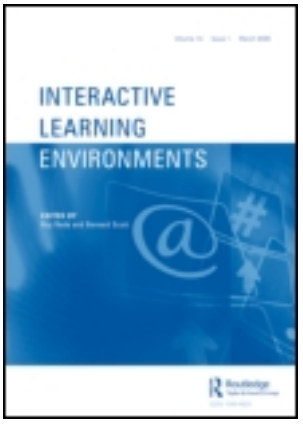

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The pervasive involvement of information and communication technologies and computers in our daily lives influences changes of attitude toward computers. We focused on finding these ecological effects in the differences in computer attitudes as a function of gender and age. A questionnaire with 34 Likert-type items was used in our research. The sample consisted of 659 students from 14 high schools, aged 15–19 years attending the first, the second, the third, and the fourth years of study. The results of the questionnaire were divided into the two dimensions of concrete computer enjoyment and computer anxiety. On the first dimension both younger students and girls have positive attitudes. On the second dimension both younger students and boys have more positive attitudes. Overall, girls have more positive attitudes than boys. This is interesting because in the existing literature there is evidence that boys have more positive attitudes toward computers than girls. Perhaps a change is taking place.

Keywords: computer attitudes; computer anxiety; computer enjoyment; questionnaire; students

1. Introduction

Nowadays, computers and other information technologies have a very important place in the learning and teaching process. Computers are also an integral part of students' everyday life outside of school and within school, they are used in writing homework or essays, within every school subject, not only in informatics; as a survey recently demonstrated at almost every Slovak school (Demkanin, 2008). As a result, Slovak students are revising their opinions and attitudes toward computers and the use of computers in their lessons. The doors of new knowledge are open to students, because computers and information and communication technologies (ICT) allow immediate access to a vast array of information. We can observe things in videos, simulations and graphics, which in years before could not be seen; for example, deoxyribonucleic acid (DNA) analysis, the reproductive cycle, etc. We also can communicate new questions, results, proposals to colleagues or across oceans via electronic mail.

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Initially, computer technology was viewed as a way to improve students' access to instruction and instructors. The vision was that computer hardware and software would make teaching and learning better and more effective (Brewer, 2003). Before this can happen, students, and teachers too, have to see the greater value of using computers in lessons (Dede, 2000). Dørup (2004) finds in his study that students prefer using computers in the teaching process and students have generally had a positive attitude toward distance learning. But these positive attitudes could be changed by many factors, such as classroom organization, resources, environment, teachers, schoolmates, etc. (Kennewell, 2001).

The pervasive influence of computer technology has made significant changes in the concept of school. With the help of computer technology, students are now able to be more proactive in the learning process in order to achieve learning goals better.

Attitudes toward technology use out of the school setting are an important and often overlooked component of successful curriculum integration of technology. Much of the research done on technology integration assumes that when appropriate technological tools are in place in the classroom, students, teachers, and parents will overwhelmingly support the change toward a technologically based curriculum. It is often felt that schools cannot ignore the impact of technology and the changing face of curriculum (Alexiou-Ray, Wilson, Wright, & Peirano, 2003). However, this is not true in some cases, because there are still many obstacles, including students' dislike of educational software. But depending on the character of this educational software, some could be suitable for boys and some for girls (Sheldon, 2004). Educational software packages that promote gender-biased characters and sex-typed behavior are destructive to the educational experience of girls and women not only because they promote socially constructed gender roles that may serve to hold girls and women back in technology-related fields but also because females will likely be less interested than males in technology when they are largely "left out" of the experience (Plumm, 2008).

Bennett (2002) suggests changes in the roles of teachers, students, and computers. In this new perspective, students would interact collaboratively with teachers and technology; computers would deliver and remediate lessons, and the teacher would be a facilitator and a mentor (Bennett, 2002; Dooling, 2000).

Problems with equitable student access to technology, often referred to as "the digital divide or the disparity in access to computers across socioeconomic, regional, or cultural lines" is a growing concern nationwide, as computers gain even more importance in business and education (Shaver, 1999). In addition to computer availability, other issues concerned with equitable student access to computers include: computer adequacy, availability of software, Internet access, and home availability of computers (Shaver, 1999).

There is a need for better understanding of student, school personnel, and parental attitudes concerning computer use in the classroom. Dooling (2000) found that students believed that "the effectiveness of computer technology experiences at school depends on the student's or students' prior knowledge".

Computers are commonly identified with the areas of mathematics and science, but mathematics teachers have been slow to introduce computers into their classroom activities (Norton, McRobbie, & Cooper, 2000; Rosen & Weil, 1995). Teaching practices have been reported as conservative and this general conservatism may in part explain the slow response of many mathematics teachers to the potential of computers in the classroom (Gregg, 1995). Mathematics and science are areas

where for many years there has been a widespread concern about sex-related differences. It is not surprising, therefore, to find similar differences emerging in the area of attitudes to computers. Many research studies and discussions investigated gender differences among students at all grade levels in learning, attitudes and achievement in the areas of mathematics, science, and technology. The research literature on computer education has examined gender differences since the early 1980s (Young, 2000). In the educational research literature, various factors associated with gender differences have been explored in connection to computer technology achievement.

The research on computer attitudes represents an important subject in the understanding of differences in computer performance in the workplace (school) (Van Braak & Goeman, 2003).

With the development of computers in education many different approaches have investigated different factors related to the use of computers. The relationship between attitudes toward computers and computer experiences has been investigated by many authors (Levine & Donitsa-Schmidt, 1997; Potosky & Bobko, 2001; Schumacher & Morahan-Martin, 2001; Smith, Caputi, & Rawstorne, 2000).

Numerous studies pertaining to attitudes toward the computer and their relationships with variables such as age and gender have not yielded clear-cut conclusions. For example, various studies comparing male and female computer attitudes show no significant differences (King, Bond, & Blandford, 2002; Mizrachi & Shoham, 2004; Scott & Rockwell, 1997; Teo, 2006). Some studies have found that surprisingly, males have a greater fear of using computers (Reed, Erwin, & Oughton, 1995; Siann, Macleod, Glissov, & Durndell, 1990). Other studies have had opposite findings (Colley, Gale, & Harris, 1994). For example, Shashaani (1997) found that boys are more interested in working with computers than girls. Boys have better ICT and computer skills, they use computers more in their leisure time, and their attitudes toward computers are more positive than the attitudes of girls. They use computers more for play and recreational purposes, they are more interested in hardware, and they take on more independent challenges in learning about computers and ICT than girls do (Hakkarainen et al., 2000; Papastergiou & Solomonidou, 2005). In the world there is a trend, that technology has a special connection with boys and males. The culture of technological knowledge is a set of socially constituted practices, and these practices have encouraged boys and men, more than girls and women (Clegg, 2001; Facer, Sutherland, Furlong, & Furlong, 2001). It is interesting that the gender differences in computer use and competence have not been found among younger children (Facer et al., 2001).

It is inequitable that these gender differences remain dependent on access and training. Schools can diminish the gender inequality by giving girls access to use technology in combination with learning. When girls have similar access to computers at school as boys do and if they receive computer training, the gender differences in computer use have disappeared (Ilomäki & Rantanen, 2007; Sølvberg, 2002). In general, the gender differences at school were also small in the use of specific applications, and girls especially liked the combination of communicative and creative-writing elements more than boys (Volman, van Eck, Heemskerk, & Kuiper, 2005). Ilomäki and Rantanen (2007) suggest that girls' ICT competence increases with time, and that they may reach a high level of

understanding of and competence in, for example, communication-related applications. However, a high level of technical ICT competence and motivation remains characteristic of boys, similar to the way in which technical competence has been gender-related in the past. However, the situation still remains confusing: for instance, Horne (2007) found no differences between boys and girls on testing students with the use of computers. Interaction between gender and technology is complex, being mediated by a number of factors, such as status and identity (Joiner, Littleton, Chou, Morahan-Martin, 2006).

Some studies have shown that more computer experience and training improve computer attitudes (Gaudron & Vignoli, 2002; Ropp, 1999). A large number of studies have shown that those individuals who have access to computers at home demonstrate more positive attitudes toward computers (Selwyn, 1998; Sexton, King, Aldridge, & Goodstadt-Killoran, 1999; Yaghi, 1997). In addition to that, boys have positive attitudes toward computers in most studies. Younger pupils, boys and girls, have more positive attitudes toward computers than older ones (Comber, Colley, Hargreaves, & Dorn, 1997; Laguna & Babcock, 1997). But there are many studies where it is reported that older students have more positive attitudes to computers than younger ones (Bozionelos, 2001; Dyck & Smither, 1994). Garland and Noyes (2005) investigated attitudes toward computers and books as learning tools. They did not find any statistically significant difference. Litchfield, Oakland, and Anderson (2002) found that it is the amount of time spent using computers that has the greatest impact on computer attitudes.

It is evident that there is much research connected with students' attitudes to computers, but none in Slovakia. We would like to find out the attitudes of Slovak students to computers, and their preferences for using computers in the learning process.

2. Methods

2.1. Purpose of study

Slovakia is a part of the developing countries using computers and ICT in the learning and teaching process. There are a lot of enthusiastic people but also critics of using computers in schools – elementary and high school. In the last few years, there has been a great effort on the part of some institutions and people with the help of government regarding the introduction of ICT into learning process. The creation of more positive students' attitudes toward this equipment is a precondition of success with this process.

Our study aims to answer the following questions:

(1) What are Slovak students' attitudes toward computers and can this be integrated with all the previous studies?
(2) Were there gender effects in enjoyment and anxiety toward using computers?
(3) Were there age effects in enjoyment and anxiety toward using computers?

These hypotheses were evaluated:

(1) Boys have more positive attitudes toward computers than girls.
(2) Older students have more positive attitudes toward computers than younger students.

2.2. Instrument

In our research, which was focused on finding out the students' computer attitudes, we used an anonymous Computer Attitude Questionnaire (CAQ). This questionnaire was used by Steve Kennewell and Alex Morgan, who kindly allowed us to use it (Morgan & Kennewell, 2005). The questionnaire was translated into Slovakian. The questionnaire was divided into two sections. In the first section there was introductory text, following demographic variables; namely, gender, age, and the year of study. The second section consisted of 34 items, focused on students' views about computers. We tried to preserve the structure of the questionnaire, so we did not add additional variables. And we investigated differences in attitudes between gender and classes. Every item in the questionnaire was rated on a Likert 5-point scale (Likert, 1932) using the following descriptions: "strongly agree" (5 points), "slightly agree" (4 points), "neutral" (3 points), "slightly disagree" (2 points), "strongly disagree" (1 point). Sixteen of the 34 questions were constructed negatively and they were inverted for scoring. A factor analysis was used to create two dimensions namely, "computer enjoyment" (16 items) and "computer anxiety" (11 items). Details (items, factor score) about dimensions are given below. We deleted 7 items, whose factor loading was smaller than 0.3 (Anastasi, 1996). The reported internal consistencies for the two dimensions were assessed by computing Cronbach α: 0.84 (Computer Enjoyment) and 0.77 (Computer Anxiety). In the next evaluation we used analysis of variance (ANOVA). We tried to find out whether there are some statistically significant differences as a function of gender and year of study.

2.3. Participants

The sample size consists of 659 students from 14 Slovak high schools. The schools were chosen according to the classic style of teaching in the Slovak curriculum. We chose schools, where, according to the government, computers were being used as a learning and teaching component. The conventional length of study in Slovak high schools is 4 years. We distributed 720 questionnaires with a rate of return of 91.53%. We obtained results from every year of study. We obtained completed questionnaire results from 149 (22.61%) students in the first year of study, from 145 (22.00%) students in the second year of study, 220 (33.38%) students in the third year of study and 145 (22.00%) students in the fourth year of study. The smallest sample size from one school consisted of 38 filled questionnaires and the largest one was 60 filled questionnaires. The age of students was between 14 and 19 years. The average age was 16.88 ($n = 659$; SD = 1.26). In the whole sample there were 393 (59.64%) girls. Respondents filled out the questionnaire during regular lessons. At first the questionnaires were sent to teachers, who distributed the instruments among students. The time for filling out the measurement tool was not longer than 20 min.

3. Results

A principal component factor analysis with Varimax rotation was conducted on responses to the CAQ questions. After a careful examination of the factors table, we excluded from the scale questions with corrected item-total correlations <0.30 (Anastasi, 1996) and questions with high loading on more than one factor.

As we can see in Table 1, we discovered two dimensions. The first, called *computer enjoyment*, consists of 16 items and has a value of Cronbach's α: 0.84 and the second, called *computer anxiety*, consists of 11 items and has a value of Cronbach's α: 0.77. Seven items were deleted.

In the first dimension we found a statistically significant difference between results by gender ($F_{1,\ 653} = 33.80, p < 0.001$). The average value of girls' results was 4.20 and of boys' was 3.95. It seems that girls get greater pleasure from the use of computers for work or in leisure activities. We found a statistical difference in the results among students by year of study. First-year students achieved the highest score in this dimension (Figure 1). Second-year and third-year students achieved

Table 1. Factor analysis of CAQ.

Questionnaire items	Computer enjoyment	Computer anxiety
1. A computer could make learning fun. (P)	*0.54*	0.21
3. I enjoy using computers. (P)	*0.49*	0.26
5. Computers help you learn. (P)	*0.52*	0.22
7. Computers are useful for finding out information. (P)	*0.43*	0.14
9. Computers are boring. (N)	*0.48*	0.26
10. When I leave school I would like to use a computer in my job. (P)	*0.51*	0.24
15. I hate using computers. (N)	*0.49*	0.28
19. Using a word processor makes your work look neat. (P)	*0.34*	0.14
22. I would like to take a computer course. (P)	*0.42*	−0.03
23. Computers aren't as useful as they are made out to be. (N)	*0.41*	0.27
24. Computers should be used in all subjects. (P)	*0.71*	0.07
25. I find watching a computer screen boring. (N)	*0.42*	0.30
28. Every home should have a computer. (P)	*0.55*	0.06
29. I would like to use computers more often in all my lessons. (P)	*0.74*	0.08
31. Everybody will have to use computers in the next century. (P)	*0.42*	0.03
33. A computer is a really useful tool for school work. (P)	*0.60*	0.14
4. It takes too long to do things using computers. (N)	0.20	*0.59*
11. Some of the words used in computing make me nervous. (N)	0.04	*0.58*
12. Computers never do what you expect them to do. (N)	0.18	*0.58*
13. Computers don't let me think for myself. (N)	0.20	*0.32*
16. I feel confident in using a computer. (P)	0.28	*0.52*
17. Sometimes I worry that all my work will disappear off the computer screen. (N)	0.10	*0.52*
18. Computers take up too much time. (N)	0.05	*0.43*
20. Computers make me nervous. (N)	0.24	*0.63*
26. I prefer to work on a computer with a friend. (N)	0.07	*0.35*
27. Computers are too difficult for me to use. (N)	0.23	*0.56*
34. You can do your work much more quickly on a computer. (P)	0.29	*0.43*
Eigen values	*7.73*	*1.89*
Deleted items		
2. I don't like working by myself on the computer.(N)	0.08	0.29
6. I avoid using computers whenever I can. (N)	0.40	0.46
8. Boys are better than girls at using computers. (P)	0.20	−0.04
14. I would like to learn more about computers. (P)	0.21	0.04
21. Once I start on the computer I find it hard to stop. (P)	0.14	−0.42
30. I am worried about making mistakes on the computer. (N)	0.00	0.22
32. Girls are better than boys at using computers. (P)	0.11	−0.08

P, positive item; N, negative item.
Numbers of items are equivalent of CAQ numbers.

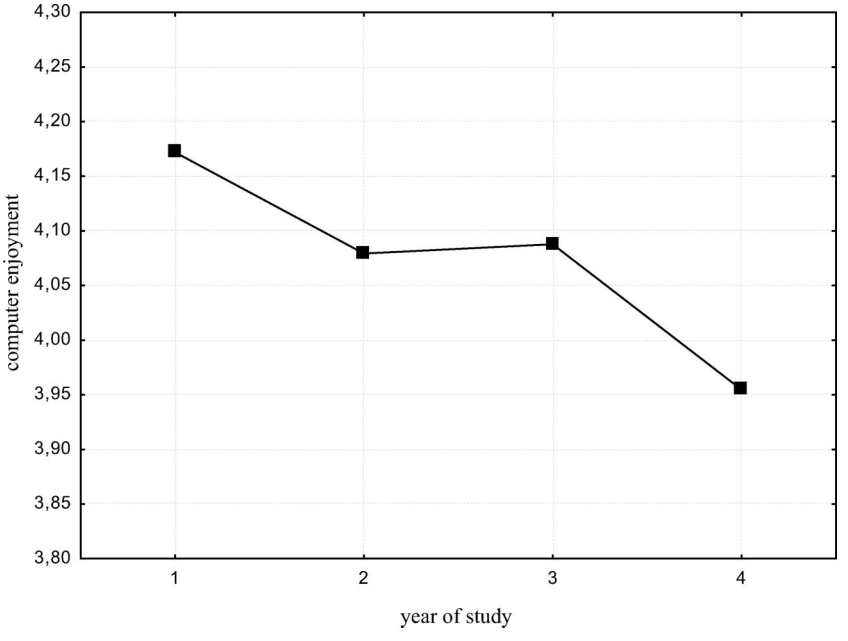

Figure 1. Scores of students in the ''computer enjoyment'' dimension.

similar scores. The lowest score was by students in their fourth year of study. There was a statistically significant difference ($F_{3,\ 650} = 4.05$, $p < 0.01$). Scheffés post-test found there was a statistically significant difference between first- and fourth-year students ($P = 4.15$, $p < 0.01$). More than 3/4 (75%) of all students consider the computer as a tool that could make learning fun. More than 90% of all respondents enjoy using computers. There is no difference whether it is for work or for fun. It is possible that work or fun is treated equally because computers make work more comfortable and using computers during games is very popular among children, teenagers, and adolescents too. Computers help about 75% of respondents in their learning activities. We can observe that computers, at least among students, are substitute libraries and books full of information about concrete problems. These results confirm our finding that almost all students agree with our statement that computers are very useful for finding out information. It is obvious that more than 90% of students do not consider computers boring, because as we can see in previous answers, many students use computers. Approximately 70% of students would like to use computers in their future job. The positive influence of computers provides an explanation for other students' statements, that only $<10\%$ of students hate using computers. In another item, more concrete, whether the work done by using word processors looked neater, about 85% of respondents agreed with this proposition. There are a lot of students who used computers for fun and work, as we can see in previous answers, but there is a group of them who like to improve their abilities and skills using computers. More than 40% of the respondents would like to attend a computer course. About 80% of all students consider computers very useful. Very acceptable is the finding that more than half of respondents would like to use computers in all subjects. In Slovakia, computers are used only in informatics in most schools. Maybe in some schools there are computers used in other subjects, but

that is a minority of schools. Another item confirms this, where 2/3 of students would like to use computers in all lessons, not only in informatics. And more than 85% of students consider computers a very useful tool at school, because computers make students' work easier and add to their motivation for learning by computers. Nearly 3/4 of respondents do not consider a computer screen boring. In Slovakia not all households are equipped with computers. So, nearly 80% of the respondents take for granted that all households should have at least one computer and 2/3 of respondents thought that every human being will own a personal computer or notebook in this century. From these findings it is clear that students perceive computers in a very positive light.

In the second dimension called *computer anxiety* we found a statistically significant difference between results by gender ($F_{1,\ 653} = 45.14$, $p < 0.001$). The average value of girls' results was 3.61 and boys achieved the value of 3.93. It means that girls have a greater anxiety about the use of computers. We found a statistical difference in the results by students' year of study. The first-year students achieved the highest score in this dimension (Figure 2) meaning that these students have the lowest computer anxiety. The lowest score was achieved by students in their third and fourth year of study; they have the highest anxiety related to the use of computers. There was a statistically significant difference ($F_{3,\ 650} = 4.29$, $p < 0.01$). We used Scheffe's post-test and there was a statistically significant difference between first- and fourth-year students ($P = 3.65$, $p < 0.01$) and between first- and third-year students ($P = 3.67$, $p < 0.01$). Nearly 3/4 (75%) of students did not think that work with using computers takes too long. According to this finding we could say that computers speed up work. This fact confirms another item. Similar numbers of students answered that thanks to computers their work is completed quickly. Approximately 20% of respondents indicated that some words describing computers

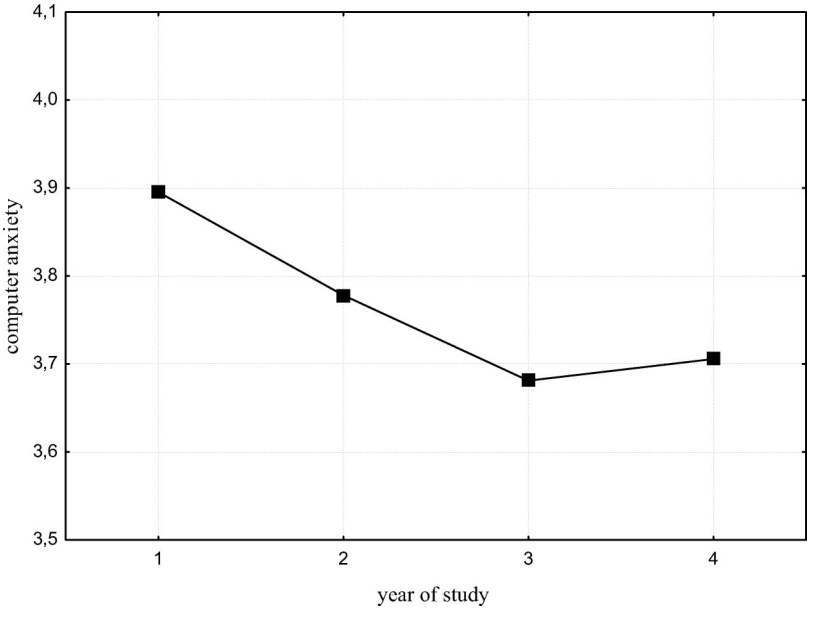

Figure 2. Score of students in the "computer anxiety" dimension.

make them nervous, and almost half of all students thought that computers stifled their creativity and that computers do not let them think for themselves. Nearly all students wrote that computers do what they expect. The majority of students from our sample know how to use computers for their study duties and for work. Only half of these students feel confident in using computers, while we expected a larger number based on the general availability of computers. We expected that there will be more students who would be more confident in using computers. There is a connection with our previous question, where more than 40% of respondents would like to attend some computer courses. There are some applications that are not well understood by the students or their use is not well defined. More than half of students do not fear that all their work might be lost from the computer, but 1/3 have this qualm. This 33% of students do not have sufficient confidence in computers. About 40% of respondents think computers take up too much of their time. These people probably spend a lot of time on computers and they do not keep up with other activities, for example fun, meeting with friends, etc. About 85% of all students do not consider computers a factor in making people nervous or irritable. More than half of respondents work alone on the computer rather than with other schoolmates or friends, but a substantial number of students (25%) prefer to work on computers with somebody else. Maybe these people are not sure of their own individual abilities or perhaps interacting with others makes solitary computer work more enjoyable. Many students (83%) do not consider computers very demanding; only a small group of students consider computers difficult to use.

4. Discussion

This study provided details about computer use and computer attitudes among students in Slovak schools using a sample of 659 high school students. Our findings show a positive evaluation of computers in personal and social life.

Similar positive findings were shown by Garland and Noyes (2005). Steele, Palensky, Lynch, Lacy, and Duffy (2002) found out that students in their sample held moderately positive attitudes about computers in general, and slightly negative attitudes about the role of computers in education. Teo (2006) found a high level of positive computer attitudes. Using computers more frequently and developing a variety of computer-related skills and techniques increases knowledge of the computer. This widens the pragmatic learning environment potential that in turn promotes a positive feeling towards the computer (Houtz & Gupta, 2001).

Finally, we found out that girls held a more positive attitude to computers than boys. On the basis of this result we can reject the first hypothesis. Our finding could be influenced by computer use in work, because girls and women use computers more in work than boys and men. Males typically use computers for playing games. Females typically communicate more with others. So computers connected to the Internet are a good way to communicate with other people, using chat, mail, and other applications. Nowadays, a majority of software is in the native language of users, so girls do not face that additional hurdle. This statement is coming out from the experiences of authors, who are teachers of seminars focused on using computers in the teaching process. Also, we can reject the second hypothesis because younger students have more positive attitudes toward computers than older students. Younger students use computers in the majority of cases in their leisure activities. On the basis of this assertion, younger students do not see disadvantages to using

software and hardware. Older students use computers mostly for working activities and they are nervous when their work with computer applications meets unexpected difficulties. Similar results were shown by Mizrachi and Shoham (2004). Girls in their research have more positive attitudes toward computers than boys. But our finding is in contradiction with other studies. Cooper (2006) wrote that the general public believes that men and boys are more interested in using computers, and are more competent in the use of computers. The negative attitudes of girls adversely impact their computer performance. Knowing that girls have negative attitudes toward computers and are reluctant to use them only reinforces the stereotype that computers are for boys and not for girls. However, we may be seeing a change in these attitudes. Females may have been socialized differently in today's computer generation to become more comfortable with computers, hence removing barriers to opportunities for training. This could be due to the increased use of computers for teaching and learning in schools that might have worked against the cultivation of gender differences as reported in previous research (North & Noyes, 2002). Computer attitudes and computer skills are related to gender in favor of men, that is, that men have better attitudes to computers and more computer skills and experiences than women do (Varank, 2007). As level of education increases, people, regardless of gender, tend to use computers more for a variety of activities, such as writing assignments, searching in databases, communicating with others, and collecting data, which make them more familiar and experienced with computers. Familiarity and experience, which serve as the major predictors of initial user performance, might improve both men's and women's perceptions about their computer skills, and thus, might reduce the perceptional differences between genders (Rozell & Gardner, 1999). If students have limited skills, the absence of successful usage can cause negative attitudes toward computers (Varank, 2007). Increased use of computers at schools, work, or at home for even limited tasks or specific purposes, such as writing assignments, filling out forms, playing games, or chatting can be successfully performed without possessing high-level computer skills. This may considerably improve attitudes toward computers, and, reduce the strength of the relationship between computer skills and computer attitudes.

We found that girls and the youngest students derive greater pleasure from the use of computers. The majority of students have positive attitudes to computers, similar to the statement of Comber et al. (1997), where all students achieved high scores in all items, but in their study males achieved higher scores than females, whereas we found the opposite, and the youngest students had more positive attitudes to computers than the oldest ones as we also found in this study. Many studies show that boys or men have a more positive attitude toward computers and they achieve higher scores in items which are connected with computer enjoyment (Busch, 1995; Colley et al., 1994; Whitely, 1997).

Computer courses skills may be considered part of the computer experience, and computer experience such as prior class or work experience using word processing, data entry, or even computer ownership may reduce anxiety and improve confidence (Orr, Allen, & Poindexter, 2001). We found that girls and the oldest students have more fear of the use of computers. A similar result was shown by Jennings and Onwuegbuzie (2001). It can be caused by using new computer programs, which are stressful for girls and it can cause fear from the using of it. On the other hand, girls can feel greater gratification at the using of programs which are well known for them

in comparison with boys. Females generally have less positive attitudes and greater feelings of anxiety toward technology (Durndell & Haag, 2002; Rees & Noyes, 2007). Shashaani and Khalili (2001) found in their research with undergraduate students that females felt more helpless around computers, stating that computers made them nervous and uncomfortable. Their study revealed that women had lower self-confidence in their ability to use a computer. However, they found no significant gender differences in perceived usefulness of computers.

5. Conclusion

To summarize, girls and younger students appear to take more pleasure from the use of computers and, interestingly, they feel higher anxiety from the use of computers than their older schoolmates. But in Slovakia, as in many countries, there is a need to integrate computers in all of the lessons. An effective use of computers in ICT could have the additional benefit of improving attitudes and computer skills, which in turn could improve the effectiveness of ICT, thus creating a positive feedback spiral. Teachers could assign more homework that is best solved using computers and the Internet and they could also use email to interact more with students.

Other implications for pedagogical practice, which could lead to higher and more successful usage of computers in schools, could be to:

- provide opportunities for students to reflect and discuss their approaches when using technology to facilitate metacognitive and self-monitoring strategies;
- integrate the teaching of learning strategies and content in a range of traditional and technological learning environments;
- make students more satisfied with lessons and courses, when computers and ICT tools are used;
- strengthen practical computer knowledge by training students in handling technical difficulties and
- strengthen the self-confidence of students in the computer domain, by teaching them functional and self-protective attribution patterns (Koch, Müller, & Sieverding 2008).

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