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# A CROSS-NATIONAL STUDY OF CZECH AND TURKISH UNIVERSITY STUDENTS' ATTITUDES TOWARDS ICT USED IN SCIENCE SUBJECTS

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**Abstract.** *This paper focuses on differences of attitudes related to information and communication technologies among Czech and Turkish university students. Student attitudes were evaluated summatively and with respect to gender, year, country, and type of residential area (town/village). Student attitudes were measured by a modified version of the Information and Communication Technologies Attitudes Questionnaire (Kubiatko & Haláková, 2009). The sample consisted of a total of 770 unversity students (316 Czech and 454 Turkish). The data analysis included factor analysis, MANCOVA, ANOVA, and t-test. The factor analysis yielded five dimensions: 1) Influence of ICT on teaching process, 2) Influence of ICT on human body and environment, 3) Using of ICT in teaching, 4) School and ICT, 5) ICT as didactic equipment. As a result, students from the Czech Republic, male students, sophomores, and students living in town showed more positive attitudes in comparison to other respective groups.*

**Key words:** *attitudes, information and communication technologies, questionnaire, science teaching, university students.*

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## Introduction

The history of electronic educational materials does not go far back but for several decades now there is an increasing attempt to create more such resources (Arnold, Padilla & Tunhikorn, 2009). The educational value of the information and communications technologies (ICT) was confirmed by a variety of experiments (Fančovičová & Prokop, 2008). When used appropriately, ICT can support students' collaboration and knowledge building. Further, in the context of science education, it offers possibilities for interaction with the nature and tools for real-time data logging (Juuti, Lavonen, Aksela & Meisalo, 2009). The interactive nature of ICT materials is believed to provide the opportunity for students to analyze the process, assimilate and work independently (Kaino, 2008). Many teachers have realized the potential of ICT to increase quality of teaching and learning in recent years. The ICT has pervaded all sectors of education prompting the need to prepare teachers to take advantage of these tools. Although ICT allows students to work more productively than in the past, the teacher's role in classroom, where the ICT are presented, is more demanding than ever (Keengwe, Onchwari & Wachira 2008).

### *General Description of ICT Attitudes*

Pre-service primary science teachers' (PPSTs) attitudes toward ICT are very critical and important in science education since teachers play a key role within the learning environment. If the PPSTs have positive attitudes toward ICT then they can use ICT in their classrooms effectively. ICT offers a challenge to the teaching and

learning of science and to the models of PPSTs might encounter. The teacher generally has a key role to effective application of the use of ICT in science education and the teachers have big potential to transmit attitudes and beliefs to students by using ICT.

Zhao, Tan and Mishra (2001) showed evidence to suggest that the attitudes of teachers toward ICT are directly related to computer use in the classroom. Success of student learning in using ICT depends largely on teachers' attitudes towards ICT (Teo, 2006). If teachers show positive attitudes towards ICT then they can easily provide useful insights about acceptance and usage of ICT in teaching for students. Many researchers emphasized the dimensions of attitudes towards ICT. Some examples are perceived usefulness of ICT and confidence about using ICT (Rovai & Childress, 2002; Cure & Ozdener, 2007), training (Tsitouridou & Vryzas, 2003), gender (Sadık, 2006), anxiety and liking/disliking (Yıldırım, 2000).

There is indication that many teachers believe that the level of computer experience has a positive impact on attitudes towards ICT (Kumar & Kumar, 2003). Yuen and Ma (2002) found that affective attitudes, general usefulness, behavioral control, and pedagogical employment are important factors in determining the use of ICT. Furthermore, in a study with 184 pre-service teachers, it was reported that a significant relationship existed between attitudes towards ICT and its use in educational system (Jackson, Ervin, Gardner & Schmitt, 2001). Sorgo, Verckovnik & Kocijancic (2010) observed high correlation between frequency of using a computer application for school work, perceived importance, and teachers' proficiency in use of application among Slovenian Biology teachers. The teacher's attained competence and confidence level in using ICT are important factors in students' learning. Thus, an understanding of how ICT supports and enhances learning tasks is vital issue to be determined (Baggott La Velle, McFarlane & Brawn 2003).

Integration of ICT into science and technology curricula and classroom practices can be achieved by science teachers showing positive attitudes toward ICT. These positive attitudes toward ICT can be more easily gained in pre-service teacher education by courses such as Computer, Computer Supported Learning, Information and Communication Technologies, Teaching Methods, and Design of Instructional Materials for Teaching, etc. It is important to provide prospective teachers and in-service teachers with courses and trainings, because lack of time is one of the main reasons stated by teachers for not employing ICT in teaching. Planning, practicing, and trying to integrate ICT into lessons are all time consuming. But with proper training teachers can do it with more confidence and in less time. On the other hand, a lack of ICT pedagogical training at teacher training colleges constitutes a barrier for using ICT in the classrooms; and, although individual ICT skills might be high for personal use, the transfer of these skills to the classroom environment may become problematic (Cuckle & Clarke, 2002). Integration of ICT into the teaching process can also be impeded by other barriers like lack of equipment, lack of access to the right types of technology in appropriate location, cost of technology, and poor administrative support. All these aspects can create negative attitudes towards ICT.

ICT has a transformative potential role for science teaching. The use of ICT changes the direction of scientific skills and thinking. ICT in science education helps to develop analytical skills (McFarlane & Friedler, 1998; Rogers & Wild, 1996). The interactive use of ICT provides to support and develop students' scientific reasoning and analytic skills. Some studies show, the positive influence of using ICT during teaching process on better understanding of targeted topics and concepts. For example, Stern, Barnea & Shauli (2008) describe students who were provided with molecular software simulation demonstrated a significantly better understanding of the particulate model of matter than students who were not provided with this simulation. In another study it was found that utilizing computer-assisted materials have a potential to increase students' achievement, foster conceptual change, and improve students' attitudes towards biology, if it is designed according to students' learning needs (Kara & Yesilyurt, 2008). Also, Yang & Heh (2007) used an Internet Virtual Physics Laboratory (IVPL) and found out a positive and significant effect on students' physics achievement.

Pre-service teachers can arrange their environment and adjust their instructional strategies by using ICT in science education (Zhang & Espinosa, 1997). For example Fisher, (2000) stated that PPSTs' positive attitudes toward ICT will provide teachers to face the challenges in the information age. The successful use of ICT can stimulate change in pedagogical practice. Evidence from research carried out by Underwood (1988) suggests that teachers move to a more managerial and facilitating role when using ICT,



and away from being the information provider on centre stage. ICT promises to provide a more effective method of developing both substantive and syntactic scientific understanding. Digitally presented data sets offer an alternative way to achieve learning objectives, as can simulations that generate data sets or model specific processes or phenomena (Baggott La Velle, Watson, Nichol, 2001).

*Influence of Different Variables toward ICT Attitudes*

Many explorations are focused on finding gender differences in attitudes and using ICTs. Dorup (2004) found that males had more access to computers at home, and held more favorable attitudes toward the use of computers in their medical studies as 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 ICT resources. A more recent 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. Research on gender differences in ICT has shown that in most countries girls and women are often behind in ICT usage and ICT knowledge and skills. In most countries, the participation of females in ICT professional careers and pathways is low and unfortunately continues to depreciate. Finally, a lot of research studies have shown that females and males differ in their preferences for specific computer activities.

In the literature there is a controversy among studies on attitudes towards ICT with respect to students' age. Although it is reported that younger pupils have more positive attitudes toward computers than the older (Comber, Colley, Hargreaves & Dorn 1997; Laguna & Babcock 1997), among others, a more recent study reported the opposite (Bozionelos 2001). On the other hand Spernjak & Sorgo (2009) did not find differences based on age among lower secondary school students aged between 10 and 14 when performed three laboratory exercises (Activity of yeast, Gas exchange and breathing, heart rate) as classic, computer-supported and virtual laboratory exercises. Pupils chose computer-supported laboratory as the most popular method of laboratory work. Classically performed laboratory work followed, while computer simulation was the least popular approach toward laboratory exercises.On the other hand, there is no cross-national study. In this study a comparison of attitudes between prospective teachers in the Czech Republic and Turkey is reported.

*Research toward ICT Attitudes in Turkey and Czech Republic*

A lot of research studies have been conducted about ICT in Turkey. These studies were mainly in the following categories: in-service teachers' level of employing ICT (Usluel, Mumcu & Demiraslan, 2007; Cure & Ozdener, 2008); use of ICT in teacher education (Altun, 2007; Goktas, Yildirim & Yildirim, 2008); pre-service teachers' level of using ICT (Altun, Alev & Yigit, 2009;) and pre-service teachers' attitudes toward ICT (Ozgen & Obay, 2008).

Between 2000 and 2007 most of the studies related to ICT in Turkey were about computer assisted teaching, alternative learning and teaching approaches, web-based learning, problems in using educational Technologies, internet-based learning and distance education (Bingimlas, 2009; Çepni, Taş & Köse, 2006; Bahar, Aydın & Karakırık, 2009; Cepni, 2009; Camnalbur & Erdogan, 2008; Erdogan, 2009; Simsek, 2008). Altun, Alev & Yigit (2009) found that pre-service science teachers had also positive views about ICT.

On the other hand, the research activities on the issue in the Czech Republic have not been as intense as in Turkey. Czech researchers in this field of study published in local journals, available only for the native, in this case Czech, readers.

*Purpose of this Study*

The purpose of this study was to investigate university students' attitudes towards ICT. For that

purpose samples were chosen from two different countries, namely Turkey and the Czech Republic. There are major differences between these two countries: a big difference in populations (Turkey's population is 6 times greater than the population of Czech Republic); geographic location and area, means of access to technologies, income per capita, and culture. Educational initiatives for implementation of ICT in education are also somewhat different. Therefore, it may be hypothesized that all these differences can lead to different student attitudes towards ICT. This article explores the following research question:

1. Are there any differences in attitudes toward ICT with respect on gender, residence and grade of students from both countries?
2. Is there any difference in attitudes toward ICT between students from Czech Republic and Turkey with the respect on gender, residence and grade of students?

**Methodology of Research**

*Sample*

The study was conducted at the end of spring semester 2009. A total of 454 Turkish and 316 Czech students attending two different universities participated in the study. The participating students were majoring in teaching middle school / high school science (biology, geography, chemistry). The ages of the participants were between 17 and 30 ($\overline{x}$ = 20.44; SD = 1.45). The sample size of the Czech Republic sample was created by 100 males and 216 females, 62 students from village, 90 students from town and 164 students from city, 128 freshmen, 105 sophomores and 83 third year students. The sample size of Turkey was created by 296 males and 158 females, 60 students from village, 125 students from town and 269 students from city. There were 72 freshmen, 234 sophomores and the rest (147) created third year students. In Turkey 276 students were owners of computers and 178 were not owners of computers. All Czech respondents were in the time of research owners of computers.

*Construction of the ICT Attitudes Questionnaire (ICTAQ)*

Students' attitudes toward ICT in science subjects were measured by 5 scale Likert type items. We used a modified version of the ICT Attitude Questionnaire (Kubiatko & Haláková, 2009). This questionnaire was originally created to probe student attitudes towards ICT specifically in biology. Due to the nature of the current study the word "biology" was replaced with "science subject" or "science subjects" in the entire questionnaire.

The questionnaire items are related to common ICT activities and ICT usage. There were items related to influence of ICT on the process of teaching ("ICT make lessons more interesting"); items focusing on the influence of ICT on health and human body ("using ICT related equipment may cause spine injuries"). Other group of items focused on using ICT in teaching ("I reach more information from internet than from textbooks"). A couple of items were related to ICT as didactic equipment ("I think that I achieve worse evaluation by the written examining with the ICT assistance"). We were interested in, if students are satisfied with ICT and their employment in lessons ("I am not satisfied with employment of ICT in science lessons at our school").

The original form of the questionnaire was developed in English and later translated into Slovak and Turkish by the authors with expert assistance in translation. The order of items was presented randomly; items were not grouped together with other items having a similar character. The questionnaire consists of 33 items that were rated by the participants from 1 (strongly disagree) to 5 (strongly agree). There were items worded both positively (e.g., "I do my homework quicker, when I use ICT") and negatively (e.g., "I have got a fear, when I used a computer") (Oppenheim, 1999). Negative items were reversed in scoring. The total score of individual participants provides a composite index of attitudes towards ICT usage in science subjects. A low score reflects a relatively negative attitude and a high score reflects a relatively positive attitude towards ICT. The validity of the questionnaire was established through review by two experts in the field of using ICT/computers in education. Reviewers were asked whether the items were relevant to the aim of the study. Revisions were based on their comments and suggestions.

The first part of the questionnaire contained demographic questions: gender, age, year of study, owning of computer and type of residential area (i.e., village, town, or city). The main difference between town and city is that cities are designated by a population greater than 100.000. All students from Czech Republic are owners of computer, but in the Turkey is not that. For that reason we analyzed attitudes to ICT with respect to owning of computer overall, we did not compare Czech Republic and Turkey. Age was as covariate.

*Procedure*

Questionnaires were administered in two different universities. One university was from Turkey and one from the Czech Republic. Students in this study participated by knowing that participation was anonymous and that it would not affect their course grades. They were informed that the aim was just a research attempt to examine student attitudes towards using ICT in science subjects. The questionnaire was randomly administrated. No time limit was given during completion of the questionnaire, but the longest time of filling was about 15 minutes. The researchers or the instructors administered the questionnaires.

*Statistical Procedure*

The data were analyzed statistically by conducting a factor analysis with Varimax rotation and five factors with Eigen values greater than 1.00 were derived. The five factors (dimensions) were labeled as: 1. Influence of ICT on teaching process (7 items), 2. Influence of ICT on human body and environment (4 items), 3. Using of ICT during teaching process (7 items), 4 School and ICT (3 items), 5. ICT as didactic equipment (6 items). These five factors explained 39.23 % of total variance. Most of this variance was explained by the factor/dimension 1 and 2 (14.80 % and 9.05 %).

Items (6) with factor score more than 0.30 loaded in more than one factor and factors with factor score less than 0.30 were excluded from the next analyses (Anastasi, 1990). Next reliability of the questionnaire was measured. The Cronbach's alpha for the whole instrument was 0.72, which indicates high reliability of the questionnaire (Nunnaly, 1978). The values of alpha coefficient for the scale ranged from 0.58 to 0.89 indicate an acceptable reliability (Nunnaly, 1978).

Multivariate analysis of covariance (MANCOVA) with age as covariate, dimensions as dependent variables and demographic variables (gender, residence, grade and owning of computers) as independent variables were also conducted. For obtaining statistically significant differences in results between variables and between countries t-test and ANOVA were performed. Results showed statistically significant differences on the levels: $p<0.05$; $p<0.01$ and $p<0.001$.

**Results of Research**

A factor analysis with Varimax rotation was performedon the data. After a careful examination of the table of factors, items with factor score greater than 0.30 loaded in more than one factor were excluded from further analysis. Questions with factor scores less than 0.30 were also eliminated (Anastasi, 1990).

It was also examined whether statistically significant differences existed in the results between variables of gender, type of residential area lived, year of study, and owning a computer. In performing a MANCOVA age was taken as a covariate. First, we analyzed the whole data coming from both countries and afterwards data for each country were analyzed separately. The influence of age on the results was not showed (Table 2). In the all variables was found out statistically significant difference in results (table 2). Males achieved an average score of 3.56 (SD=0.36), whereas the average score for females was 3.55 (SD=0.39). On the basis of the results males showed more positive attitudes towards computers in comparison to females. Sophomore students achieved the highest average score ( $\bar{x}$ = 3.57; SD = 0.36) and freshmen students achieved the lowest average score ( $\bar{x}$ = 3.53; SD = 0.32) and junior students achieved an average score 3.56 (SD=0.37). Students living in towns had a more positive attitude than

students living in villages or cities (their average score was 3.57 and SD = 0.39). Students living in cities achieved an average score 3.55 (SD=0.35). And students living in villages have got the lowest average score ( $\bar{x}$ = 3.47; SD = 0.40). Students, who are computer owners achieved higher score ( $\bar{x}$ = 3.55; SD = 0.38) in comparison to students who did not own computers ( $\bar{x}$ = 3.54; SD = 0.35).

**Table 1. Values of factor score in ICTAQ.**

| | Influence of ICT on teaching process | Influence of ICT on human body and environment | Using of ICT during teaching process | School and ICT | ICT as a didactic equipment |
|---|---|---|---|---|---|
| **Influence of ICT on teaching process** | | | | | |
| 1. ICT are important in teaching science subjects. | **0.72** | -0.02 | 0.07 | 0.03 | 0.03 |
| 2. ICT make lessons more interesting. | **0.68** | 0.06 | 0.10 | 0.03 | 0.12 |
| 3. Using ICT cause a higher interest about science subjects. | **0.81** | 0.03 | -0.12 | -0.15 | 0.02 |
| 4. I understand scientific concepts better, when ICT are used. | **0.76** | -0.04 | 0.05 | 0.03 | 0.14 |
| 5. I have got ideas, when the ICT are used. | **0.76** | 0.04 | -0.07 | -0.10 | -0.11 |
| 13. We obtain new information by the using the internet, because some information in the textbooks have become outdated. | **0.41** | -0.21 | 0.25 | -0.13 | 0.02 |
| 20. I do my homework quicker, when I use ICT. | **0.47** | 0.04 | 0.21 | -0.14 | 0.16 |
| **Influence of ICT on human body and environment** | | | | | |
| 7. ICT cause exhaustingly to me. | 0.29 | **0.38** | 0.08 | -0.16 | 0.28 |
| 23. Using computers is harmful for eyes. | -0.12 | **0.64** | 0.11 | 0.03 | 0.16 |
| 25. Using ICT is harmful for spines. | -0.04 | **0.72** | 0.13 | 0.03 | 0.07 |
| 28. ICT does not save energy. | 0.24 | **0.52** | -0.05 | 0.06 | 0.05 |
| **Using of ICT during teaching process** | | | | | |
| 14. I had an opportunity to cooperate with other schools by using ICT. | 0.29 | -0.23 | **0.48** | -0.02 | -0.17 |
| 21. I use ICT for paper presentation. | 0.13 | -0.19 | **0.64** | 0.02 | -0.15 |
| 22. The ownership of PC is useless, because PC's make learning impossible. | 0.02 | 0.10 | **0.61** | -0.05 | 0.18 |
| 24. It is impossible to meaningfully use ICT, because a majority of information is in languages other than Czech/Turkish. | -0.16 | 0.18 | **0.57** | 0.24 | 0.28 |
| 29. Computer is not a suitable tool for teaching, because it needs a lot of space. | 0.05 | 0.15 | **0.52** | -0.06 | 0.24 |
| 32. I have got a fear, when I used a computer. | -0.07 | 0.01 | **0.53** | -0.06 | 0.08 |
| 33. I obtain more information from internet than textbooks. | 0.12 | -0.00 | **0.35** | -0.35 | 0.15 |

| | | | | | |
|---|---|---|---|---|---|
| **School and ICT** | | | | | |
| 17. I am not satisfied with using ICT in science lessons at our school. | 0.03 | 0.08 | 0.24 | **0.43** | 0.20 |
| 18. The ICT equipments in our school are very poor. | 0.04 | -0.13 | 0.084 | **0.71** | 0.17 |
| 27. Teachers should receive more training on using of ICT for teaching. | -0.29 | 0.01 | -0.21 | **0.43** | 0.20 |
| **ICT as a didactic equipment** | | | | | |
| 8. I am not able to concentrate on teaching, when the computer is turned on. | -0.06 | 0.18 | 0.23 | -0.04 | **0.45** |
| 9. The work with educational disc make better a cognitive process. | 0.19 | -0.13 | 0.12 | -0.25 | **0.47** |
| 10. I think that using the internet is not important for teaching. | -0.03 | -0.30 | 0.19 | 0.26 | **0.37** |
| 12. I think that I achieve worse evaluation by the written examining with the ICT assistance. | 0.08 | 0.25 | 0.22 | 0.05 | **0.34** |
| 15. I am not able to concentrate on teaching, when a camera is used during teaching. | -0.01 | 0.12 | -0.05 | 0.08 | **0.62** |
| 16. My communication with the teacher becomes worse, when ICT are used during teaching. | 0.14 | 0.25 | 0.14 | 0.06 | **0.48** |
| **Eigenvalues** | **4.88** | **2.99** | **2.16** | **1.63** | **1.29** |

**Table 2. Results of multivariate analysis of covariance (MANCOVA).**

| | Wilk's λ | F | p |
|---|---|---|---|
| Age | 0.98 | 1.91 | 0.90 |
| Gender | 0.95 | **7.40** | < 0.001 |
| Grade | 0.94 | **4.19** | < 0.001 |
| Residence | 0.96 | **2.89** | < 0.01 |
| **Owning of computer** | **0.93** | **11.46** | **< 0.001** |

The data were further analyzed to see if there existed a statistically significant difference between factors/dimension. Age was used as covariate by all variables. Gender was found to create a statistically significant difference in the dimension "Influence of ICT on teaching process" ($F = 14.57$; $p < 0.001$), in this dimension was influence of age statistically significant ($F = 5.73$; $p < 0.05$). In this dimension males achieved higher scores than females. A statistically significant difference was found in the forth dimension labeled "School an ICT" ($F = 12.94$; $p < 0.001$), where females achieved a higher mean score than males. When compared founded results among grade, age influenced results in dimension 4 ($F = 4.87$; $p < 0.05$). Statistically significant differences were found in dimensions 1 and 4, where the sophomores achieved the highest average score and in dimension 2, and the freshmen achieved the highest average score. On the variable "type of residential area" results were influenced by age only in the first dimension ($F = 4.76$; $p < 0.05$). A statistically significant difference between results was found in dimensions 3, 4,

and 5. In dimension 3 and 4 the highest average scores achieved by students from village and in the last dimension (ICT as didactic equipment) it was the students from town. It was seen that age did not influence results on the variable "owning a computer". A statistically significant difference in results was found, just like in previous variable, in all dimensions except dimension 2. Students, who do not own a computer, achieved higher scores in the first dimension and in other dimensions computer owners achieved higher average scores.

**Table 3. Results of multivariate analysis of covariance (MANCOVA) in dimensions. Numbers are the F values.**

| | Age | Gender | Age | Grade | Age | Residence | Age | Computer |
|---|---|---|---|---|---|---|---|---|
| Dimension 1 | 5.73* | 14.57*** | 0.40 | 11.52*** | 4.76* | 0.56 | 3.16 | 24.48*** |
| Dimension 2 | 0.26 | 3.53 | 0.17 | 3.65* | 0.32 | 1.76 | 0.29 | 1.94 |
| Dimension 3 | 0.15 | 3.79 | 1.52 | 1.11 | 0.14 | 4.97** | 0.59 | 12.84*** |
| Dimension 4 | 0.62 | 12.94*** | 4.87* | 3.10* | 0.61 | 3.62* | 1.46 | 6.88** |
| Dimension 5 | 0.56 | 1.20 | 0.15 | 1.69 | 0.40 | 3.28* | 0.25 | 5.47* |

** p<0.05; ** p<0.01; *** p<0.001*

*A Comparison of Turkey and Czech Republic*

When the results from Turkey and the Czech republic were compared, it was found that there were statistically significant differences in results in two variables, sophomores from the Czech Republic achieved a higher mean score than their counterparts in Turkey ($t = 2.93$; $p < 0.01$), On the other hand Turkish students from town achieved a higher mean score than their Czech counterparts ($t = 2.07$; $p < 0.05$). When other variables were considered it was seen that there was not a statistically significant difference between groups (see Figure 1).

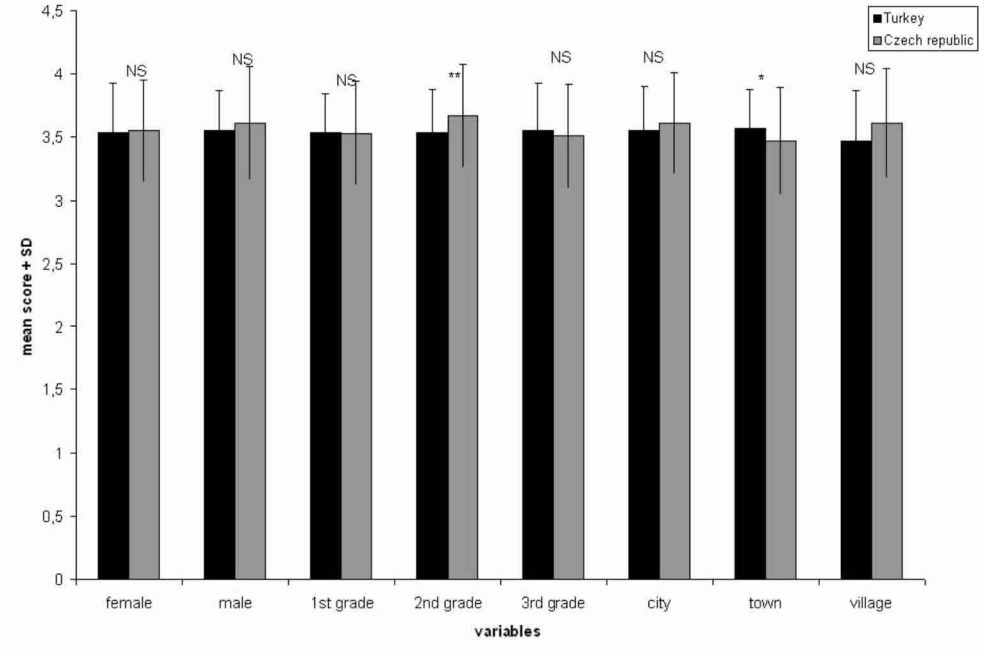


**Figure 1. Differences in attitudes to ICT in variables between Turkey and Czech Republic.**

*NS = non-significant; * p<0.05; ** p<0.01.*

In the next phase of the analysis a comparison between the 5 dimensions was performed. There were statistically significant differences with respect to all dimensions except dimension 2 (Negative influence of ICT on teaching process, see Figure 2). In the first dimension it is seen that Turkish students attained a higher mean score ($t = 12.41$; $p < 0.001$) than Czech students. In other dimensions Czech students showed more positive attitudes: Using ICT during teaching ($t = 7.28$, $p < 0.001$), School and ICT ($t = 9.45$; $p < 0.001$), ICT as didactic equipment ($t = 8.49$; $p < 0.001$).

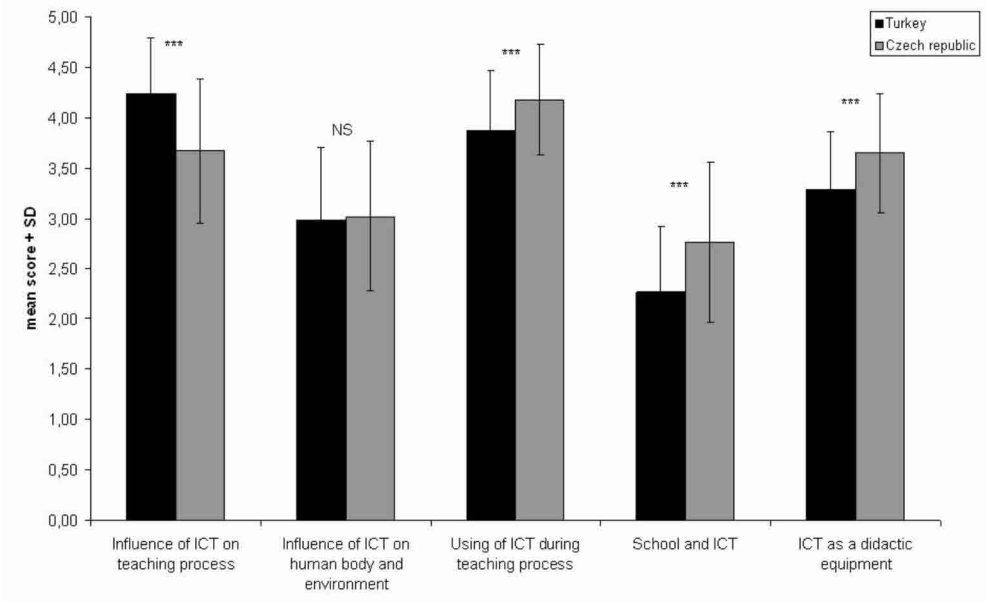


**Figure 2. Differences between attitudes in five dimensions between Turkey and Czech Republic.**

*NS = non-significat, *** p<0.001.*

In the next evaluation we compare individual variables (gender, grade and residence) and we have tried to find out statistically significant differences between Turkey and Czech Republic.

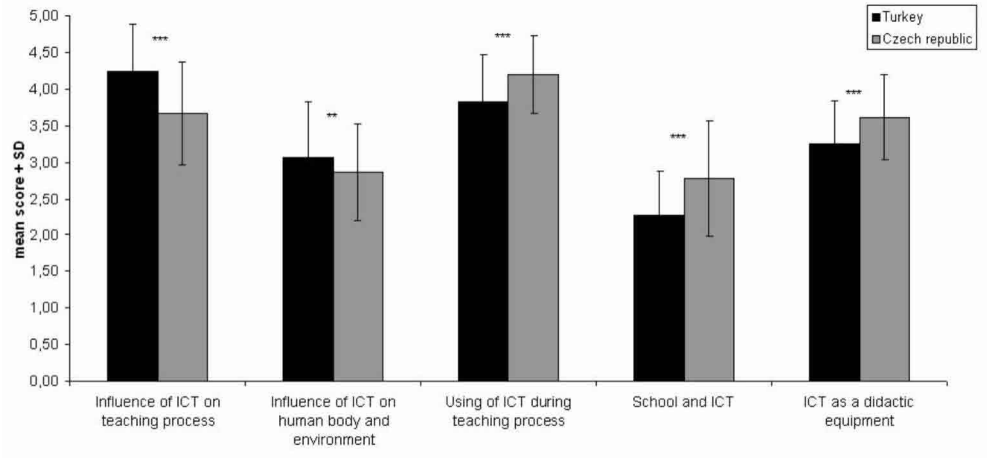


**Figure 3. Differences in attitudes toward ICT in five dimensions among females from Turkey and Czech Republic.**

*** p<0.01; *** p<0.001.*

*Gender*

When we have compared female we found statistically significant differences in results between all dimensions. In first two it was in the account of Turkish students (dimension 1: t=8.13; p<0.001; dimension 2: t=2.86; p<0.01). I other three dimensions girls from Czech Republic achieved statistically significant higher score in comparison with girls from Turkey. All differences are p<0.001 (dimension 3: t=6.02; dimension 4: t=6.56; dimension 5: t=6.00) (Figure 3).

In the comparison of male's results was situation a little bit different. In the first dimension we found out statistically significant difference in results (t=8.48; p<0.001), boys from Turkey achieved higher score in comparison with boys from Czech Republic. In other dimension boys from Czech Republic achieved statistically significant higher score In comparison with boys from Turkey (dimension 2: t=5.09; p<0.001; dimension 3: t=3.78; p<0.001; dimension 4: t=5.69; p<0.001 and dimension 5: t=6.20; p<0.001) (Figure 4).

Gender's results from Czech Republic were influenced by age (Wilk's lambda=0.93; F=4.73; p<0.001) and results from Turkey were not influenced by age as covariate (Wilk's lambda=0.98; F=2.02; p=0.052).

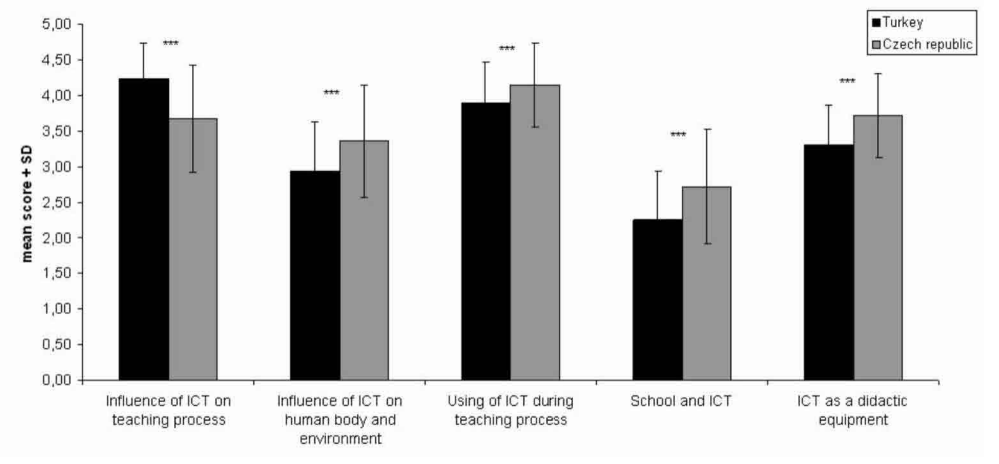


**Figure 4. Differences in attitudes toward ICT in five dimensions among males from Turkey and Czech Republic.**

**** p<0.001.*

*Grade*

In all three grades was not statistically significant difference in dimension "Influence of ICT on human body and environment (dimension 2)" (Table 4). In other dimensions and grades was found out statistically significant difference in results. First grade students from Czech Republic achieved higher score in dimensions 3, 4 and 5 and students from Turkey in others. Second grade students from Czech Republic achieved higher score in comparison with students from Turkey except first dimension (Influence of ICT on teaching process). And third grade students from Czech Republic achieved higher score in all dimensions in comparison with students of same grade from Turkey. Grade's results from Czech Republic was influenced by age (Wilk's lambda=0.95; F=3.32; p<0.01) a results from Turkey was not influenced by age (Wilk's lambda=0.95; F=1.44; p=0.21).

**Table 4. Comparison of results between Turkey and Czech Republic with respect on grade.**

| | 1st grade TR | 1st grade CZ | t | 2nd grade TR | 2nd grade CZ | t | 3rd grade TR | 3rd grade CZ | t |
|---|---|---|---|---|---|---|---|---|---|
| Dimension 1 | 4.23 | 3.56 | 7.02*** | 4.27 | 3.87 | 6.35*** | 4.20 | 3.59 | 6.26*** |
| Dimension 2 | 3.14 | 3.05 | 0.84 | 2.90 | 2.95 | 0.54 | 3.05 | 3.07 | 0.15 |
| Dimension 3 | 3.79 | 4.16 | 4.52*** | 3.89 | 4.27 | 5.57*** | 3.88 | 4.10 | 2.71** |
| Dimension 4 | 2.25 | 2.65 | 3.59*** | 2.28 | 3.02 | 8.98*** | 2.24 | 2.62 | 3.97*** |
| Dimension 5 | 3.24 | 3.68 | 5.40*** | 3.28 | 3.66 | 5.40*** | 3.32 | 3.58 | 3.36*** |

*** p<0.01; *** p<0.001*

*Residence*

There was not found out statistically significant difference in results in dimension 2 among all three types of residence (city, town and village). Czech students from city achieved higher score in dimensions 3, 4 and 5. In other there were students from Turkey. Czech students from town and village achieved higher scores in all dimensions except dimension 1. Residence's results from Czech Republic was influenced by age (Wilk's lambda=0.94; F=3.76; p<0.01) a results from Turkey was not influenced by age (Wilk's lambda=0.98; F=1.81; p=0.11).

**Table 5. Comparison of results between Turkey and Czech Republic with respect on residence.**

| | City TR | City CZ | t | Town TR | Town CZ | t | Village TR | Village CZ | t |
|---|---|---|---|---|---|---|---|---|---|
| Dimension 1 | 4.25 | 3.64 | 9.68*** | 4.27 | 3.63 | 7.84*** | 4.12 | 3.80 | 2.72** |
| Dimension 2 | 3.05 | 3.02 | 0.36 | 2.93 | 3.05 | 1.22 | 2.85 | 2.98 | 0.90 |
| Dimension 3 | 3.83 | 4.14 | 5.17*** | 3.96 | 4.12 | 2.12* | 3.88 | 4.38 | 8.03*** |
| Dimension 4 | 2.26 | 2.73 | 6.60*** | 2.24 | 2.70 | 4.56*** | 2.33 | 2.94 | 4.78*** |
| Dimension 5 | 3.28 | 3.57 | 4.98*** | 3.34 | 3.74 | 5.31*** | 3.22 | 3.74 | 4.56*** |

* p<0.05; ** p<0.01; *** p<0.001*

## Discussion

In this study the aim was to determine prospective science teachers' attitudes towards ICT. The data were collected from two countries, namely the Czech Republic and Turkey. The data were analyzed as a whole and separately for each country. The selected variables were gender, type of residential area lived, and year of study. Age was chosen as the covariate.

The factor analyses yielded five factors with Eigen values greater than 1.00. The five factors (dimension) were constructed as follows: 1. Influence of ICT on teaching process (7 items), 2. Influence of ICT on human body and environment (4 items), 3. Using ICT during teaching (7 items), 4. School and ICT (3 items), 5. ICT as didactic equipment (6 items).

Examining university students' attitudes towards ICT is an important and necessary for determining perceptions and the current status. In this way it can be revealed if the students are taking the full advantages of using ICT in education. It can also be determined if ICT are being used properly in teaching.

The finding of this study reveals that the participant university students had positive attitudes towards ICT used in science teaching. Similar findings were also reported before (Simsek, 2008) revealing that a majority of students accepted the use of ICT for learning and they maintained positive attitudes toward using ICT. A similar finding, this time specifically about utilizing the internet, was reported by

Akpinar & Bayramoglu (2008). Kubiatko & Haláková (2009) also asserted that secondary grammar school students had positive attitudes towards ICT for teaching and learning biology.

When Turkey and the Czech Republic are compared, it is seen that Czech university students have more positive attitudes towards ICT. This situation can be explained by the fact that all Czech students in the sample owned personal computers. When each factor (dimension) is considered it is seen that Turkish students' scores were higher in the first dimension only and Czech students have had higher scores in the remaining four dimensions. The reason could be that their instructors have more intensely and/or skillfully employed ICT in their teaching of science, hence set a good example for their students. It was revealed previously that Czech teachers in general use ICT for only presentation purposes or to offer information in word processors (Paraskeva, Bouta & Papagianni, 2008); and using ICT in the form of educational discs, virtual laboratories, etc. were seen rarely. However, it is known that whenever ICT are employed, they are used in the greater variety by Turkish teachers.

Research studies about ICT are focused mainly on describing differences between variables. Gender is the variable used most frequently. The majority of ICT articles are concerned with gender and attitudes towards ICT. Besides, there are also publications focusing on differences caused by race/ethnicity towards ICT attitudes and a few others discussing socio-economic or class differences (e.g., Heemskerk, Brink, Volman & Dam, 2005).

In this research study it is revealed that males have more positive attitudes towards ICT as compared to females. This finding supports the common view that "males are technically more competent than females," despite all efforts worldwide to train females at least equally competently with males in science and engineering. The similar assertions were also made elsewhere (e.g., Cooper, 2006). Cooper indicated that the public in general believes that males are more interested in using computers, and hence they are more competent in using computers. The negative attitudes of females, in turn, negatively impact their performance in using computers. Knowing that females have negative attitudes towards computers and are reluctant to use them only reinforces the stereotypical view that computers are for males and not for females. Females may have been socialized differently in today's computer generation to have them feel more comfortable with using computers and, hence, removing barriers to opportunities for receiving better training, at least partially. 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 males, that is, males have better attitudes towards computers, attain improved computer skills and experiences as compared to females (Varank, 2007). There are many hypothetical reasons why, males consistently achieve more positive attitudes towards ICT. It could be that when the computer is used for purposes other than studying, male students spend more time working with computers than female students, male students do more word processing, they use e-mail more, and they play games more often (Imhof, Vollmeyer & Beierlein, 2007).

There is no consensus on gender issues within the ICT related literature. For example, several researchers have found that males are generally using computers less than women or females have more negative attitudes towards computer and ICT (Akkoyunlu & Orhan, 2003; Miura, 1987; Murpy, Coover & Owen, 1989; Uzunboylu, 2004; Venkatesh & Davis, 2000). In addition, researchers have determined that gender has strong effect regarding using computer and ICT in attitudes study (Butler, 2000; Dupange & Krendel, 1992).

Kubiatko & Haláková (2009) found out similar results in comparison to the current study. Males have more positive attitudes toward ICT than females. When university students in Turkey and the Czech Republic are compared, this study revealed that the Czech students attained more positive attitudes toward ICT. The views of male and female participants from the Czech Republic were more positive as compared to male and female participants from Turkey. But, a more detailed analysis shows that females from Turkey had more positive views in two of the five dimensions, namely, Influence of ICT on teaching and Influence of ICT on human body and environment. Additionally, males from Turkey have had more positive views in the first dimension only.

In the analysis another variable was students' year of study. In this study participants from both countries were in their first, second, and third years. Sophomore students had the highest positive



views and the freshmen expressed the least favorable views towards ICT. But, it is not known whether age plays a role in this dimension, since age and year of study does not necessarily match. All that can be said is that there is statistically significant differences among students in different years of study. In the literature there are just few empirical studies focusing on age and attitudes towards ICT. In such a study Comber, Colley, Hargreaves & Dorn (1997) reported that the younger students had more positive attitudes towards computers than the older ones. In other studies it findings were contradictory: while in some studies it is reported that there existed a significant correlation between age and attitudes towards ICT (e.g., Handler, 1993; Massoud, 1991), in other studies the findings showed just the opposite (e.g., Blankenship, 1998; Chio, 1992). Sophomore students from the Czech Republic have held more positive views as compared to students from Turkey. The freshmen from both countries expressed almost similar views and the juniors from Turkey expressed more positive views. These differences between students in different years of their studies could be explained by the structure of the subject in each year.

The last variable in this study was the type of residential area lived. The three types were as follows: village, town, and city. There is no other study, to the best of our knowledge that reports on this variable and its relation to attitudes towards ICT. As a result of this study it is seen that students coming from towns have attained more positive attitudes as compared to students coming from villages and cities. Also, students coming from villages have the least favorable views towards ICT. Turkish students coming from towns had more positive views and attitudes as compared to Czech students coming from towns. However, when other two types of residential areas are considered it is seen that Czech students attained more positive views and attitudes. Altough it could be speculated about this finding, it is suggested that it should be investigated in other studies and other countries in depth to understand the reasons behind it.

## Conclusion

Attitudes results toward ICT using in science subject among high school students were based on statistical evaluation. Students, whose were respondents of our investigation showed an interest about using ICT in the science subjects, it was obvious from their answers. It is important awake to, that ICT can enhance students' learning in science from an early age. An effective use of ICT could have the additional benefit of improving attitudes and computers skills, which in turn could improve the effectiveness of ICT, thus creating a positive feedback spiral.

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