

## WHAT IS THE PREDICT LEVEL OF WHICH COMPUTER USING SKILLS MEASURED IN PISA FOR ACHIEVEMENT IN MATHEMATICS

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### ABSTRACT

This study aims at determining the extent to which computer using skills specified in Project for International Students Evaluation (PISA) 2006 predict Turkish students' achievement in mathematics. Apart from questions on mathematics, science and reading competencies, a student questionnaire, a school questionnaire and a parent questionnaire were also given prior to the exam to gather information on various social, cultural and economic factors that might be related to the students' academic achievement. Self-reliance in performing the operations requiring high level of computer skills, self-reliance in performing internet-related operations, using computers for internet and entertainment purposes, and using computers for programme and software purposes were examined as variables affecting mathematical achievement in this research. Multiple regression analysis was conducted so as to determine the degree to which independent variables predicted achievement at mathematics. The analysis results showed that the model constructed was statistically significant ( $F=240.45$ ;  $p< 0.01$ ). The independent variables accounted for approximately 17.7% of the overall variance. The research findings showed that students' self-reliance in performing the operations requiring high level of computer skills, using the word processor, using electronic tabulating programme in drawing graphs, preparing presentations, preparing multimedia presentations, and designing web pages affected the mathematics achievement scores in a negative way. Based on those results, it might be said that students' using computers in line with their needs, parents' controlling the time their children use computers, the internet and computer for entertainment purposes would be beneficial.

### INTRODUCTION

Educational systems should constantly be controlled so that Turkish society could become a society who can generate and export information in the future. Turkey participated in The Project for International Students Assessment (PISA) conducted by the Organisation of Economic Cooperation Development (OECD), of which Turkey was a charter member, in 2003 in order to continue the activity of measuring and evaluating students' achievement, which is already done in Turkey (Ministry of Education, 2005).

PISA is a survey which is conducted with fifteen years old children in leading industrialised countries quarterly. In this survey, which is a product of cooperation set up between the member countries of OECD and which is conducted via OECD, international expertise services are made use of in order to be able to make valid comparisons between countries and cultures (Ministry of Education, 2005). PISA is a programme which is conducted with the participation of all the OECD member countries as well as some non-membering countries and which aims to determine the extent to which fifteen years old students are raised as prepared to solve problems that they are to encounter in their future lives. The reason for selection of the fifteen years old is that in most countries of the OECD member fifteen years old students come to the end of their compulsory education and that a certain amount of knowledge, skills and attitudes is formed in students at the end this a decade period of education (OECD, 2006a).

The property that is tried to be measured with PISA project is not the extent to which students learn the topics handled in the curriculum content, but their ability to use their knowledge and skills in real life situations, their analysing their own thoughts, their reasoning, and whether or not they use the science and mathematics concepts learnt at school and thus attain a skill of communication (OECD, 2004).

Projects for comparing students' achievement such as TIMSS-R, PIRLS, and PISA can enable countries to evaluate their system of education and to pursue their students in the fields of mathematics, science and reading by years rather than being projects for competition between countries. What is expected of countries is to carry out reforms across the country required on the basis of consequences, to ensure participation in the projects in question, and thus monitor the effects of those reforms (Ministry of Education, 2005).

PISA completed the first tour of a survey of fifteen-year old-students' knowledge and skills in 2006 in OECD countries composing the 90% of world economy and in participant countries (OECD, 2006b). In the first cycle of the PISA project, which contained the period of 1997-2000, tests of mathematics, science, and reading skills were applied; yet the most emphasised field was reading skills. Since our country was applying the TIMSS-R and PIRLS projects of International Association for the Evaluation of Educational Achievement (IEA) – of which Turkey is a member, she could not join the first cycle of PISA project. The second cycle of the PISA project, in which Turkey also participated, was between the years 2000 and 2003. Students' knowledge and skills were measured in this period in the fields of science studies, reading, and problem-solving with special emphasis on mathematics. 41 countries including Turkey participated in this project. Of those countries, 30 were OECD members whereas 11 were not members. In the third cycle of the PISA project, which was conducted between the years 2003 and 2006, the fifteen year old students' skills in mathematics, science studies and reading were measured on international dimensions; yet the emphasis was shifted to the field of science studies (Ministry of Education, 2005). Fifty-seven countries which were OECD members and non-members took part in PISA 2006 applications. The tests were applied to samples of 4500-10 000 students formed in each country. PISA 2006 was composed of competence in the fields of reading, mathematics and science; and the emphasis was placed on science.

Pen and paper test was applied to the students in the exams, and two hours' time was allocated. The questions were designed in a manner so as to encounter in real life situations. Apart from questions on mathematics, science and reading competencies, a student questionnaire, a school questionnaire and a parent questionnaire were also given prior to the exam to gather information on various social, cultural and economic factors that might be related to the students' academic achievement.

Mathematical achievement, one of the features measured in PISA alongside the properties of schools, students and teachers, was investigated in a great deal of researches (Akinsola & Animasahun, 2007; Altun, 2007; Aypay, 2010; Bohannon, 1998; Cossa, 2000; Çiftçi, 2006; Duke, 2007; Duman, 2006; Duran, 2005; Güven & Kosa, 2008; Herron, 2007; İş, 2003; Khalid, 1997; King, 1998; Nonoyama, 2006; Papanastasiou, 2000; Papanastasiou, 2002; Papanastasiou and Ferdig, 2006; Park, 2005; Paton, 2010; Rakap, 2010; Ram, 2006; Sullivan, 2005; Xu, 2006; Yılmaz, 2006;). It is seen that the most frequently studied properties in researches are knowledge about information technologies, reaching and using those technologies. It was observed that a great number of investigations into the relations of possessing a computer in particular, self-confidence in matters related to computers, computer using skills, and frequency of computer using to mathematical achievement were conducted. In some of those studies (Akinsola & Animasahun, 2007; Altun, 2007; Güven & Kosa, 2008; İş, 2003; Papanastasiou, 2000; Papanastasiou, 2006; Rakap, 2010; Yılmaz, 2006) possessing a computer and using it were usually found to increase achievement at mathematics whereas findings implying that those affected achievement negatively were found in others (Aypay, 2010; Bohannon, 1998; King, 1998; Papanastasiou, 2002; Paton, 2010; Sullivan, 2005). While Papanastasio found in 2000 that computer affected mathematical achievement in a positive way, the same researcher obtained evidence in 2002 to show that it had negative effects on mathematical achievement. Some research, on the other hand, found that computer related properties had differing effects, and some of those affected mathematical achievement in a positive way, some of them affected this in a negative way (King 1998; Duke, 2007).

The number of studies concerning the data of PISA 2006 is small in Turkey. Moreover, Turkey obtained score averages lower than other participant countries in the fields of mathematics, science and reading in PISA 2003 application (OECD, 2006b; Ministry of Education, 2005). Additionally, valuable data are obtained in this way about the responses given to the survey questions, which will provide feedback to our educational system (Ministry of Education, 2005).

The fact that investigations concerning possessing a computer, computer using skills, and computer using frequency produced different results, the special importance attached to the PISA exams by the Ministry of Education, expecting that information to be obtained following the research would be beneficial in terms of educational policies and maths teaching motivated us to conduct this research. The aim of this research, on whose completion all those effects were influential, is to predict the extent to which computer use affected Turkish students' mathematical achievement in PISA 2006 application in Turkey. Self-reliance in performing the

operations requiring high level of computer skills, self-reliance in performing internet-related operations, using computers for internet and entertainment purposes, and using computers for programme and software purposes were examined as variables predicting mathematical achievement in this research.

## METHOD

### The Population and The Sample

Due to the fact that the systems of pre-school education of countries participating PISA 2006, the age of starting formal education in those countries, and the educational systems were different; this was done on the basis of grade level rather than age level. Accordingly, the population was composed of students aged between 15 years and 3 months 16 years and 2 months who were registered in a school at the beginning of PISA assessment (OECD, 2007). And the sample of Turkey was composed of students chosen from 51 provinces of the 7 geographical regions, and the students were stratified on the basis of regions and school types. Thus, Turkey sample was composed of 4942 students chosen at random from 160 schools in the strata (Ministry of Education, 2007). Table 1 shows detailed information concerning the population and the sample.

Table 1. 15 year old students Population in Turkey and the population participating in PISA 2006 Application

The number of 15 year olds in Turkey	1 423 514
The number of 15 year olds registered in the 7th or higher grade	800 968
The number of those who do not fit conditions of assessment	970
<i>Research population</i>	782 875
<i>The number of students participating in the application (sample)</i>	4 942

### Data Collection

The PISA 2006 examination, which contained the fields of science studies, reading skills, and mathematics, was a 2-hour examination. Beside multiple choice questions, there were also open-ended questions to which students had to write their own answers in the exam. The questions were comprised of written texts or graphs students were probable to encounter in daily life (OECD, 2007). Apart from questions on mathematics, science and reading competencies, a student questionnaire, a school questionnaire and a parent questionnaire were also given prior to the exam to gather information on various social, cultural and economic factors that might be related to the students' academic achievement. The student questionnaire contained questions about students and their families, students' views on various issues, the environment, occupations, and duration of education. The students were given 30 minutes to answer the questions. School questionnaire was designed to obtain information about the features of the school, the school students' characteristics, the resources of the school, school staff, the organisation of the school, the topic of environment in the curriculum, the students' preparation for further education, and vocational guidance. The school questionnaire is completed by the school principal in 30 minutes.

Information on students' activities in the past, parents' views of the school principal, professions students would like, skills required in labour market, parents' views concerning the environment, the cost of education services, parents' level of education and their occupations was obtained through parents questionnaire. The data based on mathematics scores of 4942 students from 160 schools of 51 provinces of 7 geographical regions, responses given to the students' questionnaire, the school questionnaire completed by the principals, and parents questionnaire completed by parents were used in the research.

### Data Analysis

*Dependent Variable: Mathematics achievement score* is the scores obtained from the responses students give to 48 mathematics questions. Plausible value 1, of five mathematical plausible values showing the students' mathematical performances based on the previous studies and in line with expert opinions, is used as the mathematics achievement score in this research.

*Independent Variables:* Some variables in PISA studies were evaluated on the basis of responses that students, parents and managers gave to a series of questions, and were given as indices. The indices' meeting the expectations and the validity of international comparability were confirmed with structural equality model. Indices containing many questions and students' answers were scaled using the weighted maximum likelihood estimate (WLE), and analyses were performed with a parametered item response theory. Negative index values do not mean that students gave negative answers to the questions constituting the index. The case in which a student's value in an index is negative means that only this score of his is lower than the OECD average. As the index value increases in the plus direction, averages tend to climb above the OECD averages; and as the index value decreases in the minus direction, the averages tend to fall below the OECD averages (OECD 2007).

The independent variables used in the research are:

*The index of self-reliance in performing the operations requiring high level of computer skills:* This is an index formed on the basis of answers the students give to the question “How good are you at performing each of the following operations on computer? a) Using the software in detecting and disabling computer viruses, b) shaping digital photos or other graphic images, c) forming a database (for instance with Microsoft Access), d) using the word processor (for instance, writing an essay for school), e) using the electronic tabulating programme to draw a graph, f) preparing presentations (for example, by using the Microsoft Powepoint), g) preparing multi-media presentations ( with audio, photos, and videos), designing a web page”.

*The index of self-reliance in performing internet-related operations:* This is an index formed on the basis of answers the students give to the question “How good are you at performing each of the following operations on computer? a) Chatting in the internet, b) searching for information in the internet, c) downloading files or programmes from the internet, d) attaching files to the e-mail messages, e) downloading a song from the internet, f) writing and sending e-mails” in the students’ queatinaire.

*The index of using computers for internet and entertainment purposes:* This is an index formed on the basis of answers the students give to the question “how often do you use the computer for the following purposes? a) Surfing the internet to obtain information on people, objects, or views, b) playing games, c) using the internet for cooperation with a team or group, d) downloading software (including games) from the internet, e) downloading music from the internet, f) communicating (for instance, through e-mails or chat rooms)”.

*The index of using computers for programme and software purposes:* This is an index formed on the basis of answers the students give to the question “how often do you use the computer for the following purposes? a) Writing a document (for instance, by using the Word or Wordperfect), b) electronic tabulating (for instance, by using Lotus 1, 2, 3, or Microsoft Excel), c) using the drawing, paint, and graphic programmes, d) using the educational software such as maths programmes, e) preparing computer programmes”.

The multi-regression analysis programme was used so as to determine the effects of independent variables on mathematical achievement score (Büyüköztürk, 2007). The assumptions required for performing the regression analysis were tested, and the data were found to meet the assumptions (levin and Fox, 2007; Triola, 2005: Özdamar, 1997; Neter et al., 1985). Correlations between the dependent variable and the independent variables as well as descriptive statistics concerning the variables are shown in Table 2.

Table 2. Correelations Between Dependent and Independent Variables

	1	2	3	4	5
1. Mathematics achievement score	1,000				
2. self-reliance in performing the operations requiring high level of computer skills	.066**	1.000			
3.self-reliance in performing internet-related operations	.289**	.732**	1.000		
4. using computers for internet and entertainment purposes	.004	.525**	.536**	1.000	
5. using computers for programme and software purposes	-.170**	.544**	.352**	.650**	1.000
Means	431.41	-.26	-.59	-.04	.41
Standard deviation s	93.89	1.11	1.17	1.12	1.23

\*\*p < .01

Table 2 makes it clear that the highest correlation holds between mathematics achievement score and the index of self-reliance in performing internet-related operations; which is followed by the index of using computers for programme and software purposes, and this is in a negative way. Those are followed by the index of self-reliance in performing the operations requiring high level of computer skills, and the index of using computers for internet and entertainment purposes ranking last and having a slight correlation. Since correlations do not exceed

the value of 0.80 according to the table, it was concluded that multi-colinearity was not available (Büyüköztürk, 2007; Özdamar, 1997).

### FINDINGS AND INTERPRETATIONS

According to the results of the regression analysis given in Table 3, it may be said that the model constructed with the variables of the index of self-reliance in performing the operations requiring high level of computer skills, the index of self-reliance in performing internet-related operations, the index of using computers for internet and entertainment purposes, and the index of using computers for programme and software purposes is statistically significant ( $F=240.45$ ;  $p < 0.01$ ). The independent variables account approximately for 17.7% of the total variance in mathematical achievement. According to standardized regression coefficient ( $\beta$ ), the relative order of importance of predictive variables on mathematics achievement score is the index of self-reliance in performing internet-related operations, the index of using computers for programme and software purposes, the index of self-reliance in performing the operations requiring high level of computer skills, and the index of using computers for internet and entertainment purposes, respectively. According to the t-test results concerning the statistical significance of regression coefficients, it becomes evident that the index of using computers for internet and entertainment purposes is not a significant predictor. Since the t-values of all other variables are statistically significant, they may be said to be significant predictors of mathematics scores.

Table 3. The Results of Regression Analysis Concerning computer Using Skills Affecting Mathematical Achievement

Model	unstandardised		Standardise	t	F
	B	Std error	d Regression coefficient ( $\beta$ )		
Constant	459.43	1.59		288.63**	
self-reliance in performing the operations requiring high level of computer skills	-13.07	1.89	-.16	-6.93**	
self-reliance in performing internet-related operations	40.41	1.72	.50	23.48**	240.45**
using computers for internet and entertainment purposes	-1.85	1.67	-.02	-1.11	
using computers for programme and software purposes	-18.97	1.49	-.25	-12.77**	
	$R=0,421$	$R^2=0,177$	$** p < 0,01$		

According to the sign of regression coefficients, the indices of self-reliance in performing the operations requiring high level of computer skills, using computers for internet and entertainment purposes, and using computers for programme and software purposes were found to have negative effects on students' mathematics achievement scores. In other words, as the scores in those indices rose, students' mathematical achievement scores tended to fall. And the index of self-reliance in performing internet-related operations affected mathematical achievement scores positively. Accordingly, students' mathematical achievement scores are closely related with self-reliance in performing the operations requiring high level of computer skills, self-reliance in performing internet-related operations, and using computers for programme and software purposes.

The finding of this research demonstrating that students' self-reliance in performing internet-related operations have a positive effect on their mathematical achievement scores supports the work done by Papanastasiou and Ferdic (2006) suggesting that using computers for internet purposes affects children's mathematical achievement scores positively. Yet, what is important here is that time students spend on computer should be limited. Students spending excessive time in the internet may come up with a fall in success at their classes. In a similar vein, the finding that students' using computers for programme and software purposes has a negative effect on their mathematical achievement score is compatible with the conclusions reached by Papanastasiou and Ferdic (2006) suggesting that using computers for programme and software purposes contributes to children's mathematical achievement scores in a negative way. This is because students concentrate on programme and software matters excessively, and they do not allocate sufficient time for other matters such as mathematics. No significant effects were determined for using computers for internet entertainment purposes on mathematical achievement. The findings obtained support conclusions reached by Güven and Kosa (2008), Rakap (2010), Akinsola and



Animasahun (2007), İş (2003), Yılmaz (2006), Altun (2007), and Papanatasiou (2000: 2006) in terms of the variable of self-reliance in performing internet-related operations on the computer whereas the findings in terms of other variables support conclusions reached by Aypay (2010), Paton (2010), Bohannon (1998), King (1998), Sullivan (2005), and Papanatasiou (2002). When the findings for all the variables are concerned, it could be said that conclusions similar to the ones reached by King (1998) and Duke (2007) were reached. In this research, the variable of self-reliance in performing internet-related operations affected mathematical achievement positively whereas the effect of the variable of using computers for internet and entertainment purposes was not found to be significant. On the other hand, it was concluded that the variables of self-reliance in performing the operations requiring high level of computer skills and using computers for programme and software purposes affected mathematical achievement in a negative way and at a considerable level.

## CONCLUSIONS

The research findings showed that students' self-reliance in performing the operations requiring high level of computer skills ( using the software for detecting and disabling computer viruses, shaping digital photos or other graphic images, forming a database – for instance with Microsoft Access), using the word processor (for instance writing an essay for school), using electronic tabulating programme in drawing graphs, preparing presentations (for instance by using Microsoft powerpoint), preparing multi-media presentations (audio, photos, videos), and designing web pages affected the mathematics achievement scores in a negative way. In order to learn such advanced computer skills, students may need to spend most of their time at computer. Therefore, because they could not allocate sufficient time for their lessons, their scores might have fallen.

Based on those results, it might be said that students' using computers in line with their needs, parents' controlling the time their children use computers, the internet and computer for entertainment purposes would be beneficial. Besides, the time students spend at computer should be determined, and studies in which independent variable and mixer variables are considered separately should be performed. Thus, the effect of time spent at computer on mathematical achievement and the effects of independent variables independently of the time can be specified.

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