RELATIONSHIP BETWEEN ICT VARIABLES AND MATHEMATICS ACHIEVEMENT BASED ON PISA 2006 DATABASE: INTERNATIONAL EVIDENCE

Cem Oktay Güzeller
Department of Education Sciences, Faculty of Education, Akdeniz University, Konyaaltı, Antalya 07058, Turkey.
cemg@akdeniz.edu.tr
Ayça Akın
Department of Mathematics Education, Faculty of Education, Anadolu University, Eskişehir, 26470, Turkey.
aycaakin07@gmail.com

ABSTRACT
The purpose of this study is to determine the predicting power of mathematics achievement from ICT variables including the Internet/entertainment use (IEU), program/software use (PRGUSE), confidence in internet tasks (INTCONF) and confidence in ICT high level tasks (HIGHCONF) based on PISA 2006 data. This study indicates that the ICT variables account for significant and low variance in mathematics achievement for each participating country. The IEU and PRGUSE are a negative and significant predictor of mathematics achievement whereas the INTCONF and HIGHCONF are a positive and significant predictor of mathematics achievement for the majority of participating countries. The results support the implication that the ICT is not entirely integrated into classroom and school environment.
Keywords: Internet/entertainment use (IEU), program/software use (PRGUSE), confidence in internet tasks (INTCONF), confidence in ICT high level tasks (HIGHCONF), mathematics achievement.

INTRODUCTION
The twenty-first century is called information age. In this century, the development level of countries is directly related to the importance that they give to education, human beings and information. Currently, information is accepted as the most important key factor for the economic development of the countries and people can access the information easily and quickly by means of technology. Therefore, educational systems aim to bring up individuals who can get the information, use the information to make a decision, and find solutions to problems in the information age. Not only is information and communication technology (ICT) the essence of learning environment, but also it enables students to broaden their horizons, foster students' knowledge, gain new occupational skills, and to have life-long learning skills. The contribution of ICT to provide education facilities for distant rural areas is so great, that it can't be ignored (Çavaş, Kışla, & Twining, 2004).

Organization for Economic Co-operation and Development's (OECD) (1996) is emphasized that the ability of analytical and mathematical thinking, the ability of mastering technological knowledge and using them scientifically are among a few of the life-long learning skills. The level of using ICT and the number of students per computer are also signs of the quality of education (European Commission, 2000; UNICEF, 2002). Computers which are the most important elements of ICT are indispensable for our life. Nowadays, with the help of computers and the Internet, students do homework own their own. Moreover, they also prepare for the exams with educational software and online course. Therefore, computers seem to have an unquestionable place starting from teaching basic skills, reinforcing and enhancing knowledge, knowledge-retention, and skills to accomplishing high-level goals such as problem solving, model building and critical thinking (Aşkar, 1991).

The recent developments in ICT have also affected the learning and teaching process of mathematics. In the past, the teacher was the speaker and the student was the listener during the mathematics lessons. Currently, mathematics is taught with computer-based materials in elementary and secondary mathematics classes hence, it gives an opportunity to take individual differences among students into account seriously (e.g., Cockcroft, 1982; NCTM, 2000). Integration of ICT in mathematics teaching is enabled using ICT tools throughout the curriculum to accomplish teaching goals and strengthen the student's learning (Cartwright, & Hammond, 2003). In addition to this, it is known that the attitudes of students and teachers towards computers are important in order to use ICT effectively at schools (e.g., Zhang & Espinoza, 1998).

With the development of technology, many countries participated in the international benchmarking studies such as Programme for International Student Assessment (PISA), Progress in International Reading Literacy Study (PIRLS) and The Trends in International Mathematics and Science Study (TIMSS), which provide opportunity to evaluate the participating countries' current education systems. OECD is one of the institutions which concerns with lifelong learning skills, to what extent the students improve these skills, and the importance and reflection of these skills on educational policies in the world. The PISA, which is administered with the support of OECD, is the largest international comparative research concentrating on program-based learning outcomes (Güzeller & Akın, 2011, p. 350). PISA 2003, PISA 2006 and PISA 2009 assess the three major domains that are called mathematics, scientific and reading literacy, respectively. PISA also collects the data of students' demographic features, computer familiarity, learning styles, parents, school environments, students' beliefs about themselves, and their motivations of the three major domains via student and ICT questionnaire (OECD, 2007).

Using ICT for teaching mathematics reveals the hypothesis that ICT variables may be one of the factors which affect mathematics achievement (e.g., House, 2005; Kim, Seo, & Park, 2008; Kubiatko & Vlckova, 2010). Therefore, the studies related to factors affecting students' mathematics achievement in terms of ICT variables are regarded important.

The Relation between ICT and Achievement

ICT which is the necessary equipment of teaching and learning activities has a significant role in improving knowledge and skills of teachers and students apart from preparing them for the life in the education and training (Aşkar & Olkun, 2005). It is necessary to understand how ICT is used in the classrooms, which educational purposes it serves, what role it plays for the success of the learning process, educational program and educational policy (Papanastasiou, Zembylas, & Vrasidas, 2005). The frequency of ICT use is related to student's achievement, socioeconomic status, and the level of technology infra-structure in schools (e.g., Papanastasiou, 2002; Papanastasiou, & Ferdig, 2003). The findings of most of studies (e.g., Kim et al., 2008; Kubiatko & Vlckova, 2010) show a positive and significant relation between the frequency of ICT use and the achievement of students, while the results of the few studies demonstrate a negative (e.g., Papanastasiou, 2002; Papanastasiou & Ferdig, 2003; Şahinkayası, 2008) or insignificant (e.g., Papanastasiou et al., 2003; Wittwer & Senkbeil, 2008) association between the frequency of ICT use and the achievement of students.

The results of PISA indicate that Hong Kong, Korea and Chinese Taipei perform above the OECD-average in mathematical literacy. The results can be explained that students from these countries spend their time mostly on understanding, explaining and proving mathematical arguments or theorems during the mathematics lessons by using computer software for mathematics education (House, 2002; Stigler, Gallimore, & Hiebert, 2000).

The similar results of other studies related to PISA 2006 (Kubiatko & Vlckova, 2010; Kim et al., 2008) demonstrate that the Czech Republic students who use ICT activities in the learning process have higher science achievement than the students who do not use it, and the Korean students who have used ICT for a long time achieved higher mathematics, reading and science scores than their counterparts. Using ICT in the educational process helps to create a better learning environment, and the educational software also gives students the opportunity to provide a personal and direct feedback (Papanastasiou et al. 2003; Wenglingsky, 1998).

According to PISA 2000 results, even though there is a significant and positive relation between academic achievement and the availability of computers at schools, the relation between the computer access at school and mathematics achievement gets insignificant when the effect of the variables related to family background and school characteristics are controlled (Fuchs & Wößmann, 2004). For example, an insignificant association exists between the frequency of computer use and science achievement and also the negative relationship exists between educational software use and science achievement of students from USA who participate in PISA 2003 (Papanastasiou et al., 2003). In a similar way, there is not a significant association existed between the computer access and mathematics achievement, and the frequency of computer use at home and mathematics achievement of students from Germany who participate in PISA 2003 (Wittwer & Senkbeil, 2008). Although the results of PISA 2000 indicate that the students from Germany and USA use computers more frequently at school for software and programming than the students of other countries, students from these countries perform below the OECD-average in mathematical literacy and scientific literacy (Papanastasiou et al., 2005; Papanastasiou & Ferdig, 2003). Students' frequency of computer and internet use, and their self-confidence in ICT high level tasks have mostly negative and small associations with their problem solving and mathematical literacy scores in all participating countries in the PISA 2003 (Şahinkayası, 2008). Another study related to TIMSS 1995 shows that a negative relationship exists between the frequency of computer use in the classroom and mathematics achievement of students from Cyprus, Hong Kong and USA. The reason for this relation may be explained with the occasional help of the teachers to the students, with low abilities and lack of understanding the topics, while using computer and educational software (Papanastasiou, 2002).

The Relation between Confidence in ICT and Achievement

In psychology, self-confidence is defined by Brown and Chronister (2009) as "a sense of one's power and ability to carry out a desired task or function" (p. 47-48). A student whose self-confidence is low might consistently expect help from the others, not make a decision on her/his own (Akın, 2007). Although self-confidence and self-efficacy are different from each other in general, they are used interchangeable in literature (e g., Akın, 2007). Self-efficacy is defined as "a personal belief within an individual as to the capacity to accomplish a certain task" (Kotaman, 2008, p. 112). Therefore, the definitions of these concepts also indicate that self-confidence and self-efficacy are similar psychological constructs. Student's self-efficacy is only measured at task-specific level whereas student's self-confidence is not only measured at task-specific level but also measured at a more general/domain specific level (Bandura, 1997; Bong & Skaalvik, 2003). ICT self-efficacy is closely related to the tendency to engage in ICT (Zhang & Espinoza, 1998). The student with high ICT self-efficacy reacts less to the technological developments and adopts them more quickly than student with low ICT self-efficacy (Gürcan, 2005). But only a few studies (e.g., Contreras, 2004; Gardner, Dukes, & Discenza, 1993; Kim et al., 2008; Şahinkayası, 2008) examine the relationships among ICT self-confidence/self-efficacy, predictors of ICT self-confidence and academic achievement. For instance, Gardner et al. (1993) investigate the associations among ICT attitudes, ICT self-confidence and ICT literacy on 309 students from the 7th to the 12th grades. The results indicate that there is a mutual positive relation between ICT attitudes and ICT confidence, and both of these factors positively affect computer literacy. PISA 2003 results demonstrate that the medium and positive association exists between self-confidence in routine computer tasks and mathematics and problem-solving achievement, and also the weak and positive relationship exists between self-confidence in Internet tasks and mathematics achievement, for the most of participant countries. On the contrary, the study reveals that the weak and negative relation observed between the frequency of internet use and mathematics achievement, for all countries (Şahinkayası, 2008). Contreras (2004) points out the importance of studies related to the relationship between ICT self-confidence and academic achievement with this sentence: "If no relationship between computer self-confidence and academic performance exists, investigations of computer self-confidence may be moot" (p. 178). Therefore, the purpose of this study is to examine the predicting mathematics achievement from ICT variables such as internet entertainment use (IEU), programme software use (PRGUSE), self-confidence in internet tasks (INTCONF), self-confidence in high-level tasks (HIGHCONF) based on the PISA 2006 data.

METHOD

Regression analysis is used to investigate the predicting mathematics achievement from ICT variables in this study. Therefore, the type of current study is a relational research.

Participants

The research conducted the ICT questionnaire data of the PISA 2006. The ICT familiarity questionnaire for PISA 2006 was completed by the total number of 223,278 15-year-old students who were randomly selected in 28 OECD member countries and 12 non-OECD member countries. The sample sizes of the countries were range between 318 in Liechtenstein and 19,712 in Italy.

Instruments

Mathematics achievement test. Mathematics literacy test is composed of 85 items in various difficulty levels from four areas as geometry, algebra, arithmetic and probability. Chronbach's alpha coefficients of the mathematical literacy test was .92.

Internet/entertainment use (IEU). The IEU involved the six items (e.g. Browse the Internet for information about people, things, or ideas) which were measured with 5 point Likert-type scale (see Appendix). Cronbach's alpha of the IEU was .83.

Program/software use (PRGUSE). The PRGUSE comprised of the five items (e.g. Use educational software such as Mathematics programs) which were measured with 5 point Likert-type scale ranging from "almost every day" (=5) to "never" (=1). Cronbach's alpha of the IEU was .81.
Confidence in internet tasks (INTCONF). The INTCONF included the six items (e.g. Download files or programs from the Internet) which were measured with 4 point Likert-type scale. Cronbach's alpha of the IEU was .86.

Confidence in ICT high level tasks (HIGHCONF). The HIGHCONF composed of the five items (e.g. Use software to find and get rid of computer viruses) which were measured with 4 point Likert-type scale ranging from "a few times each week"(=4) to "never" (=1). Cronbach's alpha of the HIGHCONF was .84.

Statistical Analysis

In this study, multiple linear regression analysis was conducted to determine the effects of ICT variables (including IEU, PRGUSE, INTCONF and HIGHCONF) predicting mathematics achievement based on the PISA 2006 data. This analysis was performed with SPSS 13.0 software.

RESULTS

In this research, the multiple regression model was run for each participating country in PISA 2006. Therefore, the multiple regression analysis investigated if the IEU, PRGUSE, INTCONF and HIGHCONF could significantly predict students' mathematics achievement. Table 1 showed the percent of total variance explained on mathematics achievement for each participating country.

Table 1. ***The Percentage of the Total Variance Explained by the Multiple Regression Model for Each Participating Country***

Country	Mean (SE)	Variance explained (Adjust R^2)	N
Finland	548 (2.3)	2%	4442
Korea	547 (3.8)	15%	5029
Netherlands	531 (2.6)	5%	4170
Switzerland	530 (3.2)	7%	11033
Canada	527 (2.0)	6%	19669
Macao-China	525 (1.3)	11%	4101
Liechtenstein	525 (4.2)	9%	318
Japan	523 (3.3)	9%	4822
New Zealand	522 (2.4)	12%	4428
Belgium	520 (3.0)	6%	7846
Australia	520 (2.2)	8%	13075
Denmark	513 (2.6)	5%	3864
Czech Republic	510 (3.6)	11%	5218
Iceland	506 (1.8)	5%	3504
Austria	505 (3.7)	9%	4570
Slovenia	504 (1.0)	10%	5834
Germany	504 (3.9)	7%	4102
Sweden	502 (2.4)	2%	3995
Ireland	501 (2.8)	9%	3669
All countries-average	498 (.5)	11%	223278
Poland	495 (2.4)	11%	5149
Slovak Republic	492 (2.8)	14%	4200
Hungary	491 (2.9)	13%	4069
Norway	490 (2.6)	4%	4158
Lithuania	486 (2.9)	15%	4122
Latvia	486 (3.0)	13%	4314
Spain	480 (2.3)	6%	17266
Russian Federation	476 (3.9)	10%	5092
Croatia	467 (2.4)	13%	4371
Portugal	466 (3.1)	20%	4800
Italy	462 (2.3)	8%	19712
Greece	459 (3.0)	15%	4239
Serbia	435 (3.5)	16%	4111
Uruguay	427 (2.6)	12%	3609
Turkey	424 (4.9)	18%	4012
Thailand	417 (2.3)	24%	5721
Bulgaria	413 (6.1)	15%	3678
Chile	411 (4.6)	15%	4274
Jordan	384 (3.3)	15%	4967
Colombia	370 (3.8)	15%	3506
Qatar	318 (1.0)	15%	4219

Note. SE: Standard Error

The model for all participating countries-average in the PISA 2006 indicated that the ICT predictors accounted for 11% of the total variance in mathematics achievement ($p < .01$). In all countries, this model was significant at .01 confidence level and the percent of the total variance explained varied from 2% to 24%. The findings of the Thailand for the regression model explained the largest percent of the total variance in mathematics achievement whereas the results of the Finland and Sweden for this analysis explained the lowest percent of the total variance in mathematics achievement. The model for each low-performing country was generally more powerful for explaining the percentage of the total variance in mathematics achivement than the model for each high-performing country and all countries-average, while the model for each high-performing country generally accounted for the lower percent of the total variance in mathematics achivement than the model of all countries-average. Although the European Union Member Countries mainly performed above the OECD-average in mathematical literacy, their proportions of the total variance explained were small and close to each other (e.g. Netherlands: adjusted R^2= 5%; Belgium: adjusted R^2= 6%). Most of Asian countries, except for Macao-China, Japan and Korea, represented the low-performing country in the PISA 2006. However, their proportions of variance explained were higher than the most of participating countries (e.g. Jordan: adjusted R^2= 15%; Turkey: adjusted R^2= 18%; Thailand: adjusted R^2= 24%). In general, the percentage of the total variance explained for each participating country in America (e.g. Uruguay: adjusted R^2= 12%; Chile: adjusted R^2= 15%) and Australia continent (e.g. New Zealand: adjusted R^2= 12%) was slightly above the average variance explained and close to each other.

Table 2. Relationship between ICT Variables and Mathematics Achievement Based on PISA 2006 Database: Result from Standard Multiple Regression Analysis

	Mathematics Achievement							
	IEU		PRGUSE		INTCONF		HIGHCONF	
Country	*B*	*SE*	*B*	*SE*	*B*	*SE*	*B*	*SE*
Finland	-.21	.30	-1.50***	.40	.98	.78	.1.88***	.33
Korea	-3.02***	.30	-1.30**	.38	12.23***	.88	4.34***	.26
Netherlands	-.64	.35	-1.87***	.37	11.08***	1.03	1.14**	.35
Switzerland	-1.46***	.19	-4.09***	.24	3.81***	.48	3.40***	.24
Canada	-.62***	.14	-2.65***	.16	6.22***	.37	1.95***	.16
Macao-China	-2.36***	.31	-.92**	.37	6.14***	.60	3.02***	.31
Liechtenstein	-.34	1.18	-5.33***	1.51	.78	3.41	5.69***	1.48
Japan	-.80**	.29	-2.46***	.42	3.90***	.48	1.95***	.31
New Zealand	-1.37***	.28	-4.67***	.35	5.96***	.70	2.80***	.37
Belgium	-1.30**	.35	-1.41**	.40	5.44***	.90	3.91***	.38
Australia	-1.21***	.17	-2.58***	.22	4.85***	.45	3.84***	.22
Denmark	-1.52***	.33	-1.23**	.41	4.75***	.77	2.62***	.38
Czech Republic	.11	.29	-4.50***	.37	5.26***	.85	5.40***	.39
Iceland	-3.09***	.37	.07	.42	7.25***	.89	1.23**	.40
Austria	-.32	.29	-4.10***	.39	2.92***	.76	5.43***	.41
Slovenia	.84**	.24	-4.75***	.28	4.79***	.56	1.77***	.32
Germany	.33	.31	-5.22***	.40	1.02	.77	4.40***	.40
Sweden	-2.02***	.32	-.36	.41	6.73***	.87	-.42	.35
Ireland	-1.06***	.26	-2.86***	.34	5.20***	.53	1.30***	.30
Poland	.02	.23	-3.61***	.30	3.72***	.54	3.46***	.34
Slovak Republic	-.34	.28	-3.29***	.32	5.51***	.52	2.86***	.30
Hungary	-.57*	.27	-3.22***	.35	5.62***	.58	3.28***	.34
Norway	-.01	.36	-2.90***	.39	5.98***	.90	.57	.40
Lithuania	-.31	.27	-3.08***	.31	9.07***	.62	1.66***	.35
Latvia	.41	.26	-4.24***	.31	6.02***	.66	3.55***	.33
Spain	-.97**	.30	-2.47***	.36	5.82***	.71	1.47***	.35
Russian Federation	-1.44***	.25	-2.22***	.31	.76*	.37	4.19***	.25
Croatia	-.37	.25	-2.85***	.29	5.99***	.52	2.21***	.32
Portugal	-.37	.26	-4.61***	.31	1.90**	.60	7.35***	.36
Italy	-1.66***	.43	-2.41***	.51	4.49*	.77	1.58***	.53
Greece	-1.33***	.29	-4.52***	.36	6.80***	.52	2.00***	.31
Serbia	-1.60***	.26	-2.90***	.32	5.91***	.47	2.59***	.33
Uruguay	-.05	.34	-2.06***	.38	5.53***	.64	2.64***	.38
Turkey	.51	.31	-5.82***	.35	9.35***	.59	-.87*	.36
Thailand	1.53***	.25	-6.32***	.30	8.58***	.42	-.47	.27
Bulgaria	-.58	.34	-3.59***	.34	7.36***	.65	2.44***	.39
Chile	1.29***	.28	-4.31***	.30	4.53***	.59	3.15***	.33
Jordan	-1.18***	.21	-2.72***	.26	2.69***	.35	3.50***	.24
Colombia	.53	.30	-3.68***	.36	6.34***	.58	1.66***	.35
Qatar	-.71*	.31	-3.91***	.31	5.08***	.55	2.51***	.33

Note: *B*: unstandardized regression coefficient, *SE*: standard error of *B*, $^{***}p< .001$, $^{**}p< .01$, $^{*}p<.05$.

Table 2 presented the regression coefficients for the standard multiple model to predict mathematics achievements in the PISA 2006. The results indicated that the IEU was a negative and significant predictor of mathematics achievement for the 20 participating countries at .05 level, whereas the regression coefficient of the IEU on mathematics achievement was positive and significant for several countries such as Chile, Slovenia and Thailand. Therefore, the association between the IEU and mathematics achievement was negative and significant in the majority of participating countries. The unstandardized B coefficients for the IEU were ranged from -3.09 (Iceland) to 1.53 (Thailand). In a similar way, the regression coefficients of the PRGUSE on mathematics achievement were negative and significant for almost all participating countries excepting Iceland and Sweeden at .05 level, and they were varied between -.92 (Macao-China) and -6.32 (Thailand). The INTCONF was a positive and significant predictor of mathematics achievement for the 37 participating countries excluding Finland, Germany and Liechtenstein at .05 level. The unstandardized B coefficients for the INTCONF were ranged between .76 (Russian Federation) to 12.23 (Korea) at .05 level. The regression coefficients of the HIGHCONF on mathematics achievement were positive and significant for nearly all of the participating countries excepting Norway, Sweeden, Thailand and Turkey at .05 level and they were varied from -.87 (Turkey) to 7.35 (Portugal).

DISCUSSION

The purpose of this study was to determine the predicting power of mathematics achievement from ICT variables such as the IEU, PRGUSE, INTCONF and HIGHCONF based on PISA 2006 data. This study indicated that the ICT variables accounted for significant and low variance in mathematics achievement for each participating country and the results for each Asian, European, American or Australian participating country were generally comparable and close to each other. Therefore, we could imply that Asian, European, American or Australian countries were similar between each other in regard to their cultures, educational systems and our findings. Surprisingly, the results showed that the regression coefficients of the IEU and PRGUSE on mathematics achievement were negative and significant for the majority of participating countries. The astonishing finding of this study was in line with studies such as Papanastasiou (2002), Papanastasiou et al. (2005) or Şahinkayası (2008) which revealed a negative and significant relationship between students' ICT use and academic achievement. For example, although the findings of TIMSS 1995 demonstrated that the students from Cyprus, Hong Kong and USA used computers most frequently at school, students from these countries performed below the TIMSS-average in mathematical literacy and scientific literacy. The results of the study supported the hypothesis that more time spent on computer or Internet-related activities might related with lower mathematics performance gets over time (Wenglinsky, 1998). Papanastasiou et al. (2005) also explained this finding that the students who spent most time on computer-related activities (including the IEU, PRGUSE) might neglect their school work which results to poor academic performance. However, in general, we could not deduce from our findings that the IEU and PRGUSE reduced mathematics performance, or vice versa (Papanastasiou et al., 2005).

The INTCONF and HIGHCONF were positive and significant predictors of mathematics achievement for almost all participating countries at .05 level. The finding demonstrated that as the participants perceived more confidence in internet tasks and ICT high level tasks, their mathematics achievements tended to increase. This result was consistent with previous studies (e.g., Gardner, et al., 1993; Şahinkayası, 2008) which indicated students' academic performance was positively influenced by their ICT confidence. Literature findings generally showed that self-efficacy/confidence was a better predictor for students' achievements than other psychological constructs (e.g., Ferla, Vackle, & Cai, 2009). Similarly, computer efficacy/confidence was the stongest predictor/mediator of academic performance, and technology uptake (Ellen, Bearden, & Sharma, 1991). Therefore, computer confidence which was a key element of attitudes towards ICT helped to improve mathematics achievement (Sen, 2005).

CONCLUSION

Nowadays, although the use of ICT is a central part of our life, this study indicates that a low relationship exists between ICT variables and mathematics achievement based on PISA 2006 data. The results support the implication that the ICT is not entirely integrated into classroom and school environment (Güzeller & Akın, 2011). Future research should investigate the predicting mathematics achievement from many predictors/mediators including the ICT variables so as to account for more variance in mathematics achievement.

REFERENCES

Akın, A. (2007). Öz-güven ölçeğinin geliştirilmesi ve psikometrik özellikleri. *AİBÜ Eğitim Fakültesi Dergisi, 7*(2), 165–175.

Aşkar, P. (1991). *Introducing computers into Turkish schools*. Paper presented at the annual meeting of the International Seminar on Policies and Strategies for Integrating Computers in General Education: The Spanish Atenea Project 1985–1990, OECD Madrid: 22–24 April.

Aşkar, P., & Olkun, S. (2005). The use of ICT in schools based on PISA 2003 data. *Eurasian Journal of Educational Research*, *19*, 15–34.

Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W. H. Freeman and Company.

Brown, D. & Chronister, C. (2009). The effect of simulation learning on critical thinking and self confidence when incorporated into an electrocardiogram nursing course. *Clinical Simulation in Nursing, 5(*1), 45–52.

Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review*, *15*, 1–40.

Cartwright, V., & Hammond, M. (2003). *The integration and embedding of ICT into the school curriculum: more questions than answers*. Paper presented at the ITTE 2003 Annual Conference of the Association of Information Technology for Teacher Education, Trinity and All Saints College, Leeds.

Cockroft, W. H. (1982). *Mathematics count*. Her Majesty's Stationary Office, London.

Contreras, C. L. M. (2004). Predicting computer self-confidence from demographic and personality variables and computer use. *The Quarterly Review of Distance Education*, *5*(3), 173-181.

Çavaş, B., Kisla, T., & Twining, P. (2005). *Eğitimde bilgi ve iletişim teknolojilerinin kullanımına yönelik bir araştırma: dICTatEd yaklaşımı* [A study on the use of information and communication technologies in education: dICTatEd approach]. Retrieved January 22, 2013, from, http://kn.open.ac.uk/public/getfile.cfm?documentfileid=4551.

Ellen, P. S., Bearden,W. O., & Sharma, S. (1991). Resistance to technological innovations: an experimental examination of the role of self-efficacy and performance satisfaction. *Journal of the Academy of Marketing Science, 19*(4), 297–307.

European Commission (EC) (2000). *European report on the quality of school education: sixteen quality indicators.* Luxemburg. EU.

Ferla, J., Valcke, M., & Cai, Y. (2009). Academic self-efficacy and academic self-concept: Reconsidering structural relationships. *Learning and Individual Differences*, *19*(4), 499–505.

Fuchs, T., & Wößmann, L. (2004). *Computers and student learning: bivariate and multivariate evidence on the availability and use of computers at home and at school.* CESifo Working Paper 132L Munich: GESifo. Retrieved January 22, 2013, from, http://www.res.org.uk/econometrics/504.pdf.

Gardner, D. G., Dukes, R. L., & Discenza, R. (1993). Computer use, self-confidence, and attitudes: a causal analysis. *Computers in Human Behavior, 9*(4), 427-440.

Gürcan, A. (2005). Bilgisayar özyeterliği algısı ile bilişsel öğrenme stratejileri arasındaki ilişki. *Eurasian Journal of Educational Research, 19,* 179–193.

Güzeller, C. O., & Akın, A. (2011). The inter-regional inequality of access to information and communication technology in Turkey based on PISA 2009 data. *Turkish Online Journal of Educational Technology, 10(4),* 349–354.

House, J.D. (2002). Relationships between instructional activities and science achievement of adolescent students in Japan: findings from the third international mathematics and science study (TIMSS). *International Journal of Instructional Media, 29,* 275-288.

House, J.D. (2005). Classroom instruction and science achievement in Japan, Hong Kong, and Chinese Taipei: results from the TIMSS 1999 assessment. *International Journal of Instructional Media, 32,* 295-311.

Kim, H., Seo, J., & Park, H. (2008). The impact of ICT use on students' academic performance based on PISA 2006 Korean data. *The Journal of Korean Education, 35*(4), 107–129.

Kubiatko, M., & Vlckova, K. (2010). The relationship between ICT use and science knowledge for Czech students: a secondary analysis of PISA 2006. *International Journal of Science and Mathematics Education, 8,* 523-543.

Kotaman, H. (2008). Özyeterlilik inancı ve öğrenme performansının geliştirilmesine ilişkin yazın taraması. *Uludağ Üniversitesi Eğitim Fakültesi Dergisi, XXI* (1), 111–133.

NCTM, (2000). *Principles and standarts for school mathematics*. National Council of Teachers of Mathematics, Reston/VA.

OECD, (1996). *Lifelong learning for all.* Paris: Head of Publications Service.

OECD, (2007). *Education at a glance,* Paris: OECD EDU Publishing.

Papanastasiou, E. (2002). Factors that differentiate mathematics students in Cyprus, Hong Kong, and the USA. *Educational Research and Evaluation, 8,* 129–146.

Papanastasiou, E. C., & Ferdig, R. E. (2003). Computer use and mathematical literacy. An analysis of existing and potential relationships. *Proceedings of the Third Mediterranean Conference on Mathematical Education*. Athens, Greece: Hellenic Mathematical Society, 335-342.

Papanastasiou, E., Zembylas, M., & Vrasidas, C. (2003). Can computer use hurt science achievement? the USA results from PISA. *Journal of Science Education and Technology, 12*(3), 325-332.

Papanastasiou, E., Zembylas, M., & Vrasidas, C. (2005). An examination of the PISA database to explore the relationship between computer use and science achievement. *Educational Research and Evaluation, 11*(6), 529-543.

Sen, S. (2005). *The effect of technology acceptance on post secondary African- American students' achievement in mathematics: A path analytic inquiry*. Unpublished dissertation, University of Central Florida, Florida, USA.

Stigler, J. W., Gallimore, R., & Hiebert, J. (2000). Using video surveys to compare classrooms and teaching across cultures: examples and lessons from the TIMSS video studies. *Educational Psychologist*, *35,* 87-100.

Şahinkayası, Y. (2008). *A cross-cultural comparison modeling of information and communication technologies aspects affecting mathematical and problem solving literacy and perceptions of policy makers*. Unpublished dissertation, Orta Doğu Teknik University, Ankara, Turkey.

UNICEF (2000). *Defining quality in education.* A paper presented by UNICEF at the meeting of The International Working Group On Education, Florence, Italy.

Wenglinsky, H. (1998). *Does It Compute? the relationship between educational technology and student achievement in mathematics*. ETS Policy Information Center Research Division, Princeton, NJ.

Wittwer, J., & Senkbeil, M. (2008). Is students' computer use at home related to their mathematical performance at school? *Computers & Education, 50,* 1558–1571.

Zhang, Y., & Espinoza, S. (1998). Relationships among computer self-efficacy, attitudes toward computers, and desirability of learning computing skills. *Journal of Research on Technology in Education, 30*(4), 420-439.

Appendix

Q4. Internet/entertainment use items (INTUSE)

How often do you use computers for the following reasons?

1. Browse the Internet for information about people, things, or ideas.
2. Play games.
3. Use the Internet to collaborate with a group or team.
4. Download software from the Internet (including games).
5. Download music from the Internet.
6. For communication (e.g. E-mail or chat rooms).

Items are rated on a 5 point Likert scale ranging from (5) “almost everyday” to (1) “never”.

Q4. Program/software use (PRGUSE)

How often do you use computers for the following reasons?

1. Write documents (e.g. with <Word ® or WordPerfect ®>).
2. Use spreadsheets (e.g. <Lotus 1 2 3 ® or Microsoft Excel ®>).
3. Drawing, painting or using graphics programs.
4. Use educational software such as Mathematics programs.
5. Writing computer programs.

Items are rated on a 5 point Likert scale ranging from (5) “almost everyday” to (1) “never”.

Q5. Confidence in internet tasks (INTCONF)

How well can you do each of these tasks on a computer?

1. Chat online.
2. Search the internet for information.
3. Download files or programs from the Internet.
4. Attach a file to an E-mail message.
5. Download music from the Internet.
6. Write and send E-mails.

Items are rated on a 4 point Likert scale ranging from (4) “I can do this very well by myself” to (1) “I don’t know what this means”.

Q5. Confidence in ICT high level tasks (HIGHCONF)

How well can you do each of these tasks on a computer?

1. Use software to find and get rid of computer viruses.
2. Edit digital photographs or other graphic images.
3. Create a database (e.g. using <Microsoft Access ®>).
4. Use a spreadsheet to plot a graph.
5. Move files from one place to another on a computer.
6. Use a word processor (e.g. to write an essay for school).
7. Copy data to a CD (e.g. make a music CD).
8. Create a presentation (e.g. using <Microsoft PowerPoint ®>).
9. Create a multi-media presentation (with sound, pictures and video).
10. Construct a web page.

Items are rated on a 4 point Likert scale ranging from (4) “I can do this very well by myself” to (1) “I don’t know what this means”.