COMPUTER-BASED TECHNOLOGIES IN THE PROCESS OF TEACHING/LEARNING SCIENCES IN COMPREHENSIVE SCHOOL: SOCIO-EDUCATIONAL ASPECTS

Vincentas Lamanauskas, Violeta Šlekienė, Loreta Ragulienė
Šiauliai University, Lithuania
E-mail: v.lamanauskas@ef.su.lt, violeta@fm.su.lt, fk@fm.su.lt

Abstract

The role of ICT in education in whole and particularly in science education is very important topic. It is worth emphasizing that in recent years, a general degree of integrating ICT in the process of teaching has increased in Lithuania as well as in other countries. The growth is characteristic not only at university level but also at other levels of the education system. It is accepted that ICT makes the process of teaching/learning more effective and beneficial whereas the education system starts functioning faster. The development of ICT and the process of globalization determine alteration in the education system as well as in the whole society. The implementation of new technologies in the educational process raises new possibilities for both teacher and learner, enhances education quality and makes the educational process more versatile.
On the other hand it is necessary to devote all our efforts to monitor the process of using ICT in general schools. It is necessary to conduct regularly researches of different scale for better understanding of a situation of use ICT in the teaching /learning process.
Pilot research Student and Computer-Based Technologies was conducted in October – November, 2009. To collect the required data, an anonymous questionnaire was prepared. Research sample consisted of 211 respondents who were 1st year university students (freshmen).
In the majority of cases, the students learn to use computer independently, whereas next comes help provided by friends and family members. It has been established that computer-based technologies are very rarely used during the lessons of other subjects. The respondents think that using computer-based technologies in the classroom during the lessons of sciences has the highest impact on cognitive abilities (knowledge acquisition, self-sufficient studies etc.).
Keywords: *general schools, computer-based technologies, pilot research, science education.*

Introduction

Recently, common interest in using computer-based technologies for the purpose of teaching/learning sciences has significantly increased at international level. Different types of research are carried out to reason the efficiency of the applied technologies, an impact on broadening knowledge etc. Various investigations are conducted in Lithuania. The report of the international Software and Information Industry Association of the year 2000 summarizes more than 3500 studies on applying ICT for educational purposes and presents conclusions indicating that the use of ICT in the educational process can improve teaching/learning as well as may have a positive impact on the final results, attitudes and communication with teachers and other students. On the other hand, applying only the latest training aids cannot guarantee better results of teaching/learning. ICT is an absolutely effective instrument for teaching sciences. For instance, the possibilities of multimedia create conditions for establishing 'virtual school laboratories' and doing different imitations (for example, complex natural phenomena, expensive and complicated instruments). Computer-based technologies are widely applied to find connections between real and virtual laboratories and can be incorporated into more and more involved educational technologies. In this case, the application of Augmented Reality Technologies in educational practice can be mentioned as one of the examples. The international project ARiSE (http://www.arise-project.org) has revealed interesting results. Research on pedagogical effectiveness has disclosed that these technologies can be an effective instrument for improving the quality of teaching in general (Lamanauskas, Pribeanu, Vilkonis, Balog, Iordache, Klangauskas, 2007). The later performed in-depth research on pedagogical evaluation has also demonstrated positive results (Lamanauskas, Bilbokaitė, 2009). On the other hand, the problem is a choice between virtual and real teaching/learning environment. Real experimentation, examination etc. is crucially important for learning sciences. The researchers notice that both children and adults are strongly motivated by experimenting, discovering and understanding things in their own way (Bilek, Krumina, 2008). Thus, the basic problem is the coordination of real experimentation in the classroom with the experiments conducted in the virtual environment. Chemistry is one of the examples showing that sciences are based on experiments. The examiners find that strong emphasis on 'pure' e-learning only cannot be the only choice as most frequently this is a combination of e-learning and face to face or mobile process (Cedere, Priksane, 2006; Lovatt, Finlayson, James, 2007).

Moreover, computer-based technologies as such cannot increase the efficiency of the teaching/learning process and therefore must be appropriately applied in the educational process.

Research plays a fundamental role despite the fact that regardless of a growing number of computers in comprehensive school, the immediate use of those in the process of teaching/learning is insufficient due to different reasons. The teacher should be able to take into account and involve in their daily work rapidly changing technologies and new approaches and standards in the education field, which requires a higher performance both for students and teachers (Dudareva, Bruneniece, 2008). Teaching and learning are mainly based on the interaction between a teacher and a student. The before mentioned interaction is also determined by the use of computer-based technologies. Therefore, an important point is constant supervision and evaluation of using these technologies. The received information can help with identifying the existing shortcomings and finding adequate decisions on overcoming the encountered weaknesses which is relevant in terms of managing the educational process. First of all, this is due to the fact that arranging a lesson in the classroom and the methods of teaching/learning using computer hardware differ from that based on a traditional approach. Differently, the carried out sociological research on expanding the use of IT in Lithuanian schools shows that a position on applying IT in the educational establishments is rather limited and a wider application of computers usually ends outside informatics classroom (Bedulskis, 2005). Hence, ***the object of research*** is the use of computer-based technologies in the process of teaching/learning sciences. ***Research is aimed*** at establishing the positions of 1st year students on applying computer-based technologies in comprehensive school learning sciences and at disclosing the frequency of using these technologies in the classroom during the lessons on sciences.

Research Methodology

General Characteristics of Research

Pilot research *Student and Computer-Based Technologies* was conducted in October – November, 2009. A questionnaire was used as a method of the conducted study that fully corresponds to the Lithuanian context as the respondents were the graduates from different comprehensive schools throughout Lithuania.

The Applied Instrument

To collect the required data, an anonymous questionnaire including four main blocks was prepared.

1. The level of ability to use computer (in total, 30 parameters were included, for example, ability to use programs and documents, ability to operate fail search system etc.).
2. The methods of using computers (5 parameters were included, for example, learned during informatics classes; during classes in other subjects; during extracurricular activities; helped family members, friends etc.; individual learning).
3. The evaluation of the frequency of applying computer-based technologies during the classes of sciences (5 parameters were included, for example, the frequency of using a computer projector by the teacher; the frequency of demonstrations done by the teacher, the frequency of applying computer-based technologies by the students for the purpose of practical experimentation; the frequency of communication between students and teachers outside the classroom etc.).
4. Opinions on applying computer-based technologies during the classes of sciences at school. 20 closed type questions were addressed, for example, using computer-based technologies to make lessons more interesting, to increase motivation, for communication purposes etc.

All four blocks were made of closed type statements, the questions to which are given applying a ranking scale from 1 to 5. Every statement was given the calculated popularity index ($0 \leq PI \leq 1$). The closer is PI value to 1, the more important is the statement to the respondent.

The questionnaire also included a demographical part and some other additional variables (for example, the time the respondent uses computer; the daily average of time the respondent spends on learning using computer-based technologies).

Research sample

Research sample consisted of 211 respondents who were 1st year students.

Table 1. Characteristics of the surveyed respondents. (N/%).

Sex	Female	Male	Total
	66/31,3	145/68,7	211/100
Locality	Graduates from city schools	Graduates from regional centre schools	Total
	95/45,0	116/55,0	211/100
Program of studies	Social sciences	Physical biomedical sciences	Total
	109/51,6	102/48,4	211/100

The field of social sciences was represented by the students of educology, economics, business administration and management. The field of physical and biomedical sciences involved the students of physics, optometry, mathematics, informatics, biology and ecology. The sample of research consisted of students from four departments of the same university. Though it is not strictly a random sample, however, it is supposed to be partly random due to the precondition that the respondents randomly represent comprehensive schools located at different parts of Lithuania and that the major part of the surveyed participants graduated from these schools in 2009. From this point of view, the respondents' opinion on using computer-based technologies for the purposes of teaching/learning sciences in comprehensive school is accepted as very important and objective.

Statistical data analysis

To analyze research data, the measures of descriptive statistics (averages, popularity indexes, standard deviations) and the method of data reduction (factor analysis) / multidimensional statistical analysis have been applied. To establish deviations between the variables, nonparametric chi-square (χ^2) criterion is used. The SSPS statistics batch is used as an instrument for data processing.

Research Results

The respondents‘knowledge of using computer was assessed. The obtained results are presented in Table 2. The popularity index and standard deviation ($0 \leq PI \leq 1$) were calculated.

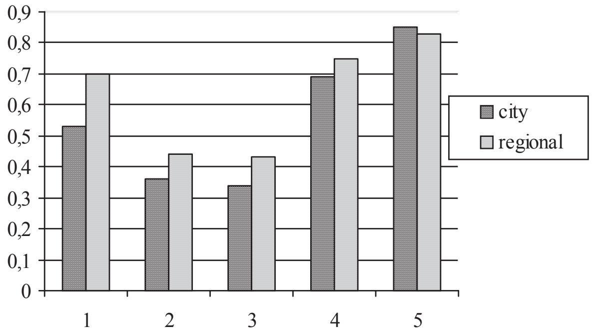
Table 2 shows that individual knowledge (PI = 0.84, standard deviation SD = 0.21) as well as friends, family members etc. (PI = 0.72, SD = 0.27) most frequently helped the students with using computer. A part of students found important knowledge and skills gained during informatics lessons (PI = 0.63, SD = 0.28). However, only a minor part of the respondents improved their knowledge and skills during the lessons of other subjects and extracurricular activities.

Forming two groups of respondents considering their specialities revealed (social sciences, SS and physical/biomedical sciences, FBS) that taking into account all 5 parameters, no statistical significant deviation between the opinions of the students representing these groups was noticed (Table 2).

Table 2. Gained knowledge of using computer.

	Ways of learning	N	PI	SD
1.	Independently	211	0.84	0.21
2.	Helped friends, family members etc.	211	0.72	0.27
3.	During informatics lessons	211	0.63	0.28
4.	During the lessons of other subjects	211	0.40	0.26
5.	During extracurricular activities			

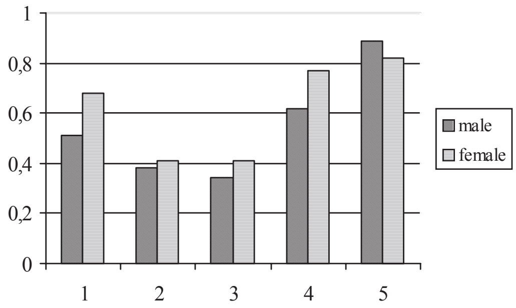
A statistically significant deviation between the opinions of the graduates from city and regional centre schools was established in view of the impact of informatics lessons on improving knowledge about using computer (Picture 1). The null hypothesis about equal averages is rejected considering the level of significance which is $p < 0.001$. Informatics lessons had a higher impact on knowledge of the students from regional centres (PI = 0.70) rather than on those from the city (PI = 0.53).



I have learnt how to use computer: 1 – during informatics lessons; 2 – during the lessons of other subjects; 3 – during extracurricular activities; 4 – others help; 5 – independently

Figure 1. Ways of using computer in terms of schools.

An assessment in terms of the sex (Figure 2) indicates that female students learn better during informatics lessons than male students, respectively (PI = 0.68) and (PI = 0.51). Female rather than male students were also stronger influenced by other people (friends, family members etc.), respectively (PI = 0.77) and (PI = 0.62). The null hypothesis about equal averages is rejected and the level of significance is $p < 0.001$. Though both male and female students in the majority of cases learnt to use computer independently, however, female students seem to be more straightforward and receptive to informatics lessons and help from other people.



I have learnt how to use computer: 1 – during informatics lessons; 2 – during the lessons of other subjects; 3 – during extracurricular activities; 4 – others help; 5 – independently

Figure 2. Ways of using computer in terms of the sex.

An assessment of the frequency of applying computer-based technologies during the classes of sciences (physics, biology, chemistry, geography) disclosed they had been used very rarely. The teachers relatively frequently used computer presenting new material during physics (PI = 0.30) and biology (PI = 0.23) lessons. Also interactive demonstrations were organized during physics (PI = 0.31) and biology (PI = 0.22) lessons. At times, the students self-sufficiently did homework and tasks on biology (PI = 0.23) and physics (PI = 0.20). Computer-based technologies were hardly applied during chemistry and geography lessons. It should be noticed that the teachers of sciences have a contact with students very rarely outside the classroom, i.e. give advice and prepare different tasks using appropriate software. No statistical deviation has been established between the answers of male and female students from the city and regional centre about the frequency of using computer-based technologies in the classroom.

An assessment of opinions on applying computer-based technologies during the classes of sciences at school and the impact of computer-based technologies on personal development has been undertaken. The following statements can be regarded as the most relevant:

- Using appropriate software made the process of learning more interesting during lessons (PI = 0.79);
- Computer-based technologies used by teachers made the lesson more engaging (PI = 0.76);
- Using computer-based technologies helped with a better understanding of a new topic (PI = 0.70).

However, the respondents have doubts about:

- Using computer-based technologies in the classroom for the purpose of raising individual motivation (PI = 0.50);
- Using computer-based technologies in the classroom for the purpose of raising interest in sciences (PI = 0.47).

It is supposed that the respondents do not relate computer-based technologies to learning motivation and deeper interest in sciences as in comparison the teachers of sciences rarely apply computer-based technologies in the process of teaching. However, sciences in particular open up strong possibilities of using these technologies for educational purposes.

Factor analysis was carried out employing the method of the main components with Varimax rotation. 20 answers to 1 question were grouped considering three factors (Table 3). 6-7 statements describe each statement. Taking into account general features these factors were given the names *Interchangeable abilities, Negative impact of computer-based technologies and Cognitive abilities*.

Table 3. The results of factor analysis of using computer-based technologies.

	FACTOR 1: *Interchangeable abilities*	Factor loadings of items
1.	Using software generated interest in the latest technologies	0.74
2.	Using computer-based technologies helped with choosing an individual method of learning.	0.74
3.	Using computer-based technologies in the classroom promoted communication between students	0.72
4.	Using computer-based technologies increased interest in sciences	0.65
5.	Using computer-based technologies helped with many-sided development of skills	0.64
6.	Using computer-based technologies helped with applying available knowledge in practice	0.64
7.	Using computer-based technologies in the classroom increased personal motivation for learning	0.63
	FACTOR 2: Negative impact of computer-based technologies	**Factor loadings of items**
1.	Using computer-based technologies distracted attention, prevented from intense concentration	0.80
2.	Using computer-based technologies prevented from continuous learning	0.78
3.	Using computer-based technologies in the classroom used to provoke stressful situations	0.73
4.	Using computer-based technologies has a negative impact on health	0.70
5.	Applying computer-based technologies in the classroom used to cause problems of communication with the teachers of sciences	0.68
6.	Using computer-based technologies in the classroom only increased dependence on them	0.67
7.	Using computer-based technologies has no impact on the process of learning	0.49
	FACTOR 3: *Cognitive abilities*	**Factor loadings of items**
1.	Computer-based technologies created possibilities of a better understanding of a new topic	0.77
2.	The applied software helped with a better acquisition of knowledge	0.77
3.	Lessons used to be more interesting when using computer-based technologies in the classroom	0.66
4.	Computer-based technologies created conditions of independent learning	0.65
5.	Lessons were not so tiring using computer-based technologies	0.63
6.	Using computer-based technologies in the classroom added more variety to the process of learning	0.62

The first factor *Interchangeable abilities* covered 7 statements describing the impact of IT on interest in sciences, technologies, motivation for learning, practical use as well as communication and collaboration between students. The second factor *Negative impact of computer-based technologies* embraced another 7 statements characterizing the impact of IT on concentration, consistent studying, stress removing etc. The third factor *Cognitive abilities* consists of 6 statements giving an account the impact of IT on learning a new topic, acquiring knowledge and making the process of learning more interesting. Every factor was given the popularity index (PI) (Table 4).

Table 4. The popularity indexes of factors.

	N	PI	SD
Factor 1	211	0.57	0.18
Factor 2	211	0.31	0.17
Factor 3	211	0.71	0.15

Table 4 shows that the third factor has the strongest impact (PI = 0.71). The respondents accept that computer-based technologies have the highest impact on cognitive abilities, i.e. using computer helps with increasing the quality of learning. The obtained result PI = 0.31 of the second factor indicates that using IT in the classroom helps with concentration, prevents form distracting attention and does not create stressful situations, i.e. has no negative impact on the state of health and personal development. In terms of the first factor, slightly positive attitude exists (PI = 0.57). The respondents do not overemphasize the impact of computer-based technologies on motivation for learning, practical use as well as on communication and collaboration between students. A statistically significant deviation between the opinions of the respondents from the city and regional centre and the impact of computer-based technologies on the first factor *Interchangeable abilities* has been noticed. The null hypothesis about equal averages is rejected at the level of significance and makes $p < 0.001$. In terms of this aspect, the position of the surveyed participants from regional centres is more positive (PI = 0.60) rather than of those from the city and makes (PI = 0.52). Therefore, it is supposed that the respondents from regional centres still want to use computer-based technologies more frequently than those from the city and therefore are more active in communicating and collaborating with their colleagues or are more engaged in sciences when using computer-based technologies.

Considering the opinions of the examined respondents in all factors, no statistical deviations between male and female students as well as between social and physical, biomedical sciences have been noticed.

Conclusions

The results of the carried out research *Student and Computer-Based Technologies* has shown that:

- In the majority of cases, the students learn to use computer independently, whereas next comes help provided by friends and family members. The lessons of informatics have a higher impact on the learners from regional centres and female students. The classes on other subjects and extracurricular activities have no significant impact on increasing knowledge of work at computer.
- It has been established that computer-based technologies are very rarely used during the lessons of other subjects. The teachers relatively frequently used computer during the lessons of physics and biology, les frequently - during the classes of chemistry and physics. The teachers of sciences very rarely use computer-based technologies outside the classroom, i.e. for tutoring, giving advice, performing different tasks.
- The respondents think that using computer-based technologies in the classroom during the lessons of sciences has the highest impact on cognitive abilities (knowledge acquisition, self-sufficient studies etc.). However, they do not find important the impact of technologies on motivation for learning, practical use, communication and collaboration between students. Moreover, applying computer-based technologies in the classroom helps with concentration, prevents from distracting attention and does not lead to stressful situations, i.e. has no negative impact on the state of health and personal development.

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Adviced by Laima Railienė,
Šiauliai University, Lithuania

Vincentas Lamanauskas	Professor, Natural Science Education Research Centre, Siauliai University, 25-119 P. Višinskio Street, LT-76351, Siauliai, Lithuania. Phone: +370 687 95668. E-mail: lamanauskas@projektas.lt Website: http://www.lamanauskas.projektas.lt
Violeta Šlekienė	Associate Professor, Head of Department of Physics, Faculty of Natural Sciences, Šiauliai University, 19 P. Visinskio Street, LT-77156 Siauliai, Lithuania. Phone: +370 41 595721. E-mail: fk@fm.su.lt Website: http://www.su.lt/
Loreta Ragulienė	Associate Professor, Lecturer of Department of Physics, Faculty of Natural Sciences, Šiauliai University, 19 P. Visinskio Street, LT-77156 Siauliai, Lithuania. Phone: +370 41 595721. E-mail: fk@fm.su.lt Website: http://www.su.lt/