CONSIDERATIONS ON PUPILS' FEEDBACK CONCERNING THE USE OF VIRTUAL EXPERIMENTS IN SCIENCE TEACHING

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1. Introduction

ICT represent an incontestable presence in the educational environment. It provides many possibilities of using for the modernization and the improvement of teaching and learning process, increasing at the same time the quality of education [1], [2]. But there is always a question concerning the effective and pedagogical use of ICT in the classroom. The educational efficacy of the new approach has been tested, the results emphasizing that using of ICT in teaching process provides pupils an active learning environment that will lead to an easier understanding of the Science concepts.

The recent researches have emphasized that the using of the simulations is benefit in the teaching process of Science concepts. Due to those optimistic results, the using of virtual instrumentation in Science teaching has growing continuously in the last decades. Different software applications were developed for designing virtual experiments that simulate the real phenomena which are taking place in different systems. These experiments can be a proper solution for teaching the pupils how to design their own learning experiments for a better and deeper understanding of the theoretical concepts.

The paper illustrates some aspects concerning the impact of virtual experiments implementation in the teaching/learning process on different topics of the Sciences area in Romania. 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.

2. Description of procedure

As virtual instrumentation represents a real revolution in the field of instrumentation and its power in creating simulation-based learning environments is well-known, the project is addressed - on the one hand - to in-service teachers training on using virtual instruments in the teaching process of different Science areas (Mathematics, Physics, Chemistry) and - on the other hand - to the pupils - as end-users - who benefit by the implementation of the virtual instruments in the classrooms. One of the targets of the VccSSe team was to study the pupils' feedback concerning the use of virtual experiments in Science teaching.

During the project-life, a collection of assessment tools have been produced by the Evaluation Group of the project partnership. Two questionnaires for initial and final evaluation of the teachers who participated to the Training Modules "Virtual Instrumentation in Science Education" organized in the frame of the project, as well as two different questionnaires concerning the impact of the virtual experiments in the classroom, addressed to teachers and pupils. The Pupils' Feedback Questionnaire contained five questions and was applied to pupils who participated to the lessons that involved the implementation of a new virtual experiment designed by the Science teachers. At the end of the implementation process the form has been filled in by 585 pupils from Dambovita County, enrolled in all education levels, from primary to upper secondary school, after using of different virtual experiments in teaching Mathematics, Physics, Chemistry, Nature Sciences and Technology.

3. Results and Discussion

The study was realized on the base of the analysis of the pupils' answers collected from the "Pupils' Feedback Questionnaire" designed by the Evaluation Group of the partnership and delivered by every pupil after the implementation process. The analysis was performed on a sample of 585 pupils (8-18 years old) as previously mentioned. The pupils' distribution by the level of education is illustrated in figure 1.

The virtual experiments designed by the teachers at the end of the training modules have been implemented in different areas, like Mathematics, Physics, Chemistry and Technology. Distribution of the questionnaires filled in by the pupils who participated to the lessons framed in the mentioned above areas is presented in figure 2.

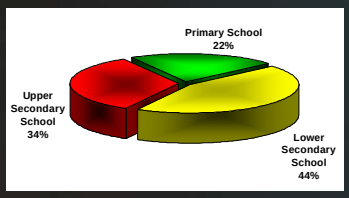

Fig. 1 **Pupils' distribution by level of education**

After the implementation of their virtual experiments in the classroom, the involved teachers considered the practices they had developed to be largely successful in terms of enhancing pupils' learning. The increasing of pupils' motivation, the deeper understanding of the theoretical concepts and the easier confirmation of a model or a hypothesis by them have been identified after the using of virtual experiments in teaching of different Science areas. This aspect is in concordance with other recent papers concerning the critical impact of the teachers' beliefs about the benefits of using ICT in the classroom.

Concerning the answers of pupils from primary school to the Pupils' Feedback Questionnaire, it has to be underlined that all the pupils that filled in the questionnaires participated to the implementation of different virtual instruments designed with Cabry Geometry II Plus or GeoGebra software in Mathematics lessons. In some of the lessons, the virtual instruments interfere only in certain steps of the lesson, and in others, the whole lesson can be lead by using these instruments. The lessons have been animated by using the virtual instruments during the teaching process. They have the advantage of stressing by intuition, analysis and logics different dimensions of the studied aspects, supporting the learning process, in accordance with different types of learning.

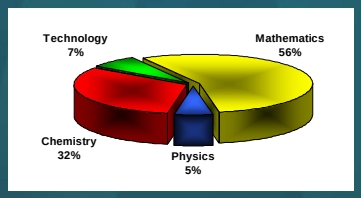

Fig. 2 **Pupils' distribution on teaching areas**

On the lower secondary level, 260 pupils filled in the feedback questionnaire, 121 of them participating to Mathematics lessons, 87 to Chemistry lessons, 12 to Physics lessons and 40 to Technology lessons that involved the using of virtual experiments designed with different software. Also, other 197 pupils involved in the upper secondary level, 76 of them filling in the feedback questionnaire for Mathematics lessons, 101 for Chemistry lessons and 20 for Physics lessons. Concerning the positive aspects of the lesson where the virtual experiments were used, the pupils' comparative answers, by different level of education are emphasized in the diagram presented in figure 3.

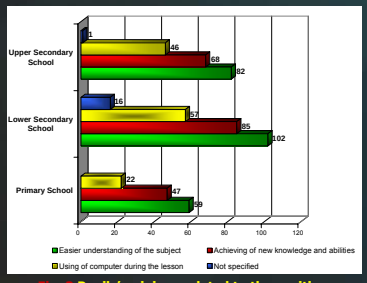

Fig. 3 **Pupils' opinions related to the positive aspects during the VI implementation in the lessons**

Other aspects of the study involved the perception of the pupils concerning the effectiveness of virtual instruments for a deeper understanding of scientific concepts. Figure 4 illustrates that about 77% of the pupils from all the levels of education are totally agreeing that the virtual experiments are very useful for understanding the scientific concepts, while 22% of them are considering that the virtual experiments are useful to some extent and just 1% of pupils didn't find the effectiveness of these experiments for the better understanding of the scientific concepts.

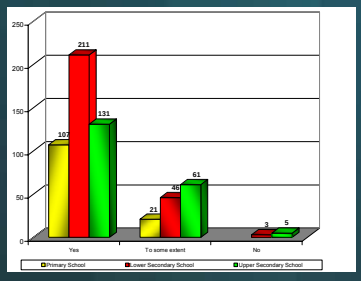

Fig. 4 **Pupils' opinions concerning the VI effectiveness for a deeper understanding of scientific concepts**

Related to the use of virtual experiments in future lessons, the distribution of pupils' answers is presented in figure 5. The distribution proves that most of the pupils (99%) are delighted to use the virtual instrumentation during the teaching/learning process, a great part of them (77%) even regularly.

Analysing the collected data from different level of education, it can be stressed that even the age of the respondents was quite different, the answers were similar, proving the advantages of using the virtual instrumentation in teaching different disciplines. Figure 3 illustrates that 41.5% of pupils considered the use and implementation of the VI in the teaching / learning process very useful and found it a suitable way for a better and easier understanding of different subjects, 34.2% of them emphasized the achieving of new knowledge and abilities and other 21.3% saw the virtual instruments like positive aspects related to the using of computer in the classroom. But the most important thing was that only 3% of pupils didn't emphasize any positive aspect of the VI implementation during the teaching process.

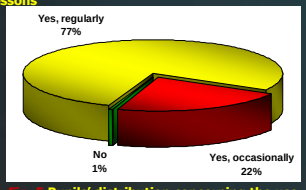

Fig. 5 **Pupils' distribution concerning the use of VI in future lessons**

Concerning other pupils' comments to the use of virtual experiments in Science teaching, the pupils' reports contain an interesting mixture of pupil enjoyment, enthusiasm, motivation and professional presentation. A big part of the pupils asked for the use of virtual experiments in future lessons that offer the possibility to acquire new knowledge, some of them claimed for additional information related to the use of VI software for designing other virtual experiments, another part of the pupils expressed their willingness to use the virtual experiments in the teaching/learning process of other disciplines. However, a few number of pupils mentioned that the periodically use of these virtual experiments could become exhausting.

4. Conclusion

The results presented above have emphasized that the use of virtual instruments can change the social dynamics of the classrooms. The information and learning tasks are influencing the notion of authentic learning by changing the learning context. Analyzing the pupils' answers, the following aspects could be pointed out: a) the easier and deeper understanding of the content due to the using of VI tools; b) the pupils' desire to extend the use of VI tools in teaching process to other disciplines; c) the increasing of the quality of the learning process; d) the rising of the attractivity for the teaching modalities which combine VI with traditional experiments.

The teacher remains the one who is deciding the manner and the moment when and which the VI tools are suitable to be used in the teaching process in order to assure the fulfilling of all the objectives established in the beginning of the lesson. In addition, even the pupils are really delighted by the using of virtual experiments instead of the real ones, the teacher does not forget that virtual experiments cannot replace entirely the real experiments developed in specific laboratories, that are focused not only for understanding the theoretical concepts but also to develop specific skills and abilities by using different utensils and laboratory equipment.

Acknowledgements

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