HIGH SCHOOL STUDENTS RELATION TO INFORMATION AND COMMUNICATION TECHNOLOGIES IN THE CONTEXT OF BIOLOGY

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Abstract

The impact of information and communication technologies and computers on our daily lives has been steadily increasing. This fact influences the change of attitudes toward information and communication technologies. In our contribution we focused on finding the differences between genders according to computer attitudes. A questionnaire with 33 Likert type items was used in our research. The sample consists of 518 students from 9 high schools. Data were evaluated with factor analysis, ANOVA, Pearson's chi-square test, Pearson's product moment and for finding out reliability of questionnaire we used Cronbach's alpha. The results of the questionnaire were divided into five dimensions in the concrete 1. The positive influence of ICT; 2. The negative influence of ICT; 3. Advantages of ICT; 4. ICT used in biology lesson; 5. Disadvantages of ICT. Totally, boys have more positive attitudes than girls.

Key words

attitudes, information and communication technologies, biology, students, questionnaire

Introduction

The recent time is influenced by an intensive usage of information and communication technologies. These technologies extend into everyday life of people; they make easier a lot of things. Their influence is obvious in educational process, for example students can pose questions to teacher through web, but they also use internet to interact with one another.

Biology teaching traditionally takes place in one or more of three different environments; the lecture theatre or classroom, the laboratory and the field ('outdoors'). However, with the advent of multimedia technology attempts are being made to translate features of each of these three learning environments to the biology student's computer desktop (Peat, Fernandez 2000; Spicer, Strat-

ford 2001). Biological educators may see the possibilities and opportunities for opening up whole new and exciting ways of learning and teaching using this new technology. Information and computer technologies could be used as a compensation for real dissection. When students were asked, what is more favorable for them, if real dissection or computer-based dissection, majority of students chooses the second alternative (Downie, Meadows 1995; Samsel, Schmidt, Hall, Wood, Schrotf, Schumacker 1994). As we can see, students are influenced by ICT to a large degree and the successful integration of computers in educational environments depends, to a great extent, on students' attitudes towards them. Among investigators who belong to this research area the term computer attitude is used. It is defined as a person's general evaluation or feeling of favor or antipathy toward computer technologies and specific computer-related activities. Computer attitude evaluation usually encompasses statements that examine users' interaction with computer hardware, computer software, other persons relating to computers, and activities that involve computer use. (Smith, Caputi, Rawstorne 2000). Various computer/ICT scales have been developed on the measuring of attitudes toward ICT (Al-Khaldi, Al-Jabri 1998, Loyd, Gressard 1984).

Many explorations are focused on finding differences in attitudes and using ICT between genders. Dorup (2004) found that in his sample, males had more access to computers at home, and held more favorable attitudes towards the use of computers in their medical studies compared to females. A small proportion of students reported that they would prefer not to use computers in their studies. Males were also significantly more inclined to replace traditional teaching activities with better ICT resources. Kaplan (1994) reported that while female users of office personal computers (PCs) believe computers are fun, men buy the machines. Men, on the other hand, are reportedly more interested in mastering computer commands and they want to own computers with voice recognition and features that extend their senses. Women want to be able to use the machines; men want to command the machines. This difference in attitude about computer technology based on gender has been explained by some individuals as an outcome of the socialization process. Society views computers as highly technical and part of a male domain (Campbell & McCabe, 1984). The current study of Palaigeorgiou et al. (2005) also confirmed that both men and women 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. The investigations of attitudes toward using ICT in biology are not too much extended. Haunsel and Hill (1989) found out that pupils using computers had more positive attitude towards biology and natural sciences than pupils who were educated by traditional styles.

The main aim of our study was to find out differences between genders in attitudes toward the use of information and communication technologies in biology. The hypotheses followed from this aim: The attitudes toward use of ICT in biology are more positive in boys than attitudes toward use of ICT in biology in girls.

Methodology

The measurement tool used in our research was the specially constructed scaled questionnaire of Likert type. The questionnaire was anonymous and it was divided into two sections. In the first section there was an introductory text, following demographic variables, namely gender, age and the year of study. The second section consisted of 33 items. The assignment was to express one's own opinion and to use the scale from "I completely agree" to "I completely disagree" with given statements. 17 items were negatively formulated, what was taken into consideration by recoding during the evaluation. The questionnaire was filled in by 518 students of nine Slovak high schools, who were 15 to 19 ($x = 16.97$, $SD = 1.00$) years old. The sample consisted of 37.84 % of boys and 62.16 % of girls from the 1st to the 4th year of study. The respondents filled the questionnaire during a lesson. At first the questionnaires were sent to teachers, who distributed instruments among students. The time of filling the measurement tool was not longer than 20 minutes.

For the statistical evaluation we used Factor analysis with Varimax rotation, which divided items in questionnaire into the five dimensions, namely: 1. The positive influence of ICT; 2. The negative influence of ICT; 3. Advantages of ICT; 4. ICT used in biology lesson; 5. Disadvantages of ICT. We deleted 5 items which factor score was smaller than 0.3 (Anastasi 1996). Next we calculated Cronbach's alpha ($\alpha = 0.82$), which indicates a high value of the questionnaire's reliability. For finding differences between genders ANOVA test, Pearson's chi-square test (χ^2) and Pearson's product moment were used.

The authors of study affer a complete questionnaire on request of interested persons.

Results

During questionnaire evaluation we found out that there was no item where the respondents unanimously chose strictly "yes" or "no" (the average would be 1.0 or 5.0) (table 1). They were close to these extrems in item No 32 "I have got fear, when I used a computer", where the predominate wos the attitude, that the pupils have no fear to use computer and there were no statistic significant differences between the attitudes of boys and girls. The similar stand was taken on the statement No 10 "I consider the work with internet unimportant for teaching process", where many students didn't agree with the statement and consider using internet during teaching process important (4.49).

The items 22 and 29 belonged to the same dimension (Negative influence of ICT) and the students expressed disagreement with uselessness of owning a PC, with making learning harder (or impossible) by using PC (4.35), and with unsuitability of usage of PC during learning because of space requirement (4.26).

Table 1 Values of Likert's scales

item No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	3.74	4.22	3.39	3.49	2.89	3.65	3.78	4.36	3.97	4.49	2.48
item No.	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
	3.24	4.03	3.49	3.49	3.49	3.06	2.23	3.78	3.45	3.96	4.35
item No.	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
	2.83	3.82	3.34	3.58	3.95	2.88	4.26	3.99	3.55	4.69	4.01

By the use of Pearson chi-square test (χ^2) we found out statistically significant difference in results between genders in 14 of 33 questions (table 2).

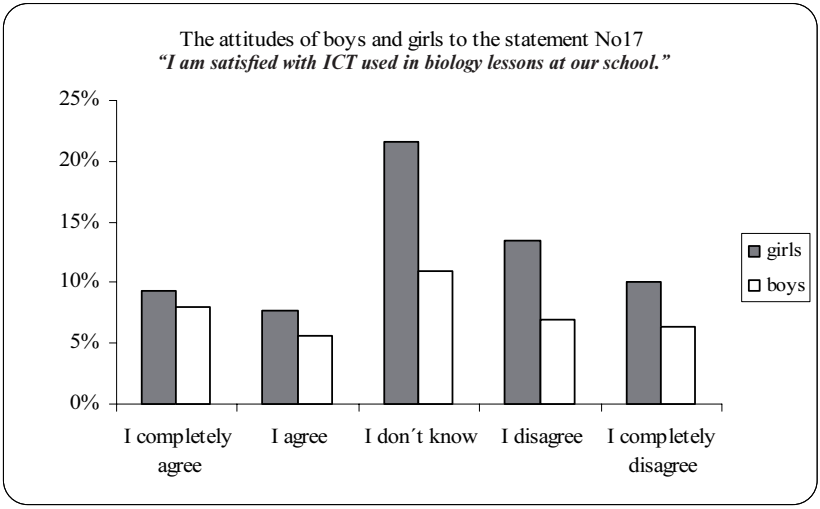
Table 2 Values of Pearson's chi-square test

item No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
χ^2	9.74^{*}	13.34^{**}	5.51	26.78^{***}	8.22	22.04^{***}	8.29	8.78	7.49	3.99	25.71^{***}
item No.	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
χ^2	12.51^{*}	6.14	5.48	12.40^{*}	11.44^{*}	16.97^{**}	7.95	7.31	9.01	7.43	4.28
item No.	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**
χ^2	31.22^{***}	11.64^{*}	34.34^{***}	9.01	17.32^{**}	33.25^{***}	7.74	12.10^{*}	8.93	6.68	7.49

* statistically significant difference $p < 0.05$
** statistically significant difference $p < 0.01$
*** statistically significant difference $p < 0.001$

In the first question girls more disagreed with the statement that ICT are important in the biology teaching. Similar finding was in the second question, where girls did not agree with statement that ICT make biology lessons more interesting. Girls have bigger problems with understanding of biology curriculum when is ICT used during teaching. In the next question we were interested in which equipment is better for students, if overhead projector or computer. There is an interesting finding that girls did not know what is better for them. They more often mark the neutral statement in comparison with other possibilities and in comparison with boys. But in the next, in which we can reject null hypotheses, girls had more positive attitudes toward teachers examining with the ICT assistance in comparison with boys. Girls have bigger problems with concentrating during biology lessons, when the camera is used and they have problems with communication with teacher when ICT are used during biology lesson. Girls were not convinced of sufficient using of ICT in biology lessons. In general boys are more satisfied with ICT used in biology lessons than girls (figure 1).

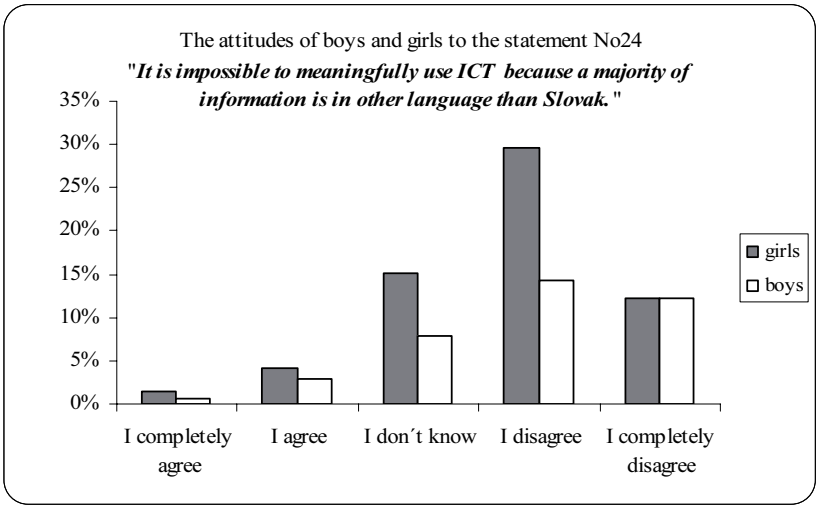
Figure 1



Girls are convinced of negative influence of ICT on eyes. They think that ICT injure eyes, boys are not convinced of this statement. A Similar item, which was connected with injuring of human body by the using of ICT, is concerned

to spine damage. In this statement girls in higher measure marked neutral possibility in comparison with boys. Girls are inclined to believe that ICT could be used in a foreign language as well as in Slovak (figure 2).

Figure 2



Both boys and girls think that their teachers are good in the use if ICT in biology lessons. Teachers need not any training, their abilities are sufficient. In the genders comparison a higher score was achieved by girls in comparison with boys. Girls marked more often the neutral statement in the item "ICT does not save energy" in comparison with boys. And the last question where statistical significant difference was found in results between genders was about ICT and mess. We found out an interesting result that girls perceive ICT and chalk as similar in making a mess. Boys think that computers are less dusty in comparison with using chalk.

We used Pearson correlation (Pearson's product moment) if there is a relationship between dimensions. The values of correlation are shown in table 3. The statistical significant differences between mentioned pupils' attitudes were not found out in comparison of two dimensions called "positive" and "negative" influence of ICT. It is possible to conclude that the items were not defined as ordered pairs which might express the same reality. We focused on different aspects of positive or negative influence of ICT. In comparison of the dimensions

"advantages" and "disadvantages" of ICT a small correlation between the results was found out. This shows the same, that the claims were not duplicated, neither defined in positive nor the same in negative way. Our aim was to think about and to expose different aspects of ICT influence on learning and teaching of high school students. The questionnaires were anonymous and the students expressed their own points of view and attitudes, which were not allowed to be sanctioned. That's why we didn't investigate the students' trustworthiness. The highest value of correlation is between factor 3 (Advantages of ICT) and factor 4 (ICT usage in biology lessons). These two dimensions correlate on the medium level.

Table 3 Values of correlation between dimensions

	factor 2	factor 3	factor 4	factor 5
factor 1	0.01	0.22	0.28	0.21
factor 2		0.11	0.13	0.35
factor 3			0.40	0.30
factor 4				0.31

The most important thing is to find out, if there is a statistical significant difference in the attitudes toward ICT between genders. We found out a statistical significant difference by the use of Analysis of Variance (ANOVA) in the results between genders ($F\ 1, 516) = 4.48$; $p < 0.05$). Girls achieved average score 3.61 ($n = 322$, $SD = 0.60$) and boys achieved average score 3.68 ($n = 196$; $SD = 0.54$). It means that boys have more positive attitudes to ICT in comparison with girls.

Discussion

In our research we tried to investigate differences in gender attitudes toward ICT usage in biology lessons. Our hypothesis followed: The attitudes toward use of ICT in biology are more positive in boys than attitudes toward use of ICT in biology in girls could be accepted. Boys have more positive attitudes toward ICT. This statement is confirmed by the use of statistical procedure. For this finding ANOVA was used. For statistic evaluation we used analysis of variance, factor analysis, Pearson chi-square test (χ^2), and Pearson's correlation and for findings out of reliability we used Cronbach's alpha. We found out five dimensions or categories, namely: 1. The positive influence of ICT; 2. The negative influence of ICT; 3. Advantages of ICT; 4. ICT usage in biology lessons; 5. Disadvantages of ICT. It is a normal thing that public view considers boys and males more technically competent like girls. Cooper has got the similar affirmation

(2006). Cooper (2006) wrote that the general public believes that men and boys are more interested in using computers, and are more competent in the usage of computers. The negative attitudes of girls adversely impact their computer performance. Knowing that girls have negative attitudes towards computers and are reluctant to use them only reinforces the stereotype that computers are for boys and not for girls. 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 at 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, men have better attitudes to computers and more computer skills and experiences than women have (Varank 2007). However, there comes forth a question, how could teachers and educational workers improve students attitudes toward ICT. In our study we present, that in Slovakia are positive attitudes toward ICT, but they could be higher and there are differences between boys and girls. There are some advises: the use of ICT is generally helpful during class suspension, most students preferred a mixed-mode learning environment, i.e. a combination of face-to-face interaction and online activities. Teachers would have to find ways of stimulating a more face-to-face situation without being in the same physical surroundings. One such imperfect solution is the provision of resources such that teachers can do real-time, live, video-broadcasts of their lectures (Bodomo 2003). Teaching and learning of biology could be made more interesting if the lesson presentation using PowerPoint is implemented with other activities to reinforce understanding of the concepts learned. There are many software available which can be provided to the students to allow them to engross the biology concepts, thus making learning more meaningful. The impact of ICT on students' learning outcomes will ultimately depend on the biology teachers. They are the ones who will decide how impart the knowledge the best. The use of ICT will undoubtedly bring new educational experiences for both the learners and the teachers.

So there is an important piece of information that students prefer use of computers. Dorup (2004) found out that between 3 and 7 % of the students (significantly more females than males) who indicated that they would prefer not to have to use computers in their studies.

As an example, roughly 50 % of males versus 25 % of females responded that they would like to replace some traditional teaching with IT-based activities.

In the comparison with this study we found out similar results in our research, our respondents like to use computers and they would like to use ICT more in teaching. So from this results are followed that ICT make the lessons more interesting, easier, more fun for them and their pupils, more diverse, more motivating for the pupils and more enjoyable among others.

Conclusion

Attitudes results toward ICT using in the biology subject among high school students were based on statistical evaluation – factor analysis, analysis of variance, Pearson's product moment, Pearson's chi-square test, and Cronbach's alpha.

Using factor analysis we found out five dimensions/categories. Using Analysis of Variance we found out some statistical significant differences between boys and girls. Boys perceive ICT in biology more positively than girls and younger students reached higher score in attitudes toward ICT.

Students who were the respondents of our investigation showed an interest in using ICT in the biology lessons, it was obvious from their answers. It is important that ICT can enhance students' learning in science/biology from an early age. But there can be a problem: there is much pressure to use ICT in science/biology lessons but teachers are not always clear about the benefits of ICT.

The major reason why to use ICT in lessons is that it allows teachers to do things better that they can be done without it. The use of ICT should allow the teacher or the pupil to achieve something that could not be achieved without it or allow the teacher to teach or the pupil to learn something more effectively (Taylor, Corrigan 2007).

Successful science lessons that employed ICT were associated with the following pedagogical skills:

- The lesson objectives were clearly identified and tasks were clearly defined.
- The time bonus was used creatively and often involved interventions to encourage discussion and investigate approaches.
- ICT activities were explicitly linked to other activities before, during and after the ICT lessons.
- Teachers planned a greater emphasis on interpretation of results and thinking about science.
- Teachers recognised and built upon the technical skills already acquired by students (Rogers, Finlayson 2003).

Knowing when not to use ICT can be just as important as knowing when and how it should be used.

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