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Information and communication technologies in science education

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Abstract

The advancements in information and communication technologies (ICT) provide significant opportunities to improve teaching and learning. The use of ICT in science education offers even more advantages due to the attractive premises to simulate and interactively explore and test experiments which would be too expensive or too dangerous in real settings (for example in nuclear physics). The aim of this paper is to contribute to the research field of technology based learning by presenting several findings obtained during a multinational educational project (Comenius) regarding the use of computer in classroom, in science education, in Romania, Spain, Poland, Greece and Finland.

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Keywords: ICT in education, science education, multinational project;

1. Introduction

The European countries and their educational systems vary in their access to the Internet and in computer use in the classroom. Societal, economic and technological changes of the past decades are making education and training for all more important than ever (Haddad & Jurich, 2002).

The challenges in the evolving marketplaces and sophisticated living environments create the need to expand access, promote efficiency, improve the quality of learning, enhance the quality of teaching and improve management systems. USA, Denmark, Japan, Finland, the Netherlands, Portugal and Spain, for example, have drawn up master plans for developing ICT in education (Cheng, 2002).

There are two main categories of ICT use by teachers: *supportive ICT use* and *classroom ICT use* (Tondeur, van Braak, & Valcke, 2007). The first category, *supportive ICT use*, refers to the use of ICT for pro-active and administrative teaching tasks, such as student administration, preparing worksheets, developing evaluation activities, keeping track of pupils' learning progress, etc. The second, *classroom ICT use*, aims to support and enhance the actual teaching and learning process, such as the use of computers for demonstration purposes, drill and practice activities, modeling, representation of complex knowledge elements, discussions, collaboration, project work, etc (Sang, Valcke, van Braak, Tondeur, & Zhu, 2010). This paper, focused more on the *classroom ICT use*, presents several finding of the VccSSe Comenius 2.1. Project regarding the use of ICT in science education.

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2. Method and results

In the last decade, the change of the teaching process from a formal one, centered on the teachers to an interactive one, centered on the learners needs become compulsory. 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. In the context of science education ICT offers possibilities for interaction with nature (Juuti, Lavonen, Aksela, & Meisalo, 2009). ICT tools like multimedia products (pictures, video-products, tutorials) and virtual instrumentation proved to be very efficient in sciences teaching (Gorghiu, Gorghiu, Alexandrescu, & Borcea, 2009) (Gorghiu, Gorghiu, Dumitrescu, Olteanu, Bizoi, & Suduc, 2010).

In 2009, Juuti et al. identified several problems which explain why ICT is not used in science teaching in such extent as it could be appropriate according the potentials reported in the literature. These problems are as following: (1) computers tend to be located in computer labs, not in ordinary classrooms or science labs; (2) the teachers have insufficient time to learn about the use of ICT and its applications in science classrooms and they have no confidence in ICT use and (3) teachers resistance to change (the difficulty to change teachers' beliefs about teaching and learning).

In the frame of the Socrates Comenius 2.1 VccSSe (“Virtual Community Collaborating Space for Science Education”) project, the teachers who attended the training course “Virtual Instrumentation in Science Education”, organized in the frame of this project were asked to fill in an initial evaluation questionnaire. The evaluation aim was to create a big picture of the course attendee ICT skills level, their expectations from the course, if they use or not the computer during the lessons and so on. The results of this survey, conducted in 2007-2008, offered interesting information regarding the use of computers into the classroom, in science education, in five European countries: Romania, Spain, Finland, Poland and Greece.

The questionnaire was provided in online form as part of the “Virtual Instrumentation in Science Education” training course activities, course organized in the frame of the VccSSe project.

2.1. Participants

To the study there have been participated 363 science teachers from Romania, Spain, Poland, Finland and Greece who attended the training course “Virtual Instrumentation in Science Education”. The distribution per countries of the participants is presented in Table 1. In the table there are presented also the cities around which are located the schools where the survey participants are working.

The participants are teachers of mathematics (172), chemistry (64), physics (107), technology, biology, astronomy, electronics and some of them are primary school teachers. A part of the participants teach more than one subject.

Table 1. Participants per countries

Country	Cities	Number of participants	Total
Romania	Targoviste	87	363
	Cluj-Napoca		
Spain	Valladolid	169	
	Gijon		
Poland	Zaragoza	66	
	Warsaw		
Finland	Bielsko-Biala	13	
	Joensuu		
Greece	Patras	28	

2.2. Computer in class - Availability

According to a study (Korte & Hüsing, 2007), conducted in 2006 in 25 UE member States as well as Iceland and Norway, “computers and the internet have arrived in European schools and are widely used in class in most countries these days”. The results of this study showed that 96% of the European schools had internet access and

broadband were more widely used in Nordic countries, the Netherlands, Estonia and Malta. Greece (15%), Poland (28%) and Cyprus (31%) have the lowest broadband access rate.

But is the computer used by the teachers to teach other subjects than informatics? Are the teachers really taking advantages of the ICT in the teaching – learning process in the classroom? How they use ICT in the classroom?

According to Korte and Hüsing, in 2006, in Finland 77% of the schools were providing computers in classrooms, in Spain 48%, in Poland 23% and in Greece only 18%.

In our survey, 28% of the total participants of 363 science teachers reported that there is a computer in their classroom and 39% have a constant access to a computer room. The results per countries show that the 100% of the science teachers participating from Finland have a computer in their classroom. The participants from Romania responded in percentage of 84 that they have a computer in their classroom or have constant access to a computer room. In Poland, Spain, and Greece the percentages are 70%, 60%, and respectively 36%. Figure 1 presents the results regarding the possibility for teachers to use a computer during the lessons.

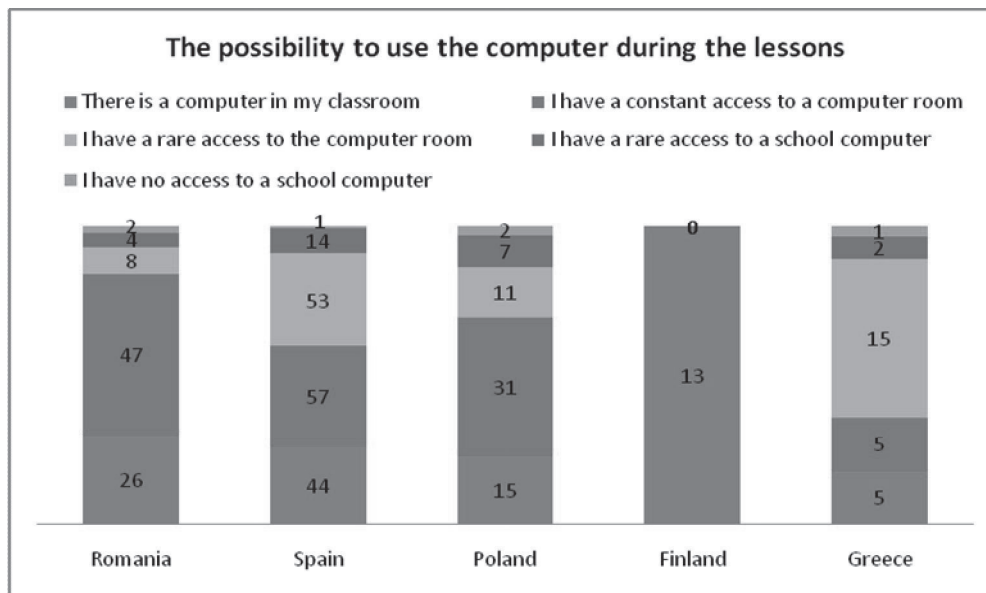


Figure 1. The possibility to use the computer in the classroom

To this question, the respondents selected from the five alternatives: (1) there is a computer in my classroom; (2) I have constant access to a computer room; (3) I have rare access to the computer room; (4) I have rare access to a school computer; (5) I have no access to a school computer. It is important to notice that in all participants' countries, except Finland, there are a few respondents that reported rare or no access to a school computer.

From the total of more than 20.000 teachers who participated to the Korte and Hüsing survey, 74% reported that they have used ICT in class in the last year. There were recorded huge variations between countries regarding the recent uses of computers in classroom: 35% of teachers in Latvia and 36% in Greece, compared to 96% in the UK and 95% in Denmark. Korte and Hüsing noted that computers are used in class by teachers of all kinds of subjects: mathematics, science and computer science (80%), general primary education (78%), vocational education (77%), and humanities and societal sciences (75%).

In our study, all the science teachers from Finland who participated to the survey responded that use computer in the classroom. On the second place, there are the greek teachers which use computer in classroom in percentage of 85%, followed by the romanians with 78%, polish teachers with 72%, and, on the last place, the spanish teachers with only 57%. Figure 2 shows the number of teachers, per countries, that responded *yes*, respectively *no* to the question: *Do you use the computer in your classroom?*

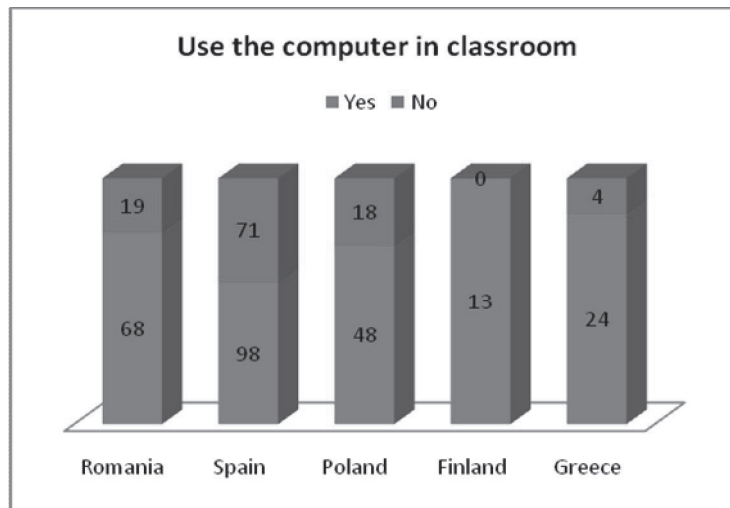


Figure 2. The use of computer in the classroom

2.3. Computer in class - Method

There are different technologies which may be used as tools to support science learning: multimedia simulation, data logging, interactive whiteboards (Hennessy, et al., 2007), virtual experiments (Gorghiu G., Gorghiu, Suduc, Bizoi, Dumitrescu, & Olteanu, 2009) etc.

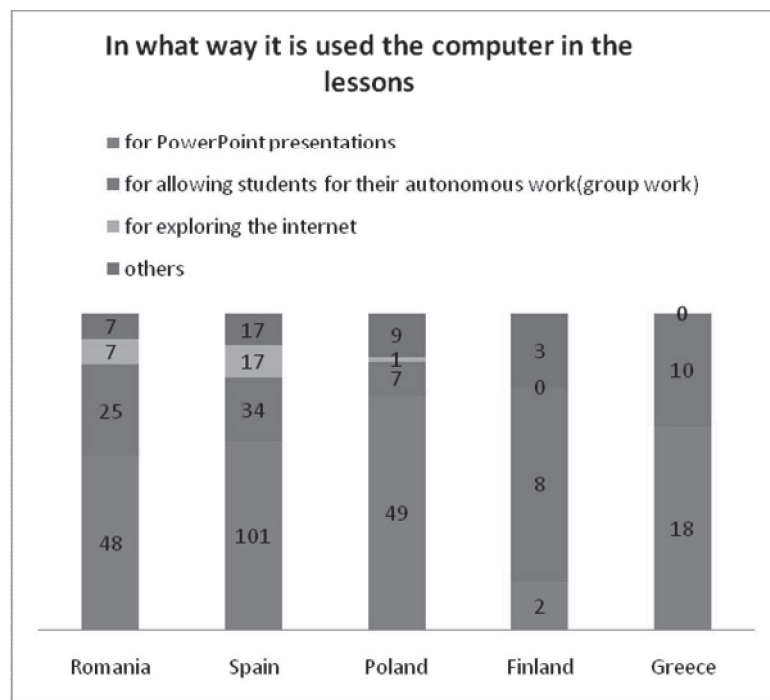


Figure 3. In what way the computer is used in the classroom

Before starting the activities of the training course “Virtual Instrumentation in Science Education”, the participants were questioned about the way they use computer in the classroom. The participants to the survey reported in percentage of 60% that use computer for power point presentation, 23% for allowing students for their

autonomous work, 7% for exploring the Internet and 10% for other activities. The results to this question, per countries, are presented in Figure 3.

A percentage of 62% of the science teachers from Finland, 36% from Greece, 29% from Romania, 20% from Spain and 11% from Poland use computer in the classroom for allowing students for autonomous work. These results highlight the high differences in approaches on ICT use in the classroom of the science teachers from the analyzed countries.

3. Conclusions

Even at the European level, the computers are widely use into the classrooms and the schools have Internet access, there are high differences between the European countries. The survey results presented in this paper along with the study results obtained by Korte and Hüsing show that the science teachers from Finland, comparing to the teachers from Romania, Spain, Poland and Greece, have computer in their classrooms and use computers during lessons, in a higher percentage. The majority of the European science teachers use computer for PowerPoint presentations. This result may reflect that the European science teachers still use standard teaching approaches and play a central role in the teaching process.

Although the number of teachers who participated to the study is limited to 363, number which does not allow making general conclusions, the results gave the opportunity to draw some interesting observations.

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