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USE of TECHNOLOGY and ATTITUDES towards TECHNOLOGY: An INTERNATIONAL ANALYSIS of the PISA 2003 DATA

TEKNOLOJİ KULLANIMI VE TEKNOLOJİYE KARŞI TUTUM: PISA 2003 VERİSİNİN ULUSLARARASI ANALİZİ

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Öz

Bu çalışmanın amacı; cinsiyet, coğrafik bölge, ve sosyoekonomik durum açısından bilgisayar kullanımı ve bilgisayara karşı tutumları analiz etmektir. Örneklem PISA 2003 çalışmasına katılan 15 yaş grubundaki öğrencilerini kapsamaktadır. Kullanıma hazır bilgisayar bulunması, bilgisayar kullanım tecrübesi, farklı amaçlar için bilgisayar kullanım sıklığı ve bilgisayara karşı tutum değişkenleri arasında anlamlı farklılıklar bulunmuştur. Matematik kaygısı ile ilgili bağlantı tartışılmıştır. Sonuçlar öyle gösteriyor ki; erkekler bilgisayara karşı daha pozitif bir tutum sergilemekte ve daha sık bilgisayar kullanım eğiliminde olmaktadırlar. Sosyoekonomik seviye yükselirken, bilgisayar kullanım deneyimleri ve bilgisayara karşı (pozitif) tutum artmaktadır.

Anahtar Kelimeler: Bilgisayar, Cinsiyet, PISA 2003, Bilgisayara Karşı Tutum

Abstract

The aim of this study is to analyze the use of computers and attitudes towards computers with respect to gender, geographical regions and socioeconomic status. The sample includes 15-year old students, who have participated in the international PISA 2003 study. Significant differences are found in the variables of availability of a computer to use, experience of computer use, frequency of computer use for different purposes, and attitudes towards computers. Connections with mathematics anxiety are also discussed. Results indicate that boys have more positive attitude towards computers and they tend to use computers more frequently. While socioeconomic level increases, experiences in computer use and Internet use and positive attitudes towards computers increase.

Keywords: Computers, Gender, PISA 2003, Attitudes towards Computers

Introduction

Technology has long been bigger part of our daily lives; thus, we encounter its application into educational settings quite often. Various software programs, the Internet, video and DVD

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players, overhead projectors are examples of technology that can be used for educational aims. This study aims to investigate how and to what extend students use computers for a variety of purposes, their attitudes towards computers, and how their attitudes change with respect to socioeconomic status, geographical regions and gender. Connections between mathematics anxiety and use of technology are also discussed. For this purpose, Programme for International Student Assessment (PISA) 2003 online database was used as a secondary source.

PISA, designed by the Organization for Economic Co-Operation and Development (OECD), it is an ongoing survey that collects data every other three years. The aim is to collect information about 15-year old students from countries around the world. Major domain assessed in PISA 2003 was mathematical literacy, while reading literacy, scientific literacy and problem-solving were the minor domains. Assessment was carried out via paper-and-pencil tests. Apart from cognitive tests for each domain, students also filled in questionnaires regarding their attitudes toward learning, family background, socioeconomic status (student questionnaire), familiarity and attitudes towards computers (information communication technology questionnaire) (OECD, 2003).

Literature Review

Use of Computers and its Implication on Mathematics Education

Computers are used for various purposes in educational settings. Tondeur *et al*. (2007) propose three dimensions of computer use in classroom: basic computer skills, computers as an information tool and computers as a learning tool. 'Basic computer skills' refers to the use of computers for teaching of basic technical skills or programs as a separate school subject. 'Computers as an information tool' refers to a general support tool, such as using computers for selecting and retrieving information or for demonstration and 'computers as a learning tool' is about using computers to practice knowledge and skills for example via instructional software. The latter two dimensions are domain specific.

Mathematics is a domain which is abstract in nature, therefore often regarded as one of the hardest subjects to learn and to teach. Appropriate use of computers and other technology can help mathematics become more concrete for the students. Chang *et al* (2006) introduced a computer-assisted problem-solving system, MathCAL, based on four problem-solving stages suggested by Polya (1945). These stages are: i) understanding the problem, ii) making a plan, iii) executing the plan, and iv) reviewing the solution. The effectiveness of the system was tested by an experiment on fifth grade students, who had recently studied four operations. The students were divided into experiment and control groups. Experiment group used computer-assisted system in eight practice sessions while the control group was solving problems on paper. Pretest and posttest results indicate that: i) students in the experiment group showed significantly more improvement than the control group on the post test, ii) there was a significant difference between pretest and posttest results in the experimental group, iii) control group also showed improvement but there was no significant difference between pretest and posttest. MathCAL can help students improve skills such as developing and revising problem-solving strategies; since it provides different assistance at different stages.

Another example of such a program is LaborScale (Adiguzel & Akpinar, 2004) , a computer based interactive learning environment (ILE). The aim is to improve seventh grade student's word problem-solving skills in learning mathematics using multiple representations such as graphics, symbols and audio. LaborScale was designed using an object oriented, direct manipulation approach. It aims assistance in solving mathematical work and pool problems, whose solutions require logic and knowledge of proportions among variables. To test the effectiveness of the system, a pretest-posttest group design experiment was conducted. Participants were given problems with varying difficulty according to their results in the pretest. They interacted only with the computer. After the instruction, a posttest was conducted. Results indicate significant improvement of student performance for each mode (graphic, symbolic, numerical solutions). Improvement in the symbolic mode was bigger than the other modes.

Another example is an interactive CD-ROM, developed using hypermedia tools, presented by Sanchez *et al.*(2002). The aim is to help secondary school students learn diverse problem-solving strategies. Hypermedia is the union of hypertext and multimedia technology and allows differentiation at the individual user level. Hypertext allows information to be arranged in a non-linear way and multimedia is a technology that integrates diverse media. Program offers the student two options: Theoretical Foundations, which can be used to examine the main principles and underlying theory for solving problems and Practical Development, to practice knowledge. Polya's (1945) four stages of problem-solving (comprehension, strategy, solution and confirmation) are also followed in the design of this program.

The computer-assisted systems introduced above are examples of interactive technology that are designed to improve students' mathematical problem-solving abilities. Such technologies are useful because (a) they are based on learning theories, (b) they can adapt to individual differences because they use multiple representations (such as graphics, video, audio etc.), and

(c) interaction with the system allows the student to receive feedback at various stages and revise their plans/strategies.

A meta-analysis on effects of computer technology on mathematics learning, conducted by Li and Ma (2010) report that computers technology was especially effective when used in elementary school level, on special need students and in classes where constructivist method of teaching was dominant. They also state that in studies involving special needs students, teaching activities involved individual or small group practices; technology was used in a way that facilitates building mental models of mathematics and visual, verbal and symbolic forms of presentations were adopted via multimedia.

Mathematics Anxiety

Mathematics anxiety is one of the most commonly investigated affective constructs related with mathematics learning. The general definition can be given as “a discomfort state created when students are required to perform mathematical tasks” (Ma & Xu, 2004). The discomfort states can be “dislike,” “worry,” or “fear.” Typical signs include tension, frustration, distress, helplessness, and mental disorganization. Sources of mathematics anxiety can be situational, dispositional, or environmental. Situational causes are “immediate factors that surround the stimulus” (Baloglu & Kocak, 2006), dispositional causes are personality related factors such as self-esteem, attitude toward mathematics, learning style in mathematics, confidence in mathematics (Baloglu & Kocak, 2006; Ma & Kishor, 1997; Ma & Xu, 2004). Environmental factors are experiences in mathematics classes, and characteristics of teachers (Baloglu & Kocak, 2006).

There are different categorizations of mathematics anxiety. Ho *et al.* (2000) point out that two dimensions of general test anxiety, affective and cognitive, have also been found relevant for math anxiety. Affective dimension refers to the emotional factors such as fear, nervousness, tension, dread, and unpleasant psychological reactions toward testing situations while cognitive dimension refers to the factors concerning worry, such as negative expectations, preoccupation with an anxiety causing situation and self-deprecatory thoughts about that situation. According to another classification, mathematics anxiety has three dimensions: mathematics test anxiety, numerical anxiety and abstraction anxiety. Mathematics test anxiety refers to anticipating, taking and receiving mathematics tests, numerical anxiety refers to worries about number manipulation and abstraction anxiety refers to worries about abstract mathematical content (Ma & Xu, 2004).

Researchers have found that mathematics anxiety is negatively related with mathematics achievement and performance, plans to enroll in mathematics classes, and selection of mathematics related majors in collage (Ashcraft, 2002; Ho et al., 2000; Meece *et al.*, 1990). It has also indirect effects to performance; people with high mathematics anxiety tend to avoid mathematics, they tend to have negative attitudes toward mathematics and they have lower mathematical self-concept than people with low mathematics anxiety (Ashcraft, 2002; Ho et al., 2000).

Technology can be used to control affective factors. Baylor *et al.* (2004) conducted a study, where students worked with one of four animated agents in learning word percentage problems. In order to address the cognitive and emotional dimensions of mathematics anxiety, the agents had the following properties: with or without motivational support and positive or evasive emotional state. Students showed significant increase in self-efficacy except the ones working with the agent that had an evasive affective state without motivational support. Across all conditions, students performed significantly better on the learning measure than before using the program (instructional content was the same across all conditions).

Computer Attitudes

Effective incorporation computer use in educational settings relies on students' acceptance of computers as a learning tool. Therefore examining students' attitudes towards computers have been an important topic in educational research. Anxiety, confidence, liking, importance, motivation and usefulness are usually considered as dimensions of attitudes towards computers (Pamuk & Peker, 2009; Teo, 2007). Relationships between computer attitudes and variables such as gender, age, socioeconomic status, computer ownership-experience have been studied in various researches (Bovée *et al*., 2007; Pamuk & Peker, 2009; Plumm, 2008; Sainz & Lopez-Saez, 2010; Teo, 2007).

Studies examining gender differences regarding computer attitudes have mixed results; while some report that boys have more positive attitude towards computers than girls (e.g. Plum, 2008; Sainz & Saez, 2010), others report that there are no gender differences related to attitudes towards computers (e.g. Teo, 2008; Bovée *et al*., 2007). Pamuk and Peker (2009) report positive attitude favoring boys in the "liking" dimension, however they found no significant gender differences regarding students' anxiety, confidence in using computers and their belief about the usefulness of computers.

Teo (2008) also report students who own computers have significantly more positive attitudes than who don't. Bovée *et al.* (2007) found positive correlation between computer experience and computer attitude. They also concluded that students form upper and middle class schools had a more positive attitude towards computers than students from township schools. According to Sainz and Lopez-Saez (2010), boys spend more time using computers than girls and students from urban areas use computers more frequently than students from rural areas.

In the light of the literature review above, there is evidence that, when carefully planned, use of technology can improve learning. In order to use these materials effectively, the following issues are crucial: i) students should have easy access to a computer, ii) they should be familiar with certain tasks done with computer, and iii) they should be enjoying using these technologies. With these concerns in mind, the following research questions are proposed:

1) How is computer availability at home, school or other places distributed with respect to geographical region and socioeconomic status of the students?
2) How do students' experiences of computer use change with respect to geographical region, socioeconomic status, and gender?
3) Are there significant mean differences between geographical region, socioeconomic status, and gender of the students; regarding the frequency of computer use?
4) Are there significant mean differences in attitudes towards computers with respect to geographical region, socioeconomic status, and gender of the students?
5) Are there any connections between mathematics anxiety and frequency of computer use and attitudes towards computers?

Methodology

Participants

The target population consisted of students aged from 15 years 3 months to 16 years 2 months. Two-stage stratified sampling strategy was used in most of the countries where first stage sampling units consisted of individual schools having 15 year old students. Schools were chosen systematically from a complete list of eligible schools with probabilities that were proportional to a measure of size. Second stage sampling unit consisted of students. 35 students were selected from each school with equal probability. From schools with less than 35 students, all the students participated (OECD, 2005b).

Instruments

The information communication technology (ICT) questionnaire (OECD, 2005a, p.267) was designed to collect information about students' use of, familiarity, and attitudes towards ICT. Development of the ICT questionnaire, together with the student and school questionnaires, was guided by the priorities of PISA Governing Board, and it was carried out in co-operation with OECD, international experts and national centers. An initial piloting of the material was done in a few participating countries. Then two versions of the questionnaire were administered in a field trial in all participating countries. Final selection of the material was made on the basis of the analyses of the field trial data (OECD, 2005b).

Participant responses to the questions IC01, IC03, IC05 and IC07 in the ICT questionnaire were used in this study. IC01 ("Is there a computer available...") has 3 dichotomous items coded as "Yes" (=1) and "No (=2). IC03 ("How long have you been using computers?") is a multiple choice item with codes "less than one year" (=1), "one to three years" (=2), "three to five years" (=3) and "more than five years" (=4). IC05 ("How often do you use…") consists of 12 items having five-point scales with response categories coded as "almost every day" (=1) to "never" (=5); where question IC07 consists of 4 items having four-point scales with response categories coded as "strongly agree" (=1) to "strongly disagree" (= 4). Student questionnaire item ST03Q01 was used to determine the gender of the student, where codes were female (=1), male (=2). For socioeconomic status, ESCS (Economic, Social and Cultural Status) index were used. This index is derived using the following variables: highest level of parental education (PARED), highest parental occupation (HISEI) and number of home possessions (HOMEPOS).

Parental education is classified using six categories, called the ISCED levels, from "no education" (=0) to "tertiary and post graduate" (=6). PARED index score shows the ISCED level of either parent, recorded into estimated years of schooling (OECD, 2005b, p. 316). HISEI index is obtained as follows: Occupational data, obtained by open-ended questions, were first coded into four-digit International Standard Classification of Occupations (ISCO) codes (OECD, 2005b, p. 316). These codes were then mapped to the international socio-economic index of occupational status (ISEI) values (OECD, 2005b, p. 316). Finally, HISEI, the Highest Occupational Status of Parents index, refers to the higher ISEI score of the either parent.

HOMEPOS is a scale index, derived from the student reports on availability of 13 household items at home (OECD, 2005b, p. 283).Scale indices are estimates of latent traits obtained using Item Response Theory (IRT) scaling methodology. International item parameters were obtained from calibration samples consisting of randomly selected sub-samples within each OECD country sample. Then weighted likelihood estimation was used to obtain individual student scores. These scores were transformed to an international metric with an OECD mean zero and standard deviation one (OECD, 2005b, p. 278). Finally, in order to calculate ESCS index, OECD standardized variables HISEI, HOMEPOS and PARED were used for a principal component analysis. Each OECD country was given a weight of 1000. ESCS scores were obtained as factor scores of the first principal component, where OECD student average was 0 and standard deviation was 1. For partner countries, the following formula was used to obtain ESCS scores:

$$ESCS = \frac{\beta_1 HISEI' + \beta_2 PARED' + \beta_3 HOMEPOS'}{\varepsilon_f}$$

Here, β_1, β_2 and β_3 represent OECD factor loadings, *HISEI', PARED'* and *HOMEPOS* are OECD standardized variables, and ε_f is the eigenvalue of the first principal component (OECD, 2005b, p. 316).

Data Analysis

In order to investigate geographic differences, countries were divided into seven regions. These regions were determined with respect to continents, with two exceptions: European countries were divided into two subgroups, European Union (EU) members and non EU members. In addition, Israel and Tunisia were categorized as South-East Mediterranean countries. Table 1 shows the regions and their codes.

Table 1.
Regional Codes

CODE	Region
1	Europe-EU countries
2	Europe-non EU countries
3	Asia
4	North America
5	South America
6	South-East Mediterranean
7	Oceania

Socioeconomic status (SES) of the students was categorized using ESCS indices. Indices were divided into 5 categories from “very low” to “very high”. Table 2 shows the boundary values for the indices and the codes given to the categories. Table 3 portrays the number of participants with respect to region, SES level and gender (missing and invalid responses excluded).

Table 2.
Categorization of ESCS indices

Min	Max	SES	Code
-4.614590	-3.099648	Very Low	1
-3.099647	-1.584706	Low	2
-1.584705	-0.069764	Medium	3
-0.069763	1.445178	High	4
1.445179	2.960120	Very High	5

Table 3.
Distribution of participants with respect to region, SES, gender

CATEGORIZATION	CODE	N
REGION	1	74384
	2	21504
	3	18422
	4	26210
	5	26045
	6	1584
	7	15822
SES	1	415
	2	13105
	3	73459
	4	85282
	5	11710
GENDER	1 (Female)	92478
	2 (Male)	91493
Missing		58
TOTAL		183971

Although index values calculated for the variables internet/entertainment use (INTUSE), program/software use (PRGUSE) and attitudes towards computers (ATTCOMP) are available in the PISA 2003 database, the researchers preferred to obtain the categories via factor analysis over the data. Principal component factor analysis conducted for the items IC05 and IC07. Varimax rotation with Kaiser Normalization was used for IC05.

GLM analyses were carried out for each category to discern whether there were any significant mean differences in the constructs with respect to gender, socioeconomic status and geographical region.

***Note*:** Missing, not applicable or invalid responses were coded as “systems missing” for calculations.

Results

Availability of a Computer to Use

Availability of a computer to use is measured by item IC01 (“Is there a computer available…) in the ICT questionnaire. Dichotomous response categories are home, school or other. Table 4 below shows the frequencies to the responses of this item with respect to socioeconomic status levels. In Table 5, frequencies to the responses with respect to geographical regions.

Table 4.
Frequency distributions and percentages of IC01 according to socioeconomic status.

Availability			SES Categories					N/A	Invalid	Missing	Total
			1	2	3	4	5				
Home	Yes	N	80	3950	54311	84998	12532				155871
		%	5.8	38.9	48	74.4	81.7				
	No	N	635	10166	22821	5898	30				39550
		%	44.5	36.3	20.2	5.2	.2				
		Total	1427	28015	113049	114300	15347	54088	2032	20597	272138
School	Yes	N	517	13128	70423	81823	11621				177512
		%	36.2	46.8	62.3	71.5	75.7				
	No	N	315	3107	7701	5547	473				17143
		%	22	.11	6.8	4.9	3				
		Total	1427	28015	113049	114300	15347	54080	4601	18802	272138
Other	Yes	N	350	10088	59230	72366	10434				152468
		%	24.5	36	52.3	63.3	68				
	No	N	386	3951	12727	9806	1054				27924
		%	27	14.1	11.3	8.6	6.9				
		Total	1427	28015	113049	114300	15347	54135	6690	30921	272138

Table 5.
Frequency distributions and percentages of IC01 according to geographical regions.

Availability			Geographical Regions							N/A	Invalid	Missing	Total
			1	2	3	4	5	6	7				
Home	Yes	N	66737	17185	12043	29240	14318	1310	15641				156474
		%	59	57.7	31.8	87.5	35.5	27.7	91.6				
	No	N	10613	5367	6819	2287	11570	2186	869				39711
		%	9.38	18	18	6.8	28.7	46.3	5				
		Total	113044	29809	37850	33409	40270	4721	17062	57146	2045	20789	276165
School	Yes	N	70786	19776	16354	30862	22865	1186	16339				178168
		%	62.6	66.3	43.2	92.3	56.8	25.1	95.7				
	No	N	5062	2740	2506	467	4133	2204	118				17230
		%	4.5	9.2	6.6	1.4	10.3	46.7	0.7				
		Total	113044	29809	37850	33409	40270	4721	17062	57138	4632	18997	276165
Other	Yes	N	56117	15644	11758	30340	22644	2047	14455				153005
		%	49.6	52.5	31	90.8	56.2	43.3	84.7				
	No	N	11999	4725	4733	942	2901	1577	1164	57194	6734	31191	28041
		%	10.6	15.8	12.5	2.8	7.2	33.4	6.8				
		Total	113044	29809	37850	33409	40270	4721	17062				276165

Experience in years of using computers

Experience of computer use was measured by multiple choice item IC03 (“How long have you been using computers?”). The choices were “less than one year” (=1), “one to three years” (=2), “three to five years” (=3) and “more than five years” (=4). Means and standard deviations with respect to socioeconomic status, geographical region and gender are displayed in Table 6, Table 7 and Table 8 respectively. Higher means indicate more experience in computer use.

Table 6.
Means and standard deviations of the responses to IC03 with respect to socioeconomic status.

SES Categories	1	2	3	4	5
Mean	1.54	1.84	2.54	3.14	3.54
St. Dev.	.845	.922	1.049	.946	.727

Table 7.
Means and standard deviations of the responses to IC03 with respect to geographical regions.

Geographical Regions	1	2	3	4	5	6	7
Mean	2.84	2.62	2.45	3.53	2.15	1.87	3.51
St. Dev.	.985	1.039	1.079	.744	1.045	1.065	.771

Table 8.
Means and standard deviations of the responses to IC03 with respect to gender.

Gender	Female	Male
Mean	2.75	2.90
St. Dev.	1.060	1.070

It is observed from Table 6 that, means of experience in computer use increase as socioeconomic status increases (see Figure 1).

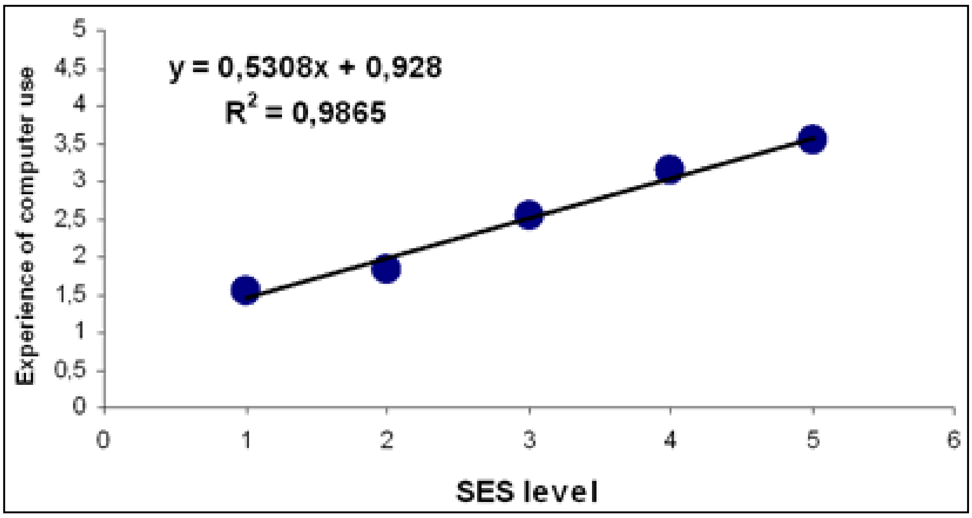

Figure 1.

Linear relationship between experience of computer use and SES level

Frequency of computer use for different purposes

Factor analysis on IC05 ("How often do you use…") resulted in two categories, labeled *internet use* (IU) and *program use* (PU). This categorization coincides with the one PISA used in index calculation with one exception: item IC05Q11 is in the program use category in PISA calculations whereas it appeared as a doublet in the factor analysis. Table 9 shows factor loadings of the items in IC05.

Bartlett's test of sphericity revealed significant probability (p=.001<.005) implying the necessity of the factor analysis employed. The component IU explains 28.74% of the variance, while PU explains 25.67%. Means, standard deviations and reliability coefficients of the categories are given in Table 10.

Table 9.

Factor loadings for frequency of computer use items

Item No.	Factor Components	
	IU	PU
IC05Q1	**.751**	.180
IC05Q2	**.405**	.344
IC05Q3	.321	.564
IC05Q4	**.619**	.344
IC05Q5	.138	**.729**
IC05Q6	**.777**	.281
IC05Q7	.224	**.671**
IC05Q8	.052	**.775**
IC05Q9	.162	**.689**
IC05Q10	**.828**	.131
IC05Q11	**.411**	**.576**
IC05Q12	**.823**	.087

Table 10.

Mean, standard deviation and reliability coefficients of the components

Component	Mean	Standard deviation	Cronbach Alpha
IU	2.89	1.573	.85
PU	3.99	1.199	.80

Remark: It is important to keep in mind that, since the response categories were coded as “almost every day” (=1) to “never” (=5), higher means indicate less frequent use of computers.

Internet Use

GLM analysis on IU has revealed significant mean differences with respect to gender, $F(1, 183969) = 5374.20$, p=.001<.05; socioeconomic status $F(4, 1839966)$ =2729.75, p=.001<.05; and geographical region, $F(6, 183964) = 2707.90$, p=.001<.05.

When mean scores for IU are examined, it is observed that females had a higher IU mean score (*M* = 3.13, *SD* = 1.572) than males (*M* = 2.65, *SD* = 1.539). Therefore, considering the For geographic regions, following IU mean scores are obtained: EU countries (*M* = 3.06, *SD* = 1.570), non EU countries (*M* = 3.02, *SD* = 1.562), Asian countries (*M* = 3.37, *SD* = 1.554), North America (*M* = 2.05, *SD* = 1.359), South America (*M*= 3.06, *SD* = 1.554), South-East Mediterranean (*M* = 3.40, *SD* = 1.460), and Oceania (*M* = 2.59, *SD* = 1.446).

Mean IU scores for socioeconomic levels are as follows: very low (*M* = 3.97, *SD* = 1.377), low (*M* = 3.64, *SD* = 1.462), medium (*M* = 3.10, *SD* = 1.573), high (*M* = 2.66, *SD* = 1.537), and very high (*M* = 2.374, *SD* = 1.458). Figure 2 displays the linear relationship between IU means and socioeconomic status levels. While forming the graph, reported IU means were subtracted from the maximum value 5 so that higher means would indicate more frequent use of the internet.

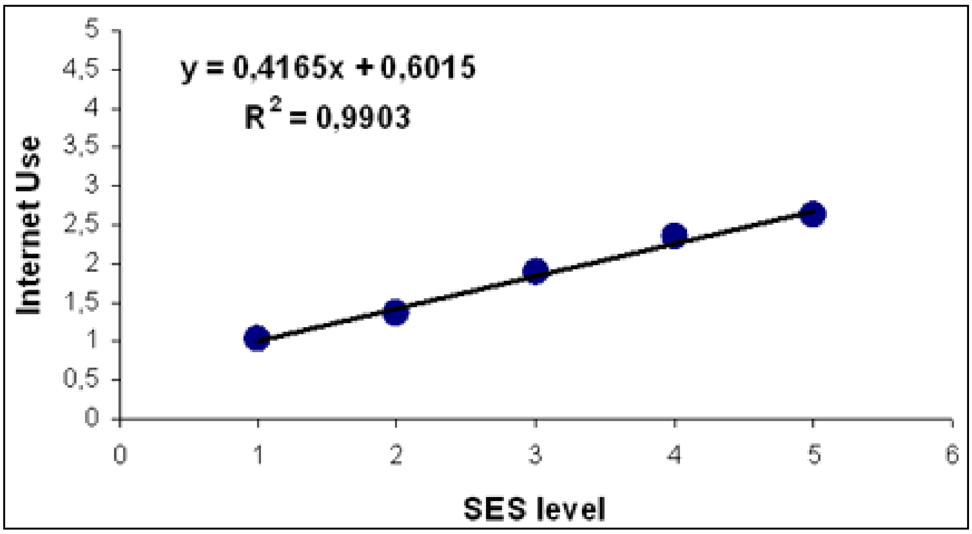

Figure 2.
Linear relation between internet use and SES levels

Program Use

GLM analysis on PU has revealed significant mean differences with respect to gender, $F(1, 183969) = 1960.95$, $p=.001<.05$; socioeconomic status $F(4, 1839966) =85.47$, $p=.001<.05$; and geographical region, $F(6, 183964) = 733.49$, $p=.001<.05$.

Examination of PU scores revealed that females had a higher mean score (M = 4.09, SD = 1.140) than males (M = 3.90, SD = 1.543). Mean PU scores for geographical regions are as follows EU countries (M = 4.09, SD = 1.137), non EU countries (M = 3.96, SD = 1.235), Asian countries (M = 4.18, SD = 1.097), North America (M = 4.07, SD = 1.333), South America (M = 3.59, SD = 1.371), South-East Mediterranean (M = 3.41, SD = 1.417), and Oceania (M = 4.04, SD = 1.099).

For socioeconomic status, the following PU mean scores are obtained: very low (M = 3.95, SD = 1.310), low (M = 3.96, SD = 1.267), medium (M = 4.03, SD = 1.201), high (M = 3.98, SD = 1.182) and very high (M = 3.90, SD = 1.165). Figure 3 depicts the polynomial relationship between PU means and socioeconomic status levels. While forming the graph, reported PU means were subtracted from the maximum value 5 so that higher means would indicate more frequent use of computer programs.

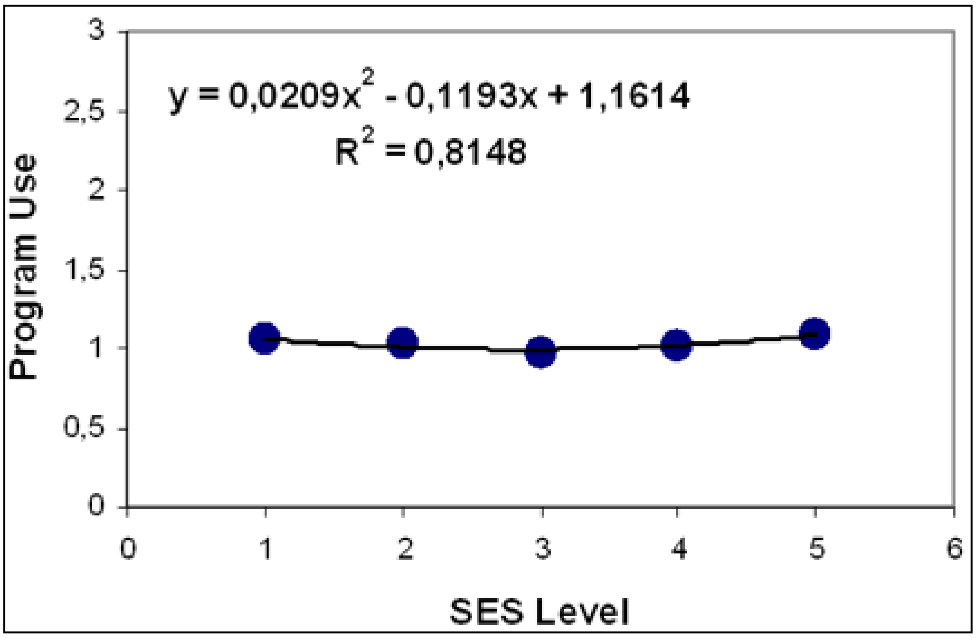

Figure 3.
Polynomial relationship between program use and SES level

Attitudes towards using computers

Factor analysis on IC07 resulted in one category, labeled attitude towards computer use (AC). Bartlett's test of sphericity was obtained with significance, p=.001<.005. Hence factor analysis can safely be used. The model explains 63.77% of the variance. Table 11 shows factor loadings of AC while Table 12 displays the mean, standard deviation and reliability coefficient of the component AC.

Table 11.
Factor lodaings of AC

Item No.	Component: AC
IC07Q1	.794
IC07Q2	.825
IC07Q3	.860
IC07Q4	.706

Table 12.
Mean, standard deviation and reliability coefficients of the components

Component	Mean	Standard deviation	Cronbach Alpha
AC	1,78	.809	.80

Remark: Since response categories were coded as "strongly agree" (=1) to "strongly disagree" (= 4), higher means indicate more negative attitude towards computers (All items state positive attitudes).

GLM analysis on AC revealed significant mean differences with respect to gender, $F(1, 183969) = 5159.71$, $p=.001<.05$; socioeconomic status $F(4, 1839966) = 249.61$, $p=.001<.05$; and geographical region, $F(6, 183964) = 259.62$, $p=.001<.05$.

Mean scores for AC are examined with respect to gender, geographical regions and socioeconomic status. It is observed that females have a higher AC mean score ($M = 1.92$, $SD = .818$) than males ($M = 1.624$, $SD = .773$). For geographic regions, following AC mean scores were obtained: EU countries ($M = 1.79$, $SD = .815$), non EU countries ($M = 1.75$, $SD = .847$), Asian countries ($M = 1.78$, $SD = .789$), North America ($M = 1.77$, $SD = .806$), South America ($M = 1.70$, $SD = .75$), South-East Mediterranean ($M = 1.62$, $SD = .821$), and Oceania ($M = 1.96$, $SD = .809$).

The following mean scores for AC for are as found with respect to socioeconomic status: very low ($M = 1.89$, $SD = .853$), low ($M = 1.83$, $SD = .796$), medium ($M = 1.80$, $SD = .811$), high ($M = 1.76$, $SD = .805$) and very high ($M = 1.76$, $SD = .806$). A linear relationship between AC means and socioeconomic status levels, as can be seen in figure 4. While forming the graph, reported AC means were subtracted from the maximum value 4 so that higher means would indicate more positive attitudes towards computers.

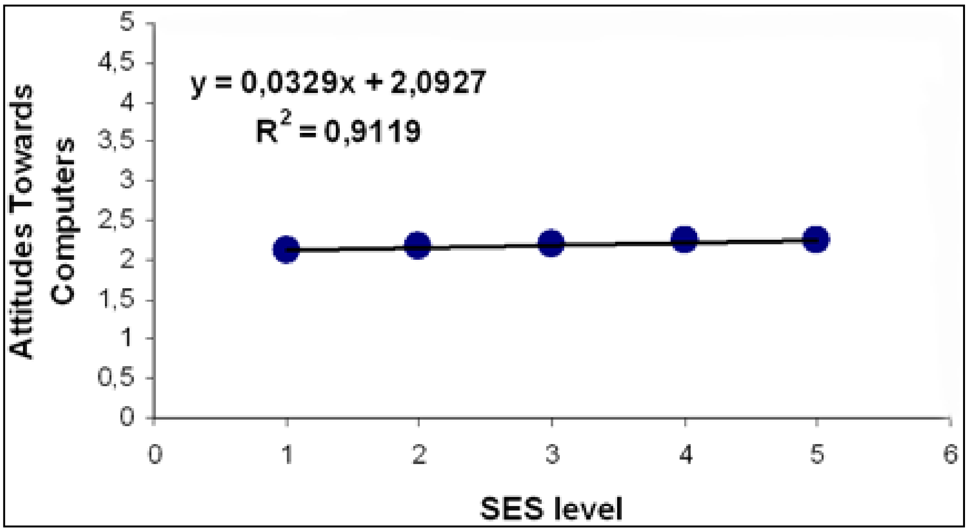

Figure 4.
Linear relationship between attitudes towards computer and SES levels

Conclusion

Using technology in mathematics education can improve learning and attitudes towards mathematics, since it enables students to be more actively engaged in learning and allow using a combination of different teaching methods (Roschelle *et al.*, 2000). Hence, it will be easier to address to different learning styles of the students. In order to use these advantages efficiently, technology must be available to every student, at home or school. However, as the results of the current study show, availability of computers changes depending on socioeconomic status and geographical regions. As socioeconomic status increases, availability of a computer at home and at school increases. Students with low to medium socioeconomic levels tend to have more access to a computer at school than at home. The highest percentage of availability of computers is in Oceania (91.6 % at home 95.7 % at school), followed by North America (87.5 % at home 92.3 % at school). The lowest percentages come from south-east Mediterranean countries (27.7 % at home, 25.1 % at school).

A significant (r^2 = .99) linear relationship is found between experience of computer use and socioeconomic status levels; as socioeconomic levels increase, experience increases. This result may be expected because students of low socioeconomic status have less access to computers, meaning they are less experienced in using computers. Their main source of computer access is schools, whereas the students of higher socioeconomic status have a bigger chance to grow up in a home with a computer. Geographically, regions with highest experience in using computers are North America, followed by Oceania. Less experienced are southeast Mediterranean countries, which, unsurprisingly coincides with the results found for socioeconomic status.

Results for frequency of computer use reveal significant mean differences with respect to gender, geographical regions and socioeconomic status. It is seen that males use the Internet and software programs more frequently than males. North America has the highest frequency of Internet use, followed by Oceania, which also coincides with previous results. However the lowest frequency of Internet use is in non-EU countries, followed by EU countries. For program use the results are not similar: South-east Mediterranean countries are the most frequent users, followed by South America, while least frequent users are Asian countries. Significant (r^2 = .99) linear relationship is found between Internet use and socioeconomic status levels; as socioeconomic levels increase, internet use increases. This can also be explained by the availability of computers to the students. However, relationship between program use and socioeconomic status is not linear, it is polynomial. While low and high socioeconomic level students' use computer programs is the most frequent, medium level students' is the lowest. An explanation for this situation can be that students tend to use the Internet more for non-academic purposes (downloading music, games etc.), and software programs are usually used for schoolwork. Hence affective factors such as anxiety and motivation are likely to have a role in frequency of use as well as socioeconomic factors. In fact, in a previous study on the same sample (Kahveci & Imamoglu, 2014), researchers found that mathematics anxiety follows a similar trend: medium socioeconomic level students have the highest anxiety, whereas very high and very low socioeconomic level students have lowest mathematics anxiety. Another possible explanation may be that students who do not use computer programs frequently for academic purposes tend to have higher anxiety (in other subjects as well as mathematics).

Results for attitudes towards computers also reveal significant mean differences with respect to gender, geographical regions and socioeconomic status. Males have more positive attitudes compared to females. This may be a reason to the result that males use Internet and software programs more frequently. Southeast Mediterranean countries have the most positive attitude towards computers, while Oceania has the lowest. This is opposite to the other findings where Oceania has the highest computer availability of computers, experience and internet use. It also has high scores in self-efficacy, self-concept and motivation, and low mathematics anxiety scores (Kahveci & Imamoglu, 2014). Southeast Mediterranean countries, on the other hand, have the least computer availability but they are most frequent program users. In addition, they have high mathematics anxiety scores. These results should further be investigated. There is a significant linear relationship between attitudes towards computer use and socioeconomic status, however, the line is close to horizontal, meaning that attitudes towards computer do not show big changes with respect to socioeconomic status. Mathematics anxiety with respect to socioeconomic status does not show a similar trend. Further research can be conducted to investigate direct relationship between math anxiety and attitudes towards computers.

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