

Complete Interactive Environment for Science Training

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Abstract. *Representation of an educational environment which offers the combined use of the advantages provided by ICT and science laboratory.*

The main aspect of the proposed educational environment is the use of ICT not in the form of custom made, usually complex and difficult to use and understand tools but on the contrary with the use of common applications which are supplied and installed by the operating system on every windows-compatible computer. Expected outcome of such an action is simplicity and effectiveness.

The experimental procedure can now be included in a daily basis. Inclusion of new educational material or adaptation of the existing one relative to custom needs is possible and expected. Access to the material can be done either locally or through routed networks, even Internet.

Keywords. information technology, computer, experimentation, computer based training,

1. Introduction

The main motive for every educational approach, modification and proposal is to make the educational process more effective than is in its current state.

Usually, proposed modifications and / or adaptations are related to the content of the training process and mostly tend to the development of models and prototypes for the proceedings, the methodology and the means which will lead to the expected results.

During the last years Information Technology with its main representatives –personal

computers– either with the use of software or with the use of hardware (mainly integration with environment sensors) has been introduced as one of the most important parameters with the help of which we increase students' conception.

The complete learning environment as long as the individual tools which have been developed for being used into science teaching include: multimedia applications for the representation of the educational material, tools that allow the creation of models and simulations of physical phenomenon's or the structure of the macrocosms and microcosms. Lately we have seen environments based on virtual reality. For science teaching in physics the main role of ICT during the educational process has to do with experimenting and collecting data digitally. Until today a serious amount of experimental procedures have been presented by using laboratorial provisions based on the use of personal computing which they cover almost every section of physics we teach, at least in secondary school. Having this in mind we can be assured that already exists a serious background into which we can count on in order to realize our experimental process [1, [2]).

The possibilities that Computer Based Laboratory (CBL) offers a completely new way for students to discover the significances of science [3]. Also students are now allowed to undercover the role of a scientific researcher [4]. The use of digital technologies during experimentation provides the opportunity to ask questions, to make prognosis, or even more to propose experiment, to collect and evaluate data, to examine ideas, to create interaction, to research of new ideas, to make comparisons and come to a conclusion. Generally the use of a

micro-computer can strengthen the ability of students to solve problematic situations and to create and evaluate graphic charts or graphic representations in general [5].

The current possibility of CBL to transform in almost real-time the collected data into graphical format (graphs) is an opportunity that was not offered during the past. For students is now possible -and quite important- not only to observe the actual experimental process but also to evaluate collected data, with the form of a graphical representation.

Another advantage of the use of laboratorial provisions is the so-called "Real Time Experimentation". Often, definitions that cannot be revealed by the use of Real-Time measuring systems, are inaccessible by didactical terms. With the use of CBL techniques (too little time frames, slow motion, pause, etc) such areas now become revealed to our students and in nowadays can be taught able [6].

The use of such tools by its self isn't usually enough to improve the results of our educational interventions [7], [8] and they raise the importance of the methodology under which those techniques are implemented into the educational process for the achievement of our predefined goals. Interventions that do not rely on promotion of exploratory activities are neither effective nor cause long term conceptual change.

2. Proposal

Our proposal which has been designed, developed and implemented consists of two individual parts. By starting the software application (module 1) and the material (mod-2).

For the design of our software we took under consideration the principles of discovery learning, as proposed by Brunner in combination with principles of Piaget and Vygotsky.

The discovery by learning theory emphasizes the importance of learning by doing. Such actions consists of research, experimentation, submission of questions and answers re-creation. The didactical approach focus on the evaluation of the information in order to provide a valid answer. To schema that is usually used contains:

- Problem identification
- Making hypothesis
- Data collection
- Data analysis
- Conclusion formatting

The methodology which is used consist of the inquiringly evolving educational model, which constitutes educational application of scientific method. Under this method we meet the following steps:

- trigger
- hypothesis
- experimentation
- conclusions
- general and theory testing

In spite of the fact that we have laid on the principles of discovery learning in some points of the method we follow we can distinguish elements which are proposed from other learning theories too, like those which stands for constructivism.

The software we propose provides a complete training environment. This software interacts with other add-on modules (e.g. real time measuring systems) providing a complete solution without the need of wasting extra time of our students in order to get familiar / comfortable with it. The application is installed locally on every personal computer and is used for the presentation of the actual educational material. The physical location of the material can be either locally (local store) or through routed network (internet too).The network solution is preferable in conjunction of having many individual local installations for obvious reasons. By this way we have to maintain, upgrade, etc only one "material stage". It is important to emphasize that the network or local solution are not exclusively between. By this we mean that the selection and / or change the source of material can be done by run-time and not at install-time. By this way our teaching process overcomes network problems, slow internet connections, etc.

In case we use some add-on software which integrates with MBL systems for data collection and representation our software offers the possibility to be customized in order to work with a number of already made such systems and also includes functionality for future integration too (Figure 1). The primary add-on module we used for data collection in our experimentation is "Coachlab™".

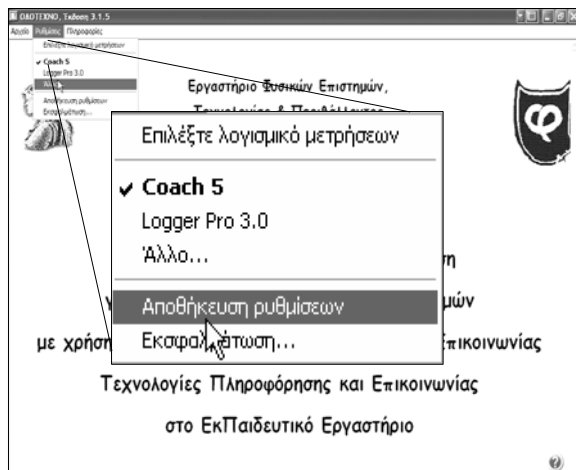


Figure 1: Selection of Real-Time MBL system

By the first time a student tries to use the software, a user registration form needs to be completed (Figure 2). By this way every single user is not anonymous but named and his/her course can be evaluated.

Figure 2: Student registration / single user creation

After the “user creation” access to the user is granted. The main idea of having individual users consists on the following:

- A physical student is a single user,
- Ideas, thoughts and answers are related to physical students,
- Observations through student notes during time not single session evaluation,

- Offline evaluation,
- in general we use a e-portfolio scenario.

This e-portfolio is implemented by a user rights mechanism which allows single users to access only their specific data. Educators have the possibility of having full access to all students portfolios. For security reasons teachers have a private login password too.

By entering into the application we are able to select the specific unit of the educational material which is needed according to our scope.

The structure of the educational material we have created follows the steps of the evolving educational model. During trigger and/or hypothesis we try to draw students’ attention and in parallel we ask for their hypothesis concerning the evaluation scenario. Their replies can be written by using common operating system applications which are executed by buttons stored at the bottom of the page. Depending on the form of the data which is needed to be written down can be used a text-editor, a voice-editor or other form-specific editors.

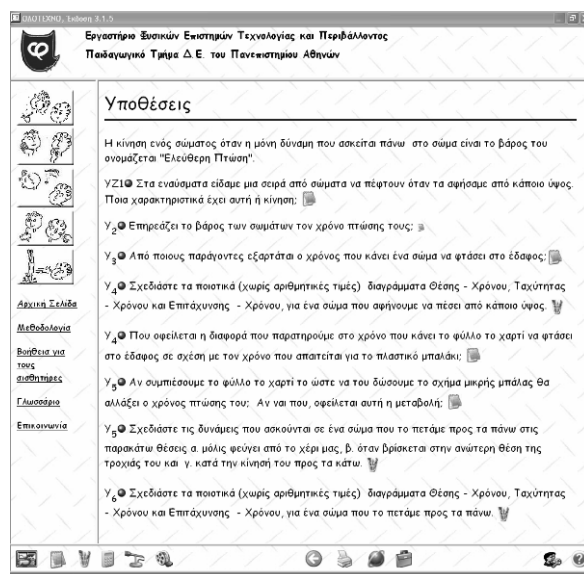


Figure 3: Main Unit Selection

During experimentation the add-on module of the MBL system is activated. During the experiment all data collection and representation is done by the add-on module. In the end that specific data can either be lost –if temporary data- or imported into our software and saved in the “e-portfolio stage”. In general the different types of files that can be created, handled and

stored are: text, chart, sound, video (through web-cameras).

More over we also provide the functionality to visit internet sites which are pre-defined (accepted and evaluated for their content) or visit custom web-sites provided by the educator.

Finally, we provide the possibility for every educator to add his / her own material in a specific form and add this material for viewing by his / her students. The add material procedure is documented and is error-free in all cases, when all restrictions are followed. For this purpose we developed a forum for exchanging ideas, material and trouble shooting / support services.

A lightweight version of the application is public available and can be downloaded for free from : <http://www.primedu.uoa.gr/~mpatrin>

4. Conclusions

The developed software has been primarily tested on students in secondary education and also with teachers-to-be. At this moment and after completing the first stage of data analysis it seems that it fulfill the specifications of its creation. From the data that been measured and analyzed, the results are quite encouraging. Specifically, we measured little or almost none time for familiarization, simplicity of use and manageability. Closing, student portfolios' assessment is under evaluation.

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