TEACHERS' PERCEPTION ON DEVELOPING AND IMPLEMENTING VIRTUAL EXPERIMENTS

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Abstract: Technological progress has allowed the emergence of new approaches to teaching. The virtual instruments development has led to lessons based on virtual experiments - applications that simulates real-life phenomenon and are specially designed for students use. Many virtual experiments can be obtained free of charge from the Internet, but their use in the classroom involves more than these tools availability. It involves the use of new teaching techniques and training materials. Through a European project, hundreds of teachers of sciences were trained to develop and implement virtual experiments in the classroom. This paper presents some of the expectations of teachers before the start of the training course and their opinion after the class implementation.

1 INTRODUCTION

Following clear evidence, Science is relying on experiments, observation and experimental results. Therefore, it is not possible to develop specific principles or laws without checking them in practice, but in many cases, this can cover a significant period of time.

From the scientific point of view, an experiment represents a caused observation, a searching or testing action for finding evidences. However, it is a deliberate provocation, under specified conditions of a phenomenon, having as purpose to observe its behaviour, to test the causal relations, to discover its essence and to verify some hypotheses (Cerghit, 1980).

In education, Science subjects are presented and taught with various degrees of simplification. However, just as in scientific research, the experiment retains a central role, and is indeed indispensable, in the teaching of Science area, regardless of the degree of rigor (Chiaverina & Vollmer, 2005).

In the last decade, virtual experiments were introduced in education on a large scale. They represent an alternative or complementary resource in the study of phenomena and processes which exist in the nature. Generally, virtual experiments are recommended to be used in the following circumstances: (a) when they help the effective implementation of the (real) experiments, allowing in this way the users to control a number of factors that influence the studied phenomena; (b) in the case of existing resources which do not allow the implementation of experiments that are necessary to understand the studied phenomena; (c) when the implementation of the real experiments can be dangerous for the users' health.

Despite the fact that the concept of Virtual Instrumentation was introduced about twenty years ago by National Instruments (with the introduction of LabVIEW), most of the virtual experiments developed not only for education but especially for engineering have not been assumed and presented as open sources. Just in the last years, some applications could be retrieved (on Internet) as free of charge and introduced in Science studies step-by-step. Taking also into consideration that "Europe needs an adequate throughput of mathematics and scientific specialists in order to maintain its competitiveness" and "the increasing importance of open learning environments in education" (Report, 2001), 9 European partners (from Romania, Spain, Poland, Finland and Greece) proposed a transnational European Socrates Comenius 2.1: "VccSSe - Virtual Community Collaborating Space for Science Education" (128989-CP-1-2006-1-RO-COMENIUS-C21), with a view to present the potential offered by virtual experiments for science education and also to promote an open educational

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resource for the European academic space (Gorghiu, 2009).

The science teachers' training in using virtual experiments in their classrooms within VccSSe project showed how valuable these tools are and their potential to improve students' learning behaviour, teaching strategy, learning results, students' motivation and so on. In the following there will be presented the context in which these results were obtained and the figures of these results.

2 THE VCCSSE PROJECT - AN OPEN EDUCATIONAL SPACE FOR VIRTUAL EXPERIMENTS

The VccSSe Project had as main objective to adapt, develop, test, implement and disseminate training modules, teaching methodologies and pedagogical strategies based on the use of virtual instruments, with the view to implement them in the classroom, through ICT (Information and Communications Technologies) tools (VccSSe, 2009).

The most important outcome of the project was represented by the creation and development of the training course "Virtual Instrumentation in Science Education", dedicated to in-service science teachers from all the educational levels in the project partners' countries.

The course had introduced specific concepts related to virtual instruments / experiments, available software packages and web examples, pedagogical methods and didactical elements for the selected virtual instrumentation educational platforms: Cabri Geometry II Plus, Crocodile Clips, LabView and GeoGebra (Gorghiu et al., 2009). 363 science teachers were enrolled at the starting point of the course.

At the same time, the project team developed the e-Space, a repository of virtual experiments that were used as examples in the context of training - in fact, a valuable database which contains virtual experiments offered as examples for the teachers who participated to the course, structured per areas (Mathematics, Physics, Chemistry and Technology) and related categories. The e-Space includes a search engine which allows the searching of virtual instrumentation (VI) examples by: description, author, keyword and language (partners' languages: English, Romanian, Spanish, Polish, Finnish and Greek) (Suduc, Bîzoi & Gorghiu, 2008).

In addition, a database with Virtual experiments (Teachers' Products Matrix), containing 218 final products designed by 206 teachers who finalized the training sessions, was developed as an open resource for all the science teachers interested in introducing virtual experiments in their lessons and not only. Together with 50 representative video-experiments related to the implementation of virtual experiments in lessons and 9 On-line / Remote Simulating Laboratories (produced by the project partnership), all of them grouped as VccSSe Exhibition, it closes the open educational space created in the frame of the VccSSe project and dedicated to the promoting of virtual experiments in European science education.

This educational space, even mainly dedicated to science teachers, is a great space of resources for any person searching a deeper understanding of different science concepts (to complete or to add new knowledge).

3 MATERIALS AND METHODS

In order to assess the pedagogical use of virtual experiments, the teachers who attended the "Virtual Instrumentation in Science Education" training modules expressed their feedback in three specific web-evaluation questionnaires: the initial one (before the course), the final questionnaire (at the end of the course) and the impact questionnaire (after classroom implementation).

The questionnaires included particularly questions dedicated for evaluating the level of their knowledge acquisition on creating and using virtual experiments in the classroom, achieving the goals and purposes of the training modules and rating the presented virtual instrumentation software (Olteanu et al., 2009).

All data were collected using web forms and the information gathered was centralized in the database.

In the following section, there is presented a part of the teachers' answers to the initial and impact questionnaires.

4 RESULTS AND DISCUSSIONS

The initial evaluation questionnaire included, besides the questions meant to evaluate the course participants background regarding the use of ICT and virtual instrumentation in the classroom, two open questions about the teachers' expectations: (a) "What do you expect from the course as far as you

are concerned?" and (b) "As far as your students are concerned, what do you expect from applying the instruments you will learn about on the course?".

Only 5% of participants said they do not know or have not filled those fields in the questionnaire. Teachers' expectations from the course can be framed in several categories: (a) 29% of the teachers hoped that virtual experiments usage will increase their ICT skills, in general; (b) 28% believed that students will more easily understand ICT-based methodologies and they will use more effective the computer; (c) 35% attended the course to learn how to design ICT lessons and how to create virtual experiments for that kind of lessons; (d) 37% wanted to improve their skills and to learn new pedagogical methods and techniques to be applied in the classroom; (e) 4% hoped they will learn to use some modelling and simulations software; (f) 5% considered that the course will improve their computer use skills; (g) and 10% hoped to obtain access to resources that can be used in their school and by others.

Regarding their expectations from applying the instruments which will be taught about on the course, the teachers' answers were summarized as follow: (a) 24% hoped that using virtual instruments will increase the students' capacity of understanding and solving the problems; (b) only 6% considered that their new knowledge will optimize the learning process; (c) 22% hoped that students will acquire skills for effective use of ICT; (d) 20% thought that students will more easily interpret phenomena experienced; (e) 41% believed that the use of virtual experiments will stimulate students' creativity, their desire to experience new things, will motivate them and will promote active learning; and (f) 22% thought that VI will increase students' interest in science subjects in general (Mathematics, Physics, Chemistry, Technology in this case).

After completing the course, teachers have implemented in the classroom the knowledge gained. Based on the experience in the classroom they have been evaluated once more, through the impact questionnaire web form. To the questions of this web form, 143 science teachers gave their answers.

The first question aimed to evaluate the importance of virtual instrumentation for teachers. 62% of the teachers considered "to great extend" the virtual instrumentation as a source of inspiration for them (Figure 1).

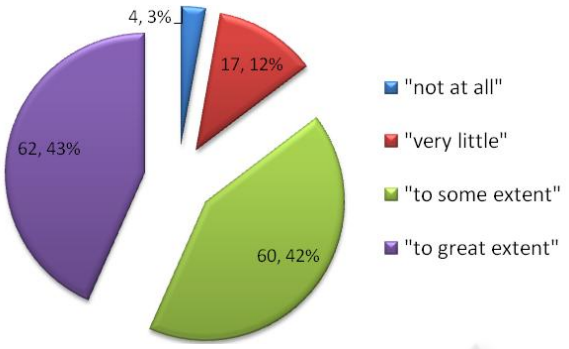

Figure 1: Virtual instrumentation is a source of inspiration for you?

Figure 2 presents teachers' opinions regarding two issues: (1) Virtual instrumentation is a good method to improve students' learning skills, and (2) Virtual instrumentation is improving students' conceptual understanding.

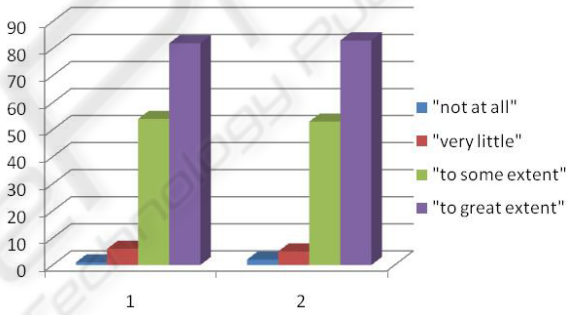

Figure 2: Student's activity improvement.

To both questions, 58% of the teachers (82, respectively 83 of the total number of the teachers, which is 143) responded "to great extent" and only 5% responded "not at all" and "very little". Therefore the great majority of the respondents observed a real improvement in students' learning skills and students' conceptual understanding when using virtual experiments in the classroom.

Figure 3 presents the teachers' answers to the following question: "To what extent has the implementation of virtual experiments in the classroom improved the quality of the following...?". The statements with the corresponding numbers in the figure are: (1) Students' learning behaviour; (2) Your teaching strategy; (3) Classroom organization; (4) Students' cooperative work; (5) Students' learning results; (6) Students' learning products and (7) Students' motivation.

64% of the teachers that used virtual experiments in the classroom observed that there is a big quality improvement in student's motivation and 34%

considered that student's learning results increased significantly.

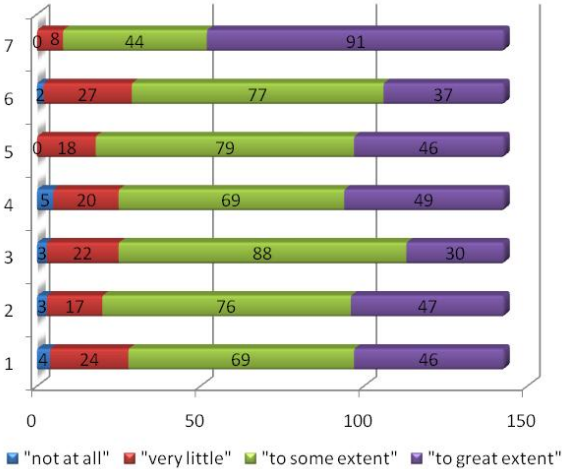

Figure 3: Improvement in quality in the classroom.

It can be observed that no teacher considered that the implementation of virtual experiments in the classroom did not improve at all the quality of the learning results and neither the students' motivation.

5 CONCLUSIONS

The results of this study show that virtual instrumentation applications are a real source of inspiration in teaching actions that should be used as an alternative and complementary instrument to traditional tools, and as a mean for improving students' understanding of science abstract concepts.

Virtual experiments are improving students' motivation for learning, in creating and maintaining students' interest for science topics as well in obtaining better results in evaluation.

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