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Implementing virtual experiments in Sciences education - challenges and experiences achieved in the frame of VccSSe Comenius 2.1. project

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Abstract

Since the beginning of the 21st Century, massive changes took place in the field of education. New teaching and learning methods based on using modern ICT tools - like virtual experiments, educational video-clips or other multimedia products - have been implemented in the educational process.
The paper presents an analysis of the impact produced by the implementation of new virtual experiments designed by 146 teachers who participated to a 40 hours training modules "*Virtual Instrumentation in Science Education*" organized in the frame of Socrates-Comenius 2.1. European project "*VccSSe - Virtual Community Collaborating Space for Science Education*". Different aspects and interpretation related to the challenges and difficulties encountered during the implementation process are also included.

Keywords: Virtual instrumentation; virtual experiment; web libraries; sciences education; comenius 2.1 project..

1. Introduction

During the last years, massive changes took place in all over the world in terms of developing new technologies, finding new materials with higher usability and lower pollution of environment. These changes are asking for a deeper understanding of the processes that are taking place inside of different systems. Consequently, new teaching and learning methods based on using modern ICT tools destined to emphasize the practical applications of the theoretical concepts were developed. Using of virtual instruments is one of these new techniques which can be used for designing different simulations of the real processes and illustrates the complex processes which are taking place in the real systems. The change of the teaching process from a formal one, centered on the teachers to an interactive

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one, centered on the learners needs became compulsory. Due to the mentioned aspects, the educational process evolved from the formal transmission of information to an active process of knowledge acquisition, based more on the studying and understanding of practical aspects of a process then learning of the involved theoretical concepts. Thus, the ICT tools like multimedia products (pictures, video-products, tutorials) and virtual instrumentation proved to be very efficient in Sciences teaching (Gorghiu et al., 2009).

The Sciences teaching and learning process is directly related with the study of natural phenomena through real lab experiments. These are imperative for the advancement of the scientific knowledge. But sometimes the real experiments can be dangerous or toxic, or teacher could be in the impossibility to organize those experiments due to a lack of different equipment or chemical reagents. In these cases, the use of virtual experiments in the classroom can be a proper way for showing phenomena that are taking place inside a system. Even teachers have been worried about the introduction of virtual instrumentation in the Sciences lessons, they started to use for the first time different web-libraries with ready-made virtual experiments. After few years, they discovered that the libraries are limited and sometimes the included virtual instruments are not fitting to the teachers' requests, lessons objectives or pupils/students' level of knowledge. In the next step, they started to design their own virtual experiments using suitable existent software. Even the designing of new virtual experiments was not easy, the most challenging step was represented by their implementation in the classroom and the impact produced on the learning process.

2. Description of the Procedure

This paper emphasizes the main aspects of the analysis related to the impact produced by the implementation of new virtual experiments designed by the teachers who participated and implemented in the classroom their results, obtained after the achieving of "Virtual Instrumentation in Science Education" training modules, organized in the frame of Socrates-Comenius 2.1. European project *"VccSSe - Virtual Community Collaborating Space for Science Education"* (Project no. 128989-CP-1-2006-1-RO-COMENIUS-C21). The partnership of the project has been formed by nine institutions from five countries: Valahia University Targoviste (Romania) - coordinating institution, Centro de Formación del Profesorado e Innovación Educativa Valladolid II (Spain), Centro del Profesorado y de Recursos de Gijón (Spain), Centro de Profesores y Recursos de Zaragoza I (Spain), Politechnika Warszawska (Poland), Regionalny Ośrodek Doskonalenia Nauczycieli "WOM" w Bielsku-Białej (Poland), Joensuun Yliopisto (Finland), Babes Bolyai University Cluj Napoca (Romania) and University of Patras (Greece). One of the main objectives of the project had in view to adapt, develop, test, implement and disseminate training modules, teaching methodologies and pedagogical strategies based on the use of Virtual Instruments in the classroom, through ICT tools (Gorghiu, 2009). In order to achieve this objective, the partnership created and developed specific materials for the training modules "*Virtual Instrumentation in Science Education*" with a total duration of 40 hours. During the training process four specific software applications have been selected by the partnership for designing virtual experiments: Cabri Geometry, LabVIEW, Crocodile Clips and GeoGebra (Gorghiu et al., 2009). At the end of the training modules, the participants had to design new virtual experiments by using one of the selected software and include it in a learning object. Two editions of the training modules have been organized by each partner institution by using Moodle as specific e-platform. After the training process most of the teachers implemented their results in the classroom and expressed their feedback about the impact of the virtual experiments in Sciences teaching.

3. Results and Discusssions

A total of 363 Science teachers started the training modules and 206 of them achieved the final tasks of the modules - designing of a new virtual experiment and a learning object which has to include the new created experiment (Figure 1). After the training modules, a number of 146 teachers implemented their learning objects and new virtual experiments in the classroom (Figure 2). In this way, about 2900 of students have been the final beneficiaries of the use of the new virtual experiments (Figure 3).

The implementation process of the new virtual experiments in the classroom has been a challenge. But, the main advantage of the designed new virtual experiments consists of the fact that they have been prepared by the teachers in accordance with the national curricula, technical possibilities and learners' level. The partnership of the project created some assessment instruments for evaluating the teachers' opinions related to impact of the virtual experiments in the classroom (Glava et al., 2009). The distribution of the teachers experience is illustrated in figure

4. The analysis of the problems appeared in the training/implementing process proved that this characteristic had an important role during both of new virtual experiments designing process and their implementation in the classroom.

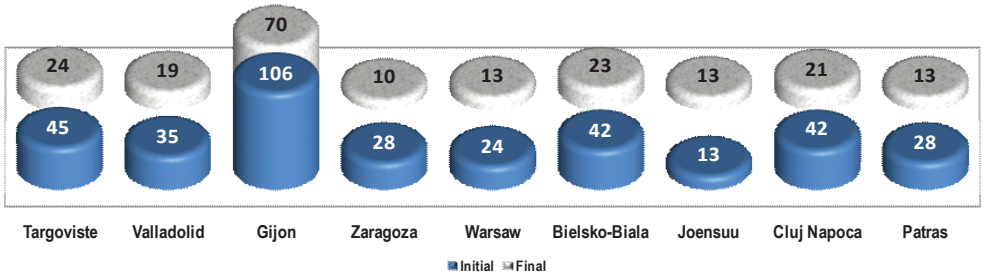

Figure 1. Distributions of participants who started and finished the training modules"*Virtual Instrumentation in Science Education*"

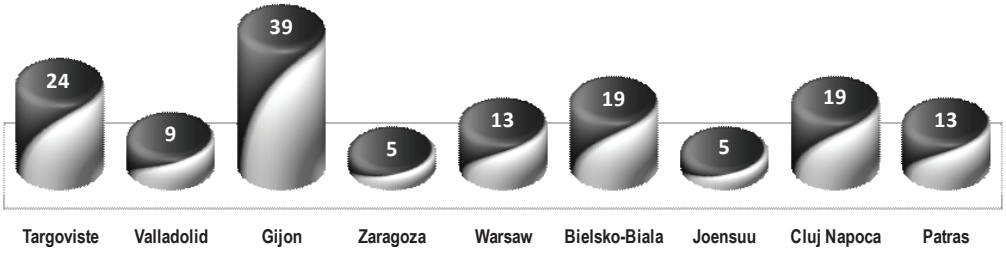

Figure 2. Distribution of the in-service teachers that implemented the final products designed in the frame of the training modules

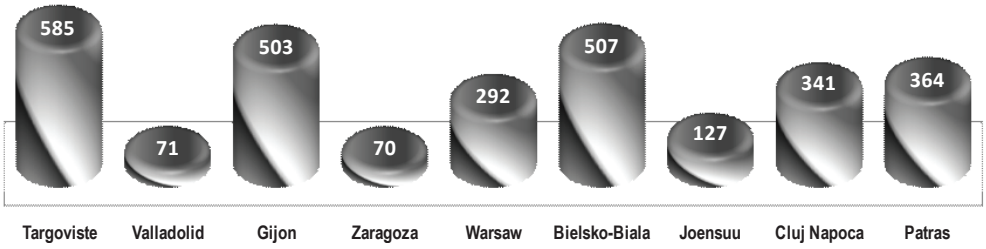

Figure 3. Number of feedbacks collected from the students after the implementation of the virtual experiments designed by teachers

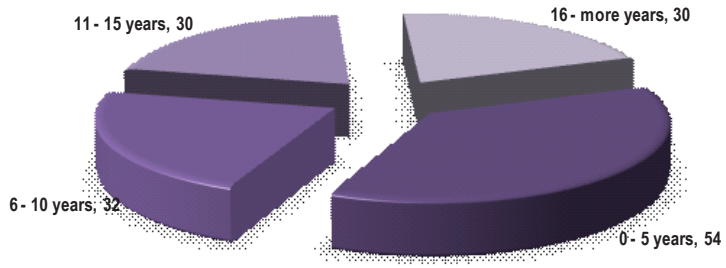

Figure 4. Distribution of teachers' experience for the participants who implemented their virtual experiments in the classroom

Evaluation of the importance of the virtual instrumentation for the teachers illustrates that this new technique can be used as a good method to improve students' learning skills and also as a means for improving students' conceptual understanding (Figure 5). The analysis of the data emphasized that 58% of the teachers agreed to a great extent, 37% agreed to some extent, 4% expressed that very little and only 1% of them disagreed to the facts that virtual instrumentation can be used as a good method to improve students' learning skills and as a mean for improving students' conceptual understanding.

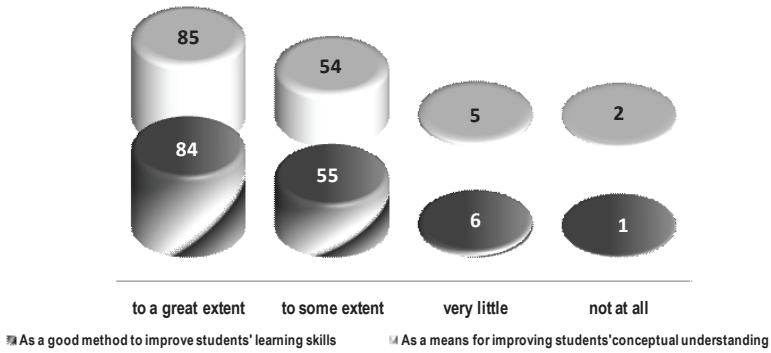

Figure 5. Evaluation of the importance of the virtual instrumentation for teachers

Concerning the evaluation of the quality of the students' learning behavior, 32% of teachers agreed to a great extent, 49% agreed to some extent, 16% expressed that very little and only 3% of them disagreed that implementation of the virtual experiments in the classroom improved the quality of the students' learning behaviour. In addition the teachers' opinions related to the increasing of the quality of their teaching strategy have been evaluated. The obtained data showed that 33% of teachers considered to a great extent and 53% of them consider to some extent that using of virtual instruments in the classroom improved the quality of their teaching strategy, while 12% expressed that a very little influence of virtual instrumentation has been observed in the improvement of their teaching strategy. Only 2% of the teachers considered that implementation of the virtual instrumentation in the classroom didn't have a real effect on their teaching strategy.

Analyzing the influence of the use of virtual instrumentation on the students' learning results, the data obtained and illustrated in figure 6 proved that all of the teachers agreed (32% - in a great extent, 56% - in some extent and 12% - very little) that using of virtual experiments lead to an improvement of the students' learning results.

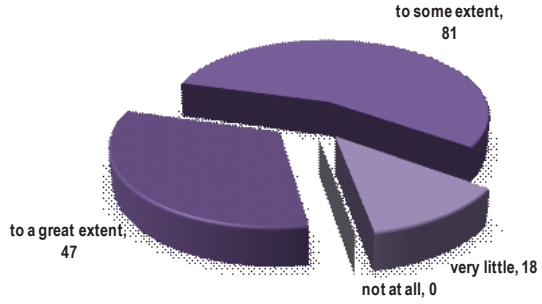

Figure 6. Evaluation of the effect of virtual instrumentation on the improvement of students' learning results

Regarding the influence of the virtual experiments implementation on the students' motivation, as figure 7 illustrates, most of the teachers (64% in a great extent and 31% in some extent) faced an increasing of their students' motivation during the teaching and learning process while 5% of teachers described a very little increasing of students' motivation.

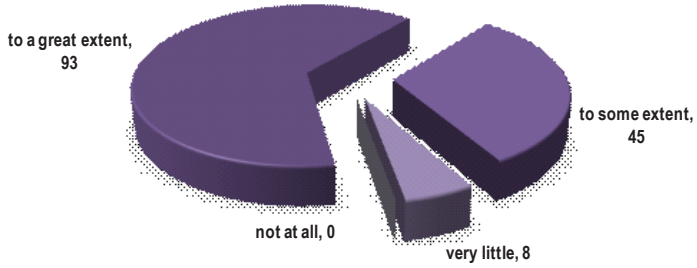

Figure 7. Evaluation of the effect of virtual instrumentation on the increasing of students' motivation

Like in any other new technology implementation in the classroom, some difficulties have been faced by the teachers. The evaluation of the problems encountered by the teachers emphasized that a big part of the teachers had minor difficulties during the implementation of the virtual experiments in the classroom. Some of them reported several difficulties but explained that those were owned to the classroom facilities, the use of hardware and software or the management of the class activities. Beside the difficulties encountered during the lessons, a great part of the teachers agreed that the implementation of the virtual experiments in the classroom was a success (Figure 8).

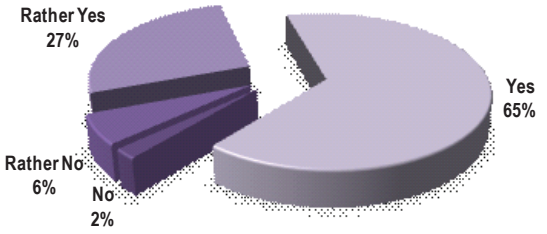

Figure 8. The rate of success expressed as a result of the implementation of virtual instrumentation in the classroom

4. Conclusions

Analyzing the collected data, it could be concluded that implementation of the virtual instrumentation during the Sciences teaching process lead to a major improvement of teacher's teaching strategy, student's learning behavior, students' learning results and products. Most of teachers from different countries reported that virtual experiments were the most useful for creating and maintaining students' interest for Science topics as well as in obtaining better results in evaluations. This last aspect correlates with good scores given to improved understanding of the concepts. Good scores were registered also in students' interactive learning mediated by virtual experiments.

A great number of the responding teachers regarded virtual instrumentation applications as a source of inspiration for their teaching actions that should be used as an alternative to traditional tools, and as a mean for improving students' understanding of abstract concepts.

As for most of the teachers using virtual experiments in teaching Sciences was one of the first experiences of this type, some difficulties were reported in management of the classroom especially in: evaluation of students performance as well as in access to hardware or general management of students.

Nevertheless, most of the teachers declared that lessons that include virtual experiments were successful or rather successful and that they would decide to use again such educational applications.

Acknowledgements

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