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Related aspects to the impact of virtual instruments implementation in the teaching process

Radu Lucian Olteanu*, Crinela Dumitrescu, Gabriel Gorghiu, Laura Monica Gorghiu

Faculty of Sciences and Arts, Sciences Department, Valahia University Targoviste, Targoviste, 130082, Romania
Automatics, Informatics and Electrical Engineering Department, Valahia University Targoviste, Targoviste, 130082, Romania

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Abstract

This paper is devoted to emphasize some aspects related with the impact of Virtual Instruments (VI) software implementation in the teaching/learning process on different topics of the Sciences area. The study was made in the frame of the three years Socrates-Comenius 2.1 project “VccSSe - Virtual Community Collaborating Space for Science Education” (no. 128989-CP-1-2006-1-RO-Comenius-C21), co-funded by the European Commission, Education and Training, School Education: Socrates: Comenius. As known Virtual Instruments represent a fundamental shift from traditional hardware-centered instrumentation systems to software-centered systems that exploit the computing power, productivity, display and connectivity capabilities of the usual desktop computers and workstations. From the educational point of view, the most important characteristic of VI is that they can simulate physical phenomena. One of the most advantages of VI is the fact that pupils can create their own applications using specific software.

Keywords: Virtual Instruments; Science experiments; pupils’ feedback; teaching process; Comenius 2.1.

1. Introduction

ICT represent an incontestable presence in nowadays school space everywhere in the world. It provides new possibilities of its using for the modernization and the improvement of teaching/learning process, increase the quality of education and meet the requirements set by the contemporary knowledge society (Gorghiu G., 2007). But there is always a question concerning the effective use of ICT in the classroom.

The educational efficacy of the new approach has not been rigorously tested. However, it is indicated that it will provide pupils with an active learning environment that will ultimately lead to a hands-on understanding of the Science concepts (Jeschke S. et all., 2007).

One of the challenges for tackling the continuous declining of the Science subjects popularity throughout Education, or seeking to increase the scientific literacy of those who will not be scientists, is how to make

Radu Lucian Olteanu.
E-mail address: r_olteanu@yahoo.com.

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experimental Science concepts accessible and relevant. Tapping into the skills that young people have already gained, becomes a very good way to tackle the challenge.

In educational frameworks like lectures and seminars, the virtual experiments can be used for demonstrations or self-learning. In practical training, they can be used to prepare pupils for developing their own learning experiments. The virtual experiments do not only aim at mediating theoretical knowledge but also to introducing into practical experimental work. Users can develop experimental designs for the different learning experiments (Tompkins P. et all., 2000). The virtual experiments are complemented by integrated topical texts, instructions, glossary, bibliographic references and tasks guiding users on how to develop, simulate and document the experiment and analyze the experimental data.

One of the problems met when in learning Science topics is to understand the role of a specific theory, of a physical model experiment. These terms are intermixed often, and the classical curriculum offering separate lectures for theory and experimental matters do not make it easier for pupils for really comprehension (Jeschke S. et all, 2007).

2. Findings and Results

Introducing ICT's in the Romanian educational process has a great importance with the view to create a real compatibility between Romanian and European educational systems. In this context, the reassessment of pedagogical approaches, teacher's competences and teaching methods have to be reconsidered (Gorghiu L. M. & Gorghiu G., 2007). The final products made by the trained teaches, involved in the "VccSSe - Virtual Community Collaborating Space for Science Education" project, have been implemented in the classroom. For achieving the project objectives the following virtual instrumentation environments were used: *LabVIEW, Crocodile Clips, Cabri Geometry II* and *GeoGebra*. The analysis is based on the pupils' answers collected by filling the "Pupil Feedback Questionnaire" after the implementation of VI tools / software in the classroom.

The analysis was performed on a sample of 368 pupils from primary, lower and upper secondary schools of Dambovita County (Romania) distributed as shown in Figure 1. The presented VI tools have been implemented in different disciplines in the first part of the training period. This study is referring to the implementation of the VI tools related to Chemistry, Physics, Mathematics, Nature Sciences and Technology and the distribution of the questioned pupils on those areas is presented in Figure 2.

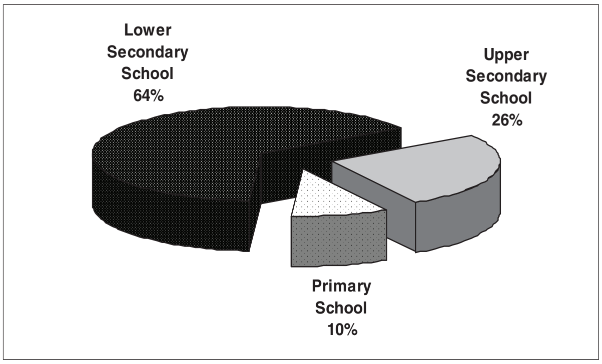


Figure 1. Pupils' distribution on education level

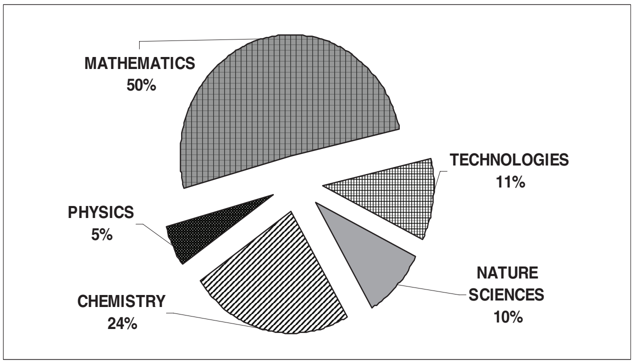


Figure 2. Pupils' distribution on teaching areas

There are, naturally, many questions and problems related to the use of experiments in Science teaching at various school levels, such as:

- How to evaluate the effectiveness of experiments for teaching?
- Is it a good balance between experiments and theory?
- What is a good balance between experiments and computer animations / modeling during teaching?

The same experiment may be used in a different way, function of the desired outcome: motivation, understanding or confirmation of a model or hypothesis.

The real laboratory is used to emphasize fundamental Science concepts of our real world phenomena, to reinforce learning through experimentation and to propose problem solving with a practical sense. Meantime its pedagogical deficiency resides in the necessity of time-space shifts between what is taught, explained and learned, and what is practiced and internalized (Jeschke S. et all, 2007). The teachers considered that the practices they had developed are successfully in terms of enhancing pupils' learning. Pupils' motivation was likewise an important factor concerning its development to a great extent.

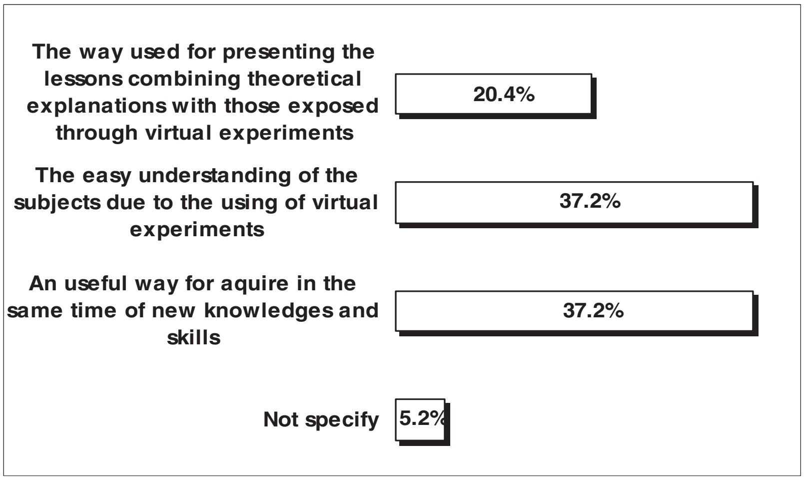


Figure 3. The distribution of the pupils' opinions on some positive aspects related to the Virtual Instruments implementation in the lessons.

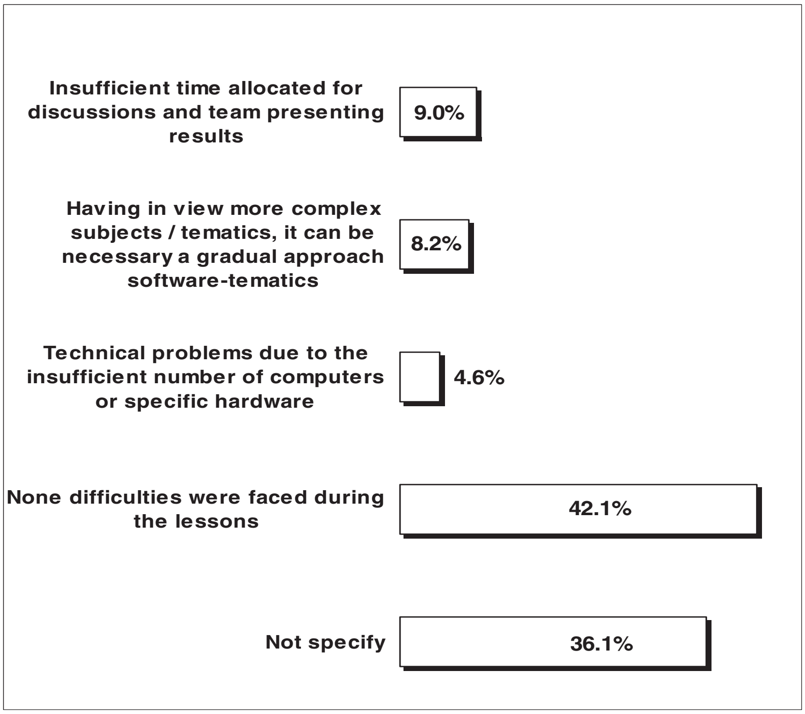
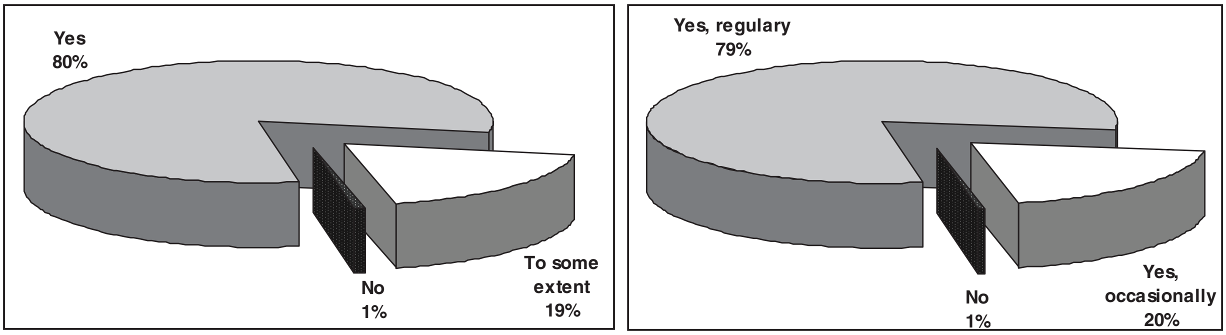


Figure 4. The distribution of pupils' opinions on the difficulties met during the Virtual instruments implementation in the lessons.

Figure 3 and 4 show the distribution of the pupils' opinions concerning their perception (positive aspects and difficulties) on the VI implementation in the lessons. It can be noticed that most of them (including those who didn't specify a certain opinion) were not confronted with difficulties during the lessons. Virtual Instruments intermediate also an easy understanding of the lessons subjects. Pupils' comments emphasized that the successfully use of VI tools requires a minimum of technical competences concerning the using of the software. Traditional activities in laboratory are designed to reduce the uncertainty and they demand less pupils' engagement and also do not emphasize a real social interaction. On the other hand, the essence of virtual laboratories consists in its informational value, the learning and the "hands-on" experiences provided and, at the same time, on freeing the educational values from the limitations induced by physical and economic factors.

Most of the pupils, as is presented in Figure 5a, consider that the using and implementation of the VI in the teaching / learning process is an interesting and useful way to understand the Science concepts. Reviewing the subject, it can be concluded that simulations can become more effective than other types of computer supported learning. Learning by simulation is generally faster than in the traditional instruction and simulations can be more effective for performance improvement. The reasons for this effectiveness are justified by the conceptual change obtained by demanding pupils to state explicitly their suppositions and implicit reasoning. As thus is illustrated in Figure 5b pupils' expectations are pointed to the regular use of the VI tools during the lessons. In addition, some of the pupils - even they were in a relative small proportion - prefer traditional lessons and this fact is important to be taken into consideration.



(a) (b)

Figure 5. Opinions concerning the usefulness of the VI in the understanding of the Science concepts (a) and the use and implementation of VI tools in future Science lessons (b)

Simulations also provide the reduction of the ambiguity and help for the identification of cause-effect relationships in complex systems and in the natural world understanding through observation and interaction, underlying scientific models that are not easily inferred from direct observation. About 40% of the pupils mentioned that the lessons were more attractive and easy understandable. They suggest also that it can be suitable to use VI tools for be introduced in other disciplines.

3. Conclusions

There is a clear evidence – supporting teachers' aspirations and pupils' expectations – that Virtual instruments tools can change the social dynamics of the classrooms (Gorghiu G., 2007). The information and learning tasks are already influencing the notion of authentic learning by changing the learning context. A more learner-centered approach would be to give a set of guidelines (not exactly the experimental procedures) and ask the learners to design and work through the experiments themselves. However, there are logistic limitations of such an approach, e.g. the safety concerns of experiments designed by learners, the availability of the physical apparatus, the amount of supervision that the teacher can realistically provide to a number of learners doing different experiments.

On the base of the presented analysis, the following aspects can be pointed out:

- easier understanding of the content due to the using of VI tools;
- extending the use of VI tools in teaching process to other disciplines, if possible;
- increasing the quality of the learning process;
- increasing the attractivity of the teaching modalities which combine VI with traditional experiments, in this case, the interactive components in a lesson becoming more important.

Since the safety issue is no longer as first importance, the supervision shifts for ensuring the safety of the pupils become a more oriented objective related to the feasibility of the experiments, actual learning outcome, motivation level of the learners and scaffolding support to the learner.

Modern technology may act as a bridge: on the one hand, computer systems make real experiments available over the Internet, any time, anywhere, and - even more important - make the measured data, observations and comments available for further analysis (Tompkins P. et all, 2000).

The same experiment may be used differently, function of the desired outcome: motivation, understanding or confirmation of a model or hypothesis. It can be remarked that the use of VI tools in the teaching process of specific disciplines from Sciences area leads to an important increasing of pupils' motivation. In fact this could be a way for having them more interested in those topics.

Acknowledgements

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