

A Lab-course Based on ICT to Teach the Microkosmos Model to Pre-service Primary Teachers

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Abstract

As research supports, a lab-course based on the microkosmos model and on ICT reinforces the ability of the learners to explain phenomena in a consistent way to the scientific one. Consequently, a science education curriculum based on the microkosmos model as a unifying element, is proposed for the introductory physics university course of prospective primary teachers. A five weeks lab course is presented referring to the curriculum, the educational method, the equipment, the supporting software and educational material. The proposed course has already been implemented and evaluated by pre- and post-tests at a group of 25 students. The emphasis was put on familiarizing students with the modeling process, on the introduction of the microkosmos model and the use of it in describing and explaining phenomena, on computer visualisation of the model by simulation programs and 3D animations, on group work in a lab with a PC per group of students, who conducted simple experiments with everyday material guided by printed worksheets.

Introduction

Recent research [1] conducted in the Pedagogical Department of Primary Education at the University of Athens, led to the conclusion that a laboratory course that is based on the microkosmos model may reinforce the ability of the learners to explain phenomena in a consistent way to the scientific one. Learning obstacles that teachers and students have to approach concepts describing the composition of matter, arise partially from the lack of supervision. Information Technology and, in particular, computer visualisation may serve as a means to overcome this obstacle [2]. Combining on the one hand the microkosmos model -as a unifying model for the description and explanation of natural phenomena- with the use of ICT on the other -as a tool for visualisation and organisation of the students' laboratory work (from a methodological point of view)-, we propose a science education curriculum for the introductory physics university laboratory course of prospective primary teachers.

1 The Lab Course

The lab course lasted for five weeks and was a part of the Physics laboratory practice of prospective primary teachers at the Pedagogical Department of the University of Athens. The proposed course has already been implemented and evaluated by pre- and post-tests at a group of 25 students. The emphasis was put on familiarizing students with the modeling process, on the introduction of the microkosmos model and the use of it in describing and explaining phenomena. The students were divided in groups of four and conducted simple experiments with everyday material guided by printed worksheets. A PC was available per group. Although students had limited computer skills, they managed to use the software in a quite satisfactory way.

2 The Microkosmos model

The microkosmos model is an educational transformation of the standard model. It includes elementary particles, their interactions and energy as a fundamental concept. It provides a basis for the description and explanation of physical phenomena included at the primary school curriculum. In other words, according to the model several phenomena are explained by the composition of matter and the behavior of the particles involved.

3 The use of ICT – The software

The software was created on a web page philosophy and developed by HTML language. The digital material of the software was created in the Science, Technology and Environment Laboratory and included 3D animations (by 3D Studio Max) and simulations (with Monte Carlo methods) as well as sounds, images, videos and descriptive texts. The software on the one hand provided a tool for the visualization of the models and on the other guided the students and organized the instruction following a series of steps and providing instructions for the experiments.

3.1 The curriculum

The content of the software was organized in units according to the curriculum for the introductory physics university laboratory course of prospective primary teachers. These units were as following: models in science, the microkosmos model (the particles, the interactions, how scientists developed this model), energy, the three states of matter (solid, liquid and gas), boiling, condensation, evaporation, water expansion, sound, electric current.

3.2 The educational method

The software was developed according to the scientific method. This method was transformed into an educational one and consisted of five steps. Each unit included the following steps: trigger (material to bring out students' interest), hypothesis (questions to help students express their hypotheses), experiments (guidelines for the experiments and 3d animations / visualizations of the model), conclusions, applications (cases for implementation and generalization of the model).

3.3 The experiments

The software provided details for the conduction of the experiments: list of the (simple and everyday) materials, photos of the experimental device and written orders. In any case the students were supported by the software to conduct the experiment and not to view it on the PC screen. Printed worksheets with navigation orders were distributed so as students were better guided and facilitated to take notes on their hypotheses and remarks on the experiments.

3.4 The model

The software emphasized on the scientific modeling process and the nature of science, which was presented in detail, as it is stated that the use of explaining models by students is influenced by their view regarding the nature of scientific knowledge [3]. The approach aimed at helping students view science as a continuous search for a better model and that in order to describe and explain natural phenomena scientists often use more than one models or different aspects of a model. In order to overcome the alternative ideas that visualization of models may cause, whenever a model appeared on the screen, it was clearly stated that it was a model and it was distinguished from the real phenomenon. The microkosmos model was proposed as a convenient model that applies to a series of phenomena, but

different aspects of it may be used in order to describe and explain each phenomenon in a satisfactory way.

Conclusions

A science education curriculum for prospective primary teachers that is based on the microkosmos model as a unifying element and is supported by the presented educational software, that facilitates students to conduct simple experiments and includes simulations / visualizations of the model, may satisfactorily be implemented in a lab course of five weeks (10-12 hours), may serve as a linking basis for the description and explanation of numerous natural phenomena appearing to be irrelevant between each other, and appears to be well accepted by the students / prospective teachers.

References

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