Eurasia Journal of Mathematics, Science & Technology Education, 2008, **4**(3), 255-262

Students' Attitudes Toward Computer Use in Slovakia

Jana Fančovičová and Pavol Prokop
University of Trnava, Trnava, SLOVAKIA

Received 10 June 2007; accepted 19 March 2008

ICT has a very short history in Slovakia. A majority of Slovak schools accessed computers and internet only after 2000. Different financial support and schools' participation in various projects resulted in non-random distribution of computers across Slovakian elementary schools. We examined whether 1) attitudes toward computers could be affected by the accessibility of computers at schools and 2) how the use of computers between school and home environment differ. Attitudes toward ICT were positive and gender differences were weak. Although we found school had an effect on the behavioural dimension of attitudes, it was not caused by the accessibility of computers per se. However, large numbers of students per computer (up to N = 68) greatly reduced student's use of computers at schools. Lack of internet connection at home caused greater supplementation of internet-related activities in schools relative to home. Gender and age-related differences in ICT participation were greatly influenced when comparing the home and school environment.

Keywords: Attitudes, Computer, ICT-use, Schools, Pupils, Slovakia.

INTRODUCTION

All schools should be highly computerised, all teachers should be able to use the technology to enhance their working methods and all young people should be able to broaden their horizons. These goals are among the priority objectives for 2010 that the education and training systems of EU countries have set themselves in the follow-up to the Lisbon strategy (Key Data on Information and Communication Technology in Schools in Europe, 2004).

Introduction of information – communication technologies (ICT) into education in European countries was at the end of 1970's and at the beginning of 1980's. For the first time, ICT was accepted as a subject of education. Only later, it was understudied as an educational tool. The European commission published the plan "Learning in the Information Society" in 1996. The plan included four aims:

- ✓ support creating electronic networks among schools,
- ✓ support the preparation of teachers for using ICT,
- ✓ provide information about possibilities of using ICT,
- ✓ support the development of multimedia tools in education (Information and Communication Technology in European Education Systems, 2001).

The aims underlying the introduction of ICT into the education system in Slovakia are expressed in terms of ICT knowledge and skills required at each level of education:

- ✓ enabling acquisition of the basic skills needed to use computers in optional subjects at the first stage of primary education,
- ✓ enabling acquisition of the basic skills needed to use the Internet and appropriate software for individual school subjects at the second stage of primary education and secondary level,
- ✓ attaching particular importance to the study and use of ICT to research sources, so that software specific to certain subject areas can be used in higher education.

Programme Declaration by the Minister of Education relating to curricula defined for each level of education and approved by the Minister: principle relating to the thorough development of higher

Correspondence to: Pavol Prokop, PhD in Science Education, Trnava University, Faculty of Education, Deparment of Biology Priemyselná 4, PO Box 9, SK-918 43 Trnava, Slovakia
E-mail: pavol.prokop@savba.sk

E-ISSN: 1305-8223

education in the 21st century and principle relating to the development of education for the new millennium.

The Ministry of Education and the regional authorities are involved in introducing ICT into Slovak schools namely through the pilot project Infovek, or under agreements with Microsoft which supplies schools with Microsoft Windows operating systems and with Microsoft Office. Since 1998 aims of the project Infovek had been to introduce ICT into teaching and learning in primary and secondary schools, by connecting these schools to the Internet before the end of 2002, training their teachers and enabling all pupils to master basic computer skills before the end of 2003 (Sýkora et al., 1999). The initial global plan of the project Infovek to engage all schools to the project till 2004 failed. The principal reason was economic limitation. The objective assumes that about 50 – 60 % of all schools could be engaged in the project.

New technologies are the instruments for change and innovation. The educational value of ICT was confirmed by variety of experiments. Students who use ICT achieve better results in communication, co-operation and in solving problems (Williams, 2003). Graff (2003) and Mikropoulos et al. (2003) claims that ICT support the improvement of pupils' mental and creative activities. Creative use of ICT can increase creative thinking (Wheeler, 2002). Brosnan (1998) confirmed the significant effect of computers at home on knowledge which was obtained from computers. The primary schools with high level of computerisation obtained significantly better results in national testing (Bussière & Gluszynski, 2004). Pupils highly rated using animation, visual design and design software (Kreisel, 2003). Interestingly, several studies have shown that ICT usage at home differs from those at school (Kent & Facer, 2004; Sutherland, Facer, & Furlong, 2000). For example, school students reported that they spend more time with computer games at home than in the school (Kent & Facer, 2004).

Using new technologies contributed to positive attitudes of pupils toward ICT (Neo, 2003). For example, Haunsel and Hill (2002) found out that pupils using computers had more positive attitude towards biology and natural sciences than pupils who were educated by traditional styles. Several studies found gender differences in attitudes toward ICT. Brosnan (1998) showed that 6-11 year old boys had more positive attitudes towards computers than girls. Graff (2003) found that girls were less likely to use computers and were less confident in using ICT than boys. Pupils' attitudes towards computer exercises were highly positive (Ogilvia, 1999) and, additionally, most of students could work at their own speed and their computer literacy improved. The current study of Palaigeorgiou et al. (2005) also confirmed that both men and woman had similar engagement with computers and held concerns for the future effects of continuous computer use, but women were more anxious about hardware usage, and judged less positively the consequences of computers in personal and social life.

In the present study, we examined effects of variations in ICT facilities in Slovak elementary schools on students' attitudes toward ICT use. In addition, we examined differences of selected computer activities both at home and in schools.

METHOD

A total of eleven elementary schools from different part of Slovakia were asked to collaborate on the research. All school agreed to answer a basic questionnaire focusing on their implementation of computers. The results of the questionnaire are listed in Table 1. Four of these schools (first four columns in Table 1) entered into with further collaboration aimed on the investigation of students' attitudes toward ICT (ATICTQ) and their utilization of computers questionnaire (UCQ). Full versions of each questionnaire are available via the author upon request. Unfortunately, it was impossible to administer both ATICTQ and UC together, and the anonymity of participants was essential. Thus, we obtained data which could not be examined as related variables although high relatedness between participants of both

Table 1. *The distribution of computers and basic characteristic of ICT implementation in 11 schools in Slovakia*

Total number of students	470	821	174	245	665	420	723	769	895	470	665
Total number of teachers	28	53	12	19	45	31	37	47	49	41	44
Number of PC for students	28	12	21	20	13	19	30	15	30	15	11
Number of PC for teachers	4	2	4	3	2	3	3	4	10	15	11
Number of PC connected with internet	25	14	16	22	7	26	30	19	40	12	12
Total number of PC	37	14	25	24	17	28	45	23	40	20	16
Mean no. of students per one PC	16.79	68.43	8.29	12.25	51.15	22.11	24.1	51.27	29.83	31.33	60.45
PC in special classrooms	y	y	y	y	y	y	y	y	y	y	y
PC in classrooms	n	n	y	y	n	n	y	n	y	n	n

questionnaires is expected. We therefore evaluated this data separately, but we believe that there is close relationship between responses on both questionnaires.

Attitudes toward ICT

Overall, 214 secondary students (105 boys, 109 girls) aged 10 – 14 yrs from four different Slovak elementary schools participated in the ATICTQ. In order to examine factors influencing students' attitudes toward ICT, each student completed a questionnaire which consisted of 35 items. Questions were carefully divided into three attitude dimensions (cognitive, behavioural and affective). Each item was scored by participants using Likert-type scale ranged from 1 (strongly disagree) to 5 (strongly agree). Both positive and negative items were used in the test, while negative items were scored in the reverse order. Also, students were asked to provide information such as gender, their most favourite school subject, ownership of home computer and number of hours they spend using computers. Participants' favourite school subjects were then categorised into one of three categories – social sciences, natural sciences and others (art and physical sciences). One open ended question was related to the type of activity the pupils spend with computer (What activities do you use computers most frequently for?). After the data collection was completed, we used factor analysis to determine internal relationships between items within each dimension. Due to the weak correlations with other items, three items from the cognitive dimension (Items 18, 19, and 29) and three items from the behavioural dimension (Items 4, 7, 27) were excluded from the further analysis. Reliability of the test was calculated by Guttman split-half reliability (0.72), Cronbach's alpha of all items together (0.87), and for each dimension separately (Tab. 2). Values of reliability were higher than 0.7 which indicate that the instrument used in our study can be considered as reliable (Nunnaly, 1978; Pallant, 2001).

Utilization of computers

In total, 145 students (66 boys, 79 girls) from the same four schools and the same age group participated in the UCQ. The UCQ consisted from 12 items focusing on the use of computers at home and in the school. The aim of UCQ was to examine whether there are differences in the kind of activity with computers at home and in the school. Each item, except two basic questions Do you have computer at home? and Do you have an internet connection at home? was scored following frequency of use, from 1 (never), 2 (once per month), 3 (once per week) to 4 (everyday). Five items were related with the use of PC, computer games, the use of MS Word, searching information from internet and the use of e-mail at home. The same items were used in context of their use in the school. Pooled data from all four schools were than examined by factor analysis with varimax rotation.

RESULTS

General characteristic of participated schools

Total number of students per school varied from 174 to 895. The number of students per PC varied greatly – from 8 to 68 (mean = 34). All schools had computers in separate classrooms and only four of eleven have computers also in normal classrooms. Seven schools reported utilizing computers in other school subjects than ICT, and about half of the schools (six) held special sessions for students with higher interest in ICT. More than half of participants (175 of 214) reported having computer at home.

Students' attitudes toward ICT (Attitudes Toward ICT Questionnaire (ATICTQ))

Students' responses on behavioural, cognitive and affective dimension can be considered positively, because their values were higher than average expected values (see Figure 1).

Behavioural dimension

The high number of independent variables did not allow us to examine their effect using a single test. We therefore used a series of univariate ANOVAs with Bonferroni adjustments recommended by Jaccard and Wan (1996) and Holland and Copenhaver (1988) to retain the overall Type I error rate at the 5% ($p < 0.05$) and 1% ($p < 0.01$) levels, respectively.

In this procedure, the probability values obtained from all significance tests are rank ordered from highest (most significant) to lowest (least significant). The first test is considered significant if the obtained p value exceeds the alpha level (0.05 or 0.01) after it has been

Table 2. Descriptive characteristic of three basic components of attitudes

Dimension	Number of items	Cronbach's alpha	Discriminant validity	Inter-item correlation
Behavioural	10	0.7	0.71	0.19
Affective	12	0.71	0.65	0.18
Cognitive	7	0.7	0.69	0.23

divided by the total number of tests. The second test is considered significant if the obtained p value exceeds the alpha level after it has been divided by the (number of tests – 1). The third test involves dividing the obtained p value by the (number of tests – 2). This procedure is followed until a non significant test result is obtained.

We found that boys had higher mean scores than girls (mean ± SE, 35.3 ± 0.49 vs. 33.15 ± 0.47, n1 = 105, n2 = 109), number of minutes positively correlated with mean score of the questionnaire ($r = 0.21$) and mean scores differed between schools (Fig. 1). All these differences were significant at least at 0.05 levels. Tukey HSD post-hoc test revealed significant differences between School 2 and 3 ($p < 0.01$) and marginal difference was found between School 2 and 4 ($p = 0.06$). If the relative number of students per computer could be major predictor of differences between schools, one would expect that lowest scores (i.e. less positive attitudes) should have occurred in the School 1 (see Table 1 for student/computer values). However, as shown in Figure 1, the relative number of students per computer seems to be not the best predictor of differences between students' attitudes. We failed to find effects of age, owning home PC and student's professional orientation on students' behavioural attitudes toward ICT.

A majority of students agreed that work on a PC makes activities more effective (Items 1 (60%), 2 (70%), 34 (53%), and work with a PC makes their work more creative or interesting (Items 14 and 35 with 64 and 73 per cent agreement). In contrast, about 50 per cent of students need help when problem with their PC emerges (Items 21 and 26) and little more (67 per cent) showed that they are really good when using PC (Item 33). About 77 per cent of students see benefits when using e-mail and about 65 per cent would like to use computer in biology lessons (Item 25).

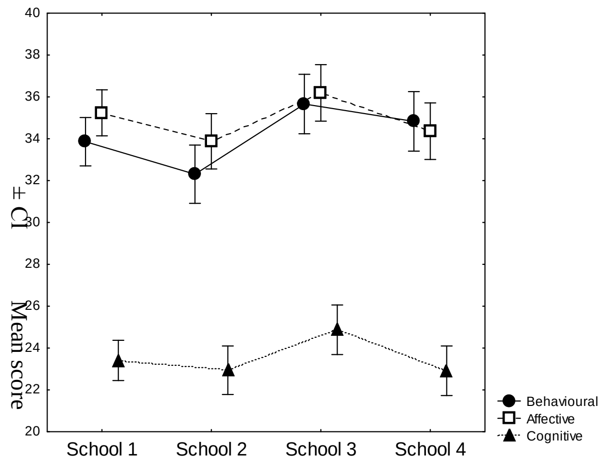

Figure 1. *Distribution of attitudes toward computer use in four different schools in Slovakia.*

Cognitive dimension

We failed to find any effects of the examined predictors on responses from the cognitive dimension. Only marginal effect of school was found ($p = 0.06$), but it also disappeared after Bonferroni adjustment. Correlation between time spend with a PC remained also non-significant ($r = 0.08$).

About 70 per cent of participants agreed that the use of computer is necessary (Item 16) and the use of e-mail allow us to learn more about different cultures (Item 12). Interestingly, the role of e-mail in elaboration of our own ideas (Item 10) and learning from each other (Item 8) was not clearly supported (about one third of participants agreed and about 40 per cent were unresolved in both cases). The majority of students (more than 70 per cent) agreed that the use of computer increased their knowledge (Item 17) in general; however, only 39 per cent of participants reported that computer help them better understand learning in the school (Item 23). Almost 80 per cent of participants would like to know more about computers (Item 31).

Affective dimension

We used the same procedure as in the previous case. Gender ($p < 0.05$) and time spend with computers showed similar tendency as in the previous case ($r = 0.145$, $p < 0.05$), but after Bonferroni corrections this significance disappeared. Other variables remained non-significant.

More than 60 per cent agreed that they very much like to use computers for communication with other people (Items 5 and 6). About half of participants said that they feel to be a part of society when using the internet (Item 11) and about 80 per cent did not feel isolated from other people when working on a computer (Item 28). About half of participants would like to spend more time with computers (Item 20), 65 percent would like to have computing as a special school subject (Item 30) and 82 per cent are happy when they can use a PC in any school subject (Item 24). About 55 per cent of participants feel good when their work is printed out (Item 3), but less than half (44 per cent) feel to be successful when using computers (Item 13). Only few participants (5 – 7 per cent) reported that they did not enjoy contact with computers (Items 15, 22, 32).

Relationships between dimensions

Total scores from all three dimensions significantly correlated with each other. These similar trends can be found in Fig. 1. All correlations were positive with Pearson's r ranged from 0.523 to 0.72 (all $p < 0.001$).

Activity with the computer use

A total of 206 out of 214 participants responded to open ended questioning related to the type of activity spent with the computer. Because several students provide more than one activity, the sum of activities exceeds 100 %. Thus we compared each activity in respect to gender and age separately.

Pooled data from all schools showed that the most frequent activity was playing computer games (64% responses), then working on the internet (27% responses), writing (26% responses) and others. We found out that boys preferred playing games whereas girls preferred writing (Figure 2). The use of internet was similar between two sexes.

We used Pearson chi-square test to examine whether activities on computers were affected by age. We found no effect of age on playing games ($\chi2 = 8.89$, df = 5, $p = 0.14$), nor writing ($\chi2 = 4.01$, df = 5, $p = 0.54$). However, marginal effect was found in the case of the use of internet ($\chi2 = 10.73$, df = 5, $p = 0.057$). Older students tended to use the internet more frequently in comparison with younger ones. Differences are shown in Fig. 3.

Students' responses toward utilization of computers questionnaire (UCQ)

Factor analysis extracted three factors (PC1 – PC3) from ten UCQ items (Table 3).

This means that the use of PCs in the school was very consistent (PC1), but the use of e-mail and information from the internet at home was quite different than the use of PC for games or MS Word. Analysis of means shown in the Table 3 confirms this finding.

Relative different usage of e-mail and information from the internet at home is probably caused by infrequent internet connectability of home PCs. While the majority of participants (119 of 145) owned a home PC, only 25 students had home internet connections. Thus, access to internet related activities at home could be considered as very limited. Students use computers at least one day per week, but its use is different between home and school. Computers at homes were used mainly for computer games, while prevalent activities in schools were related with searching for information from the internet and using e-mail. Importantly, values for computer use at schools varied from about 1.68 to 2.36 which suggest that students use computers in general about once per month.

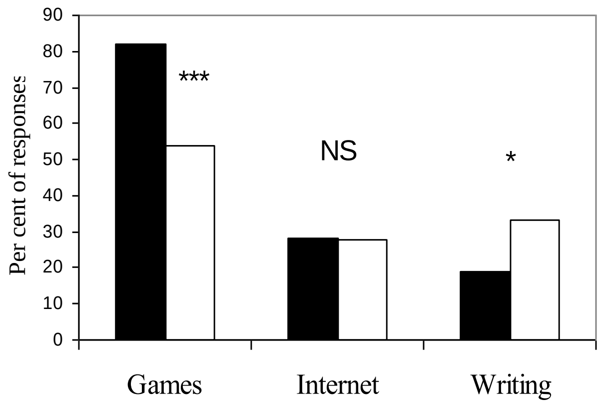

Figure 2. Responses of boys (solid bars) and girls (open bars) on their most frequent activity on computers. Differences were calculated by 2 x 2 chi-square test (* $p < 0.05$, *** $p < 0.001$).

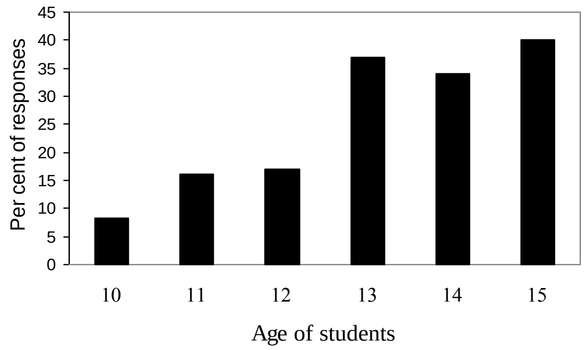

Figure 3. Age-related differences in the use of the internet.

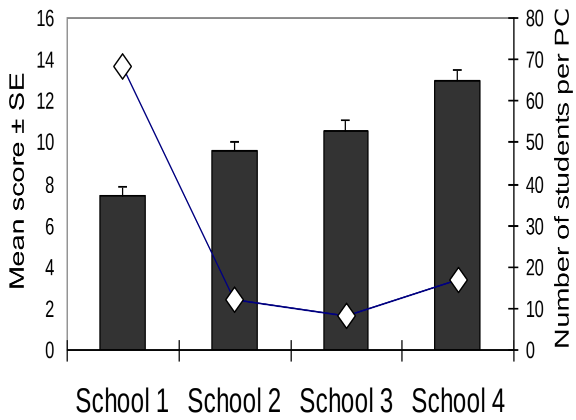

Figure 4. Responses on computer use in schools (black bars) and total number of students per computer in each school (open squares connected with a line).

Table 3. Categorization of items following factor analysis. Values lower than 0.3 not shown.

		PC1	PC2	PC3	Mean score	SE
Home	PC		-0.74		2.89	0.1
	Games		-0.68		2.71	0.1
	MS Word		-0.33		1.94	0.08
	Information			0.68	1.39	0.07
	E-mail			0.79	1.26	0.05
School	PC	-0.68			2.36	0.07
	Games	-0.54			1.79	0.08
	MS Word	-0.77			1.86	0.08
	Information	-0.78			2.24	0.08
	E-mail	-0.56			1.68	0.08
	Explained variance	3.27	2.17	1.47	-	-

Table 4. The variation of computer use in four different schools when controlling the effect of age.

	SS	DF	MS	F	P
Age	112.63	1	112.63	14.38	0.0002
Gender	0.029	1	0.03	0.003	0.95
School	515.19	3	171.73	21.92	0.00001
Gender × School	20.79	3	6.93	0.88	0.45
Error	1065.46	136	7.83	-	-

We did not detect any differences in the mean scores for the use of PC in the school between PC owners and non PC owners or between internet connected or non connected PCs.

Finally, we examined possible differences in computer use in schools. We used ANCOVA, where gender and school were defined as categorical predictors and age was considered as a covariate. Sum of responses from items belonging to PC1 was dependent variable. The results are shown in Table 4. The mean score increased significantly with age ($r = 0.295$, $p < 0.001$). This means that older students used computers in schools more frequently than younger ones. Regardless of the effect of age, strong differences in computer use were found between four schools (Fig. 2). Tukey post-hoc HSD test revealed that all differences (except those between School 2 and 3) were significant at least at 0.05 level. Visual analysis of Figure 4 shows that School 1 which demonstrated the highest the relative number of students per computer, the lowest frequency of computer use in the school. Thus, it seems that the relative number of students per computer significantly limited students' work with computers.

Interestingly, when we used responses of items from PC2 and PC3 (i.e. the use of home PCs) as dependent variables, gender as predictor and age as a covariate, we failed to find the effect of age ($F_{2,141} = 1.5$, $p = 0.2$), but the effect of gender was clearly significant ($F_{2,141} = 6.83$, $p = 0.001$). Boys showed higher scores in both PC2 (mean ± SE, 8.45 ± 0.33 vs. 6.78 ± 0.31) and PC3 (2.86 ± 0.17 vs. 2.48 ± 0.15) dimension.

DISCUSSION

This is the first study which reports differences among attitudes and ICT use after the implementation of ICT in Slovakia. There is great variation in the relative number of students per computer which leads to less frequent work on computers, but students' attitudes toward ICT were not affected by the mentioned variable.

The level of school computerisation between schools in Slovakia widely varies. In most countries, there are about 5 - 20 pupils per one computer, but few European countries show over 40 pupils per one computer. Our results suggest that Slovakia is one of least computerized countries.

Computer facilities are intended mainly for administrative and teaching staff. After that, they are made available to pupils. In countries in which computerisation is less widespread, pupils may generally access computer facilities in special rooms for this purpose away from the classroom, whereas in schools in countries in which computerisation has reached a more advanced stage, the computers may be located both within classrooms and outside them (in a special room offering computer facilities or multimedia library) (Key Data on Information and Communication Technology in Schools in Europe, 2004).

Attitudes

We found out that attitudes toward ICT use among schools were different; this was, however, not caused by the relative ratio student: computer per se. The effect of gender was weak, because we found significant differences only in the behavioural dimension. This is somewhat surprising, because greater differences especially in the affective dimension could be expected (Beckers & Schmidt 2001; King, Bond, & Blandford, 2002; Palaigeorgiou et al., 2005). On the other hand, no relationships between ownership of home computer, age, or students' professional orientation were found. Interestingly, the time spent with computers positively correlated only with the behavioural dimension.

In summation, we failed to find major predictors of students' attitudes toward ICT. The effect of ownership of home computer can be partly camouflaged by the low sample of students without computers. In contrast, very low numbers of students had internet connections at home. These differences with additional effects of school environments did not allow us to examine whether for example children without a home computer and limited access to computer at school have less positive attitudes toward ICT.

Computer related activities at home and at school

Low numbers of home internet connections available to children probably resulted in the shift of internet-related activities from home to school. In contrast, other activities, such as playing computer games were greatly filled at home. In contrast, weak differences were found in the use of MS Word in comparison between home and school activities (see Kent & Facer, 2004). Surprisingly, the use of computers in everyday school activities was low; generally, students used ICT approximately once per week to once per moth. Older students used ICT more frequently than younger ones. Importantly, we found that the effect of school played a very significant role in computer-related activities in schools. Our data suggest that students with great student: computer ratios have limited access to computers and their computer activities between schools strongly differ. This would lead in greater ICT compensations in out of school activities or lower ICT skills, but our data does not allow us to explain these potential effects.

Computer limitations in schools could indirectly explain differences found in the use of home computers. While boys were significantly more active in the use of home PCs, gender differences at school disappeared. In addition, the effect of age was significant only in relation to ICT in schools. Thus, we suggest that boys and girls together spend similar time with ICT at school for example in curriculum use. This is probably more accessible for older children. In this scenario, younger children in general and boys in particular cannot spend enough time with ICT at school, thus, they must compensate their time with ICT at home. Girls that are not as much interested in ICT as boys therefore spend less time with ICT at home.

Acknowledgement

We would like to thank John Young for English corrections of the manuscript.

REFERENCES

Beckers, J., & Schmidt, H. (2001). The structure of computer anxiety: a six-factor model. *Computers in Human Behavior*, 17, 35 - 49.

Brosnan, M. J. (1998). The role of psychological gender in the computer-related attitudes and attainments of primary school children (aged 6-11). *Computers & Education*, 30, 203 - 208.

Bussiére P., & Gluszynski, T. (2004). The impact of computer use on reading achievement of 15-year-olds. *Learning Policy Directorate, Strategic Policy and Planning Branch Human Resources and Skills Development Canada*, 2004, 59.

Graff, M. (2003). Cognitive style and attitudes towards using online learning and assessment methods. *Electronic Journal of e-Learning*, 1, 21 - 28.

Holland, B. S., & Copenhaver, M. (1998). Improved Bonferroni-type multiple testing procedures. *Psychological Bulletin,* 104, 145 - 149.

ICT@Europe.edu: *Information and Communication Technology in European Education Systems,* 2001, 186 pp. (EURYDICE Survey 4).

Jaccard J., & Wan C. K. (1996). *LISREL approaches to interaction effects in multiple regression*. Thousand Oaks, CA: Sage Publications.

Kent N., & Facer A. (2004). Different worlds? A comparison of young people's home and school ICT use. *Journal of Computer Assisted Learning,* 20, 440 - 455.

Key Data on Information and Communication Technology in Schools in Europe – 2004 Edition, EURYDICE, 2004

King, J., Bond, T., & Blandford, S. (2002). An investigation of computer anxiety by gender and grade. *Computers in Human Behavior*, 18, 69 - 84.

Kreisel, K. (2003). Evaluation of a computer-based nutrition education tool. *Public Health Nutrition*, 7, 271 - 277.

Mikropoulos, Katsikis, A., Nikolou, E., & Tsakalis, P. (2003). Virtual environments in biology teaching. *Journal of Biological Education,* 37, 176 - 181.

Neo, M. (2003). Developing a collaborative learning environment using a web-based design. *Journal of Computer Assisted Learning*, 19, 462 - 473.

Ogilvie, R. W., Trusk, T. C., & Blue, A. V. (1999). Students' attitudes towards computer testing in a basic science course. *Medical Education*, 33, 828 - 831.

Palaigeorgiou, G. E., Siozos P. D., Konstantakis N. I., & Tsoukalas I. A. (2005). A computer attitude scale for computer science freshmen and its educational implications. *Journal of Computer Assisted Learning*, 21, 330 - 342.

Romi S., Hansenson G., Hansenson A., & Gan R. (2002). E-learning: A comparison between expected and observed attitudes of normative and dropout adolescents. *Education Media International*, 39, 47 - 54.

Sýkora P., Brestenská B., Kalaš I., Mandíková K., Pišútová K., Baranovič R., & Papp, T. (1999). *Projekt Infovek Slovensko: Návrh realizácie prvej fázy pilotnej etapy* (August 1999 - December 1999). Asociácia Projektu Infovek, Bratislava, 1999.

Sutherland R., Facer K., & Furlong J. (2000). A new environment for education? The computer in the home. *Computers & Education*, Special Edition, 34, 195 - 212.

Wheeler S., Waite S. J., & Bromfield C. (2002). Promoting creative thinking through the use of ICT. *Journal of Computer Assisted Learning*, 18, 367 - 378.

Williams, J. (2003). Computers and project-based learning. www.media-methods.com

◈◇◈