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PolyMorphic Combinations of Sensors and Actuators, Operating MultiThematic Educational Experiments in a Computer-Based Laboratory – Proposal and Implementation

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Abstract

We propose polymorphic combinations of sensors and actuators, operating multithematic educational experiments in a Computer-Based Laboratory. The implementation of the experimental practice in the educational procedure is organized according to the scientific / educational method with a parallel use of the ICT. The ICT are used in order to present units of science, guide the students during all the steps of the educational procedure, support the experimentation (data acquisition and analysis) and help students to extend conclusions to other fields of science or technology. The proposed applications may enable teacher to plan the didactical procedure according to the class needs following the proposed methodology and techniques. We designed applications, for secondary education students (15–18 years old) which include multiple but flexible polymorphic experimental devices, based on sensors and actuators connected to the PC, able to be applied to several fields of science. The proposal is under research. The up to now results, concerning the implementation of the material and the students' interest, are encouraging.

Introduction

The previous years, the use of Computer-based laboratory in Science Education has been suggested and supported. A great number of lab experiments, which include sensors and actuators, has been developed in order different thematics of secondary or elementary education to be taught. The results which derive from the ICT based education are very engouraging. Most of the times the use of ICT is limited to data aquisition and analysis of the data received with sensors without taking advance all of the facilities provided by them.

Our suggestion

We suggest the educational procedure to be implemented in the lab by using the computer in order to apply the scientific / educational method which consists of 5 steps.

- Texts, articles, pictures, videos,..., operate as **triggers** in order to motivate students on a phenomenon. (Figure 1)
- Students are guided in order to question and write their **hypothesis** and ideas for the specific phenomenon.
- Instructions are presented for the **experiments** which are implemented with the use of sensors and actuators. The computer allows the analysis of the data. The suggested experimental devices are designed to be used in several units.
- After experimentation students come up with **conclusions** which are compared with their initial ideas on the phenomenon.
- The conclusions are **applied** to other fields of technology or science.

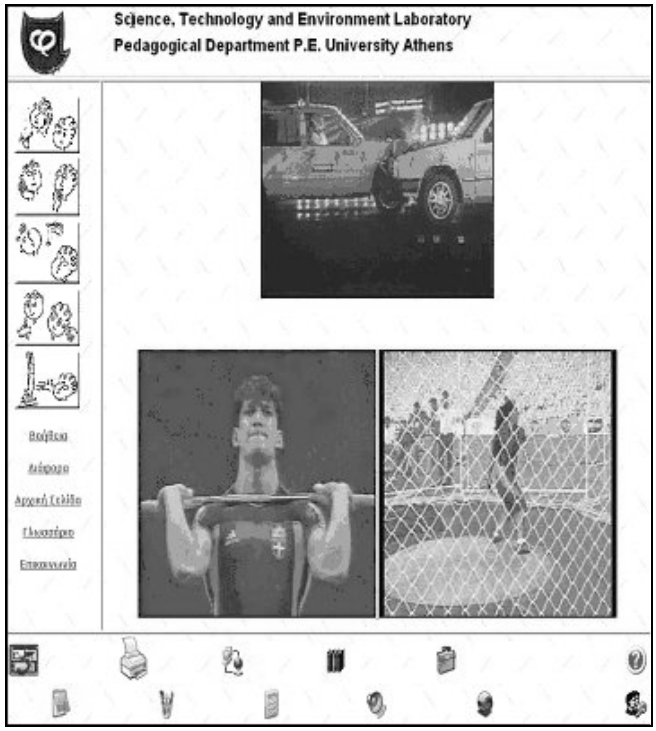

Figure 1

During the implenentation, the procedures –including hypothesis, remarks, conclusions– followed by the

students are saved to the computer in a specific folder for each student or group of students. In this way the teacher can be aware of the procedure by reading students remarks, conclusions, ... The files saved to the folder can be texts, drawings, sound files and videos (in case the students are provided with a microphone or a camera).

The educational material

In order the activities to be implemented, a platform has been created in Visual Basic. Through this platform application such as Coach 5 –for data analysis– or programs for the register of texts, drawings, videos (Notepad, Paint or windows movie maker) can be called. (Figure 2). The platform also contains pages of the educational material created in HTML or XML and can be opened by any browser. We have designed the applications in a flexible way so that the instructors to be able to add any element they believe is important for their intervention.

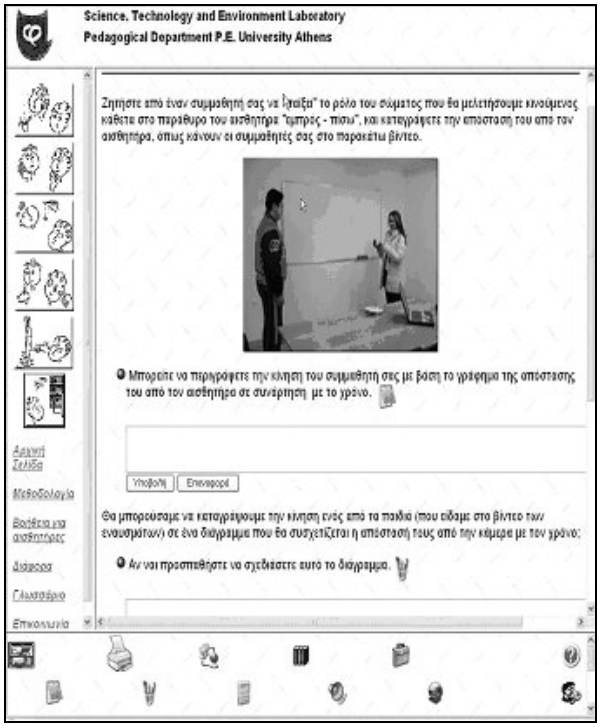

Figure 2

Results

Our suggestion is under evaluation in students/teachers education. The so far results concerning the use of the method and the interest of the students are satisfied. The students face some difficulties in data aquisition with the MBL systems. We believe that this is due to the fact that they are inexperienced in using computer systems in general. In order to surpass such problems we have adjusted the instructions.

Conclusions and implications

The use of flexible polymorphic experimental devices developed with daily materials and adjusted to experiments and the compination with the facilities offered by the computers to the guidance and the observation of the students through the educational procedure is an alternative approach to science education. We will be able to offer more results concerning the efficiency of the material when the evaluation is expanded to students of secondary education.

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