescent Oscillation

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Abstract. *Our research team's main effort is to study how the means and methodology in general affect Science teaching practice, top-placing motivating and keeping students' interest. In this context, triggered by the growing use of mobile phones by Greek students of all ages, we tried to investigate how efficient, technically and methodologically, is to integrate this tool into Science teaching.*

The material created consisted of worksheets that include an experimental part where the use of mobile phone is integrated.

The very first results are encouraging, as students not only showed interested in the new idea, but they also succeeded to fulfill more didactical targets.

Keywords. Decrescent oscillation, Experiment, Logger-Pro, Mobile phone.

1. Introduction – Framework - Purpose

In the last few years, the main goal of our research team is to develop a curriculum and propose a time table for a short time didactical seminar which aims at prospective Science teachers. This seminar should affiliate issues of educational methodology and educational exploitation of technology ([5], [6]). To adopt new instructional methods effectively in science teaching, those methods should be introduced to teachers in their pre-service education [10]. Traditional science teaching is not effective enough in altering student understandings of the physical science concepts [7]. Literature reveals that students who learn science in traditional instructional settings often leave the classroom with misconceptions [9] while Thornton [8] points out that students often perceive science as being difficult, boring and concerned with details.

Research shows that students of all ages learn science better by participating actively in the critical thinking and by interpreting physical phenomena [4].

Under this general direction, we should first study the results of the implementation of a program, which will adopt innovative ideas at the fields of methodology and technology in the everyday didactical practice.

Various studies showed that many students do not enjoy science classes because they find them uninteresting and irrelevant (e.g. [3], [9], and [10]).

This work aims at this target, viz to propose a beneficial use of a gadget that almost every Greek student owns to the everyday reality of the Science class.

Students record a phenomenon with their own mobile phone and then they process the video via Logger-Pro, a computer program, which can estimate the coordinates of a motion and evaluate derivative sizes, such as velocity and acceleration.

The phenomenon that it was chosen was decrescent oscillation, as it develops quite fast and it is not feasible to measure with accuracy the position and the velocity with a conventional (non digitally) way of experiment.

An integrated didactical proposal is developed, comprehending didactical targets, educational methodology, digital experiment phase and a worksheet.

2. Rationale-Research Questions

It was of our intention to investigate firstly the potentiality to incorporate such a tool in Science teaching and secondly to evaluate effects at students' interest.

So, the main research questions are: Is it feasible, in terms of technical efficiency, to incorporate mobile phone as a tool in Science teaching? What kind of natural sizes could be measured through this process? How do students counter this new media?

Vassilios Grigoriou, Konstantia Papageorgiou & George Kalkanis (2010). Hands-on Experimentation in Educational Physics Laboratory utilizing a Common Mobile Phone – The Case of Decrescent Oscillation M. Kalogiannakis, D. Stavrou & P. Michaelidis (Eds.) *Proceedings of the 7th International Conference on Hands-on Science.* 25-31 July 2010, Rethymno-Crete, pp. 355 – 357 **http://www.clab.edc.uoc.gr/HSci2010**

3. Methods

Because of the innovation of the whole effort, before we advance in the application of the proposal we selected to check each possible parameter. Therefore, after the decision of the field was made, the next step had to do with the recording of the phenomenon.

As an apparatus we chose Newton's disk for decrescent oscillation. The main topics at this apparatus are firstly the transformation of the kinetic energy to potential and vice versa and secondly the loss of the mechanic energy due to friction.

With the use of a mobile phone, we recorded a video of the phenomenon, which lasted approximately twenty seconds.

After that we transferred the video to a pc, via a usb port. Alternatively it could be used a bluetooth connection, so that no cables are needed but it could be more confusing as a short process is necessary in order to establish the connection between the mobile phone and the pc.

Then the video was imported to Logger Pro. As the program recognizes only avi and QuickTime format, a converter may be required, depending on the video format that a mobile phone creates. In our occasion we used A-Z Converter Ultimate in order to convert mpeg file from a Nokia phone to avi.

At the environment of Logger Pro, we chose a set of two vertical axes and after a simple calibration we picked with a mouse click the different position of the disk at different time moments. Simultaneously there were filled two columns with the coordinates of the position of the body. Also, the measure of the velocity at the two axes was estimated.

Further process of the data was made at Microsoft Excel, where graphs of the position, the measure of velocity, the potential, kinetic and mechanical energy were made.

At the next stage, we developed a worksheet, consistent with the proposed of the laboratory educational methodology, which it could be described as an inquiry methodology.

The worksheet was tested in a class of twenty students of the Pedagogical Department of the University of Athens.

4. Results

The analysis of the worksheets reveals that students managed to reach numerous didactical goals. They comprehended the issue of energy transformation through graphical interpretation, while they coped with natural sizes such as velocity, acceleration, resultant force, impetus, period and frequency (fig. 1, fig.2).

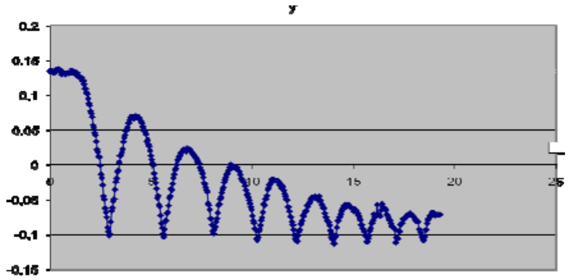

Fig 1. Graphical representation for the position of the body associated with the time.

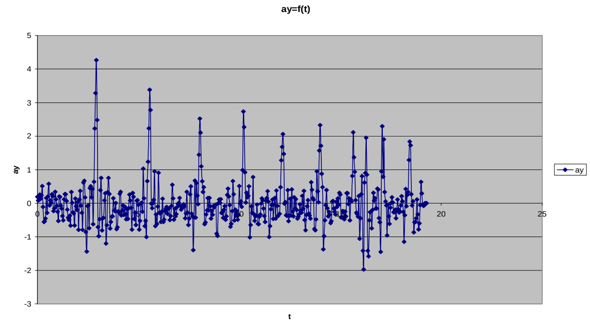

Fig 2. Graphical representation for the acceleration of the body associated with the time.

Also, their attention was tensed as they used two familiar tools for them (mobile phone and computer) in a class that often is described by them as boring.

5. Conclusions-Proposals

There is always enough space in research for innovative ideas at the didactical practice, exceeding conventional media that students find boring. It seems that it is time to test a variety of gadgets that are frequently used by almost everyone, passing the message that above all Science is something diachronic and thus modern that is not 'afraid' of any challenge. This is even more important if we consider that students believe that science is exciting only for scientists.

The main issue is to train prospective teachers at the means of educational methodology and technology, so that they will form the appropriate culture to combine both of them in the most beneficial way.

With this inspiration, other researchers (Bers and Postmore) introduced a partnership model for pre-service early childhood teachers to learn how to develop, implement and evaluate curricula in mathematics, science and technology [2]. They conclude that the partnership models allowed pre-service teachers to realize how technology could potentially improve their educational practices and what skills they need to use technology effectively.

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