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The effect of the aim and frequency of computer usage on student achievement according to PISA 2006

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Abstract

Developments in the field of internet bring along the developments in education. The increase in the importance of the use of computers and the internet in the field of education necessitated the measurement of this dimension in the tests which are applied in wide scales. The research problem consists of the effect of the computer access and aim of computer use of 15 year-old students who participated in the computer part of the Programme for International Student Assessment (PISA 2006) over their achievements in science. The variant that best processes the students' achievement in science and the most important factor that affects achievement is students' access to computers.

Keywords: Structural Equation Modeling, Program for International Student Assessment (PISA), Science Achievement.

Introduction

With globalization, circulation of information has increased, and maximum utilization of information and information technologies has also been developed. The twenty-first century has been seen as the century in which information and communication technologies are being used intensively. Information accumulates day by day on a global scale. The intensity in the scientific and technological developments influences people in every domain of life. On the one hand, this case brings out new needs; while, on the other hand, meeting the already existing demands. It is possible to observe such a need in the field of educational science as well. The rapid developments in internet technologies enabled a shift from a teacher-centered education paradigm to a student-centered education paradigm. The education of the twenty-first century is exempt from time and space; it is aim-oriented as well as end-oriented, it is student-centered, it is predominantly about active team work, it aims at achieving education, and it should harbor the differences in skills and language (Aggarwal, 2000). In addition to this, it has been thought that there are two important phenomena that the twenty-first-century education has. These are life-long learning and information society. Information society signifies a society which is composed of people who experience an intense exposure to information. In order to furnish such an education, it is obviously visible that the use of technology in education is required. When such technologies are considered, the first ones to come to mind are obviously computers and the internet (Yilmaz and Horzum, 2002). Developments in the field of internet bring along the developments in education. The increase in the importance of the use of computers and the internet in the field of education necessitated the measurement of this dimension in the tests which are applied in wide scales. In order to

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see the effect of this dimension of students' achievement, several measurement-evaluation studies have been done by using standard tests and questionnaires at national and international levels as well as at different class levels.

The PISA project is one of the wide-scale tests in which Turkey is also a participant. This project evaluates to what extend 15 year-old students in the OECD countries have achieved the knowledge and the skills to integrate into society after their compulsory education by focusing on their basic skills in the field of mathematics and science, and also their reading skills. PISA not only researches whether these students re-use the things they have learned but also researches whether they make predictions about the unknown by using their knowledge, and whether they apply the knowledge they have obtained in schools into extracurricular situations (Ministry of Education, 2007). Although the 2006 PISA study covers the reading skills and the field of mathematics, it also includes cognitive tests that aim to measure the academic performance of students who are science-oriented, along with parent and school questionnaires which are prepared to evaluate the student as a whole. The questionnaires are important in their potential to determine the factors that affect students' academic achievements. One of the questionnaires applied within the framework of PISA is the questionnaire on the use of computers. This questionnaire focuses the students' access and use of computer and communication technologies, where and in what frequency they use computers, and their aims of use and their proficiency in terms of computer use (OECD, 2005).

In its preliminary report, PISA 2006 stated that students' comprehension skills on electronic texts, which reflect the importance of information and computer technologies in the contemporary world, will be assessed in the prospective PISA tests as well. When this is taken into consideration, it is seen that the importance of students' computer use skills increase. Today, the rapid changes in the information and communication technologies, and the changes in the demands from the individuals in contemporary world naturally affect approaches in education, and it enhances the importance of technology in the teaching-learning processes. In terms of the operability of these processes, it is necessary that the student, who is the main input of education, be sufficiently equipped technology-wise, and that the student have the basic skills to use this in the education environment. Moreover, where and how frequently students use technology, their aims of use, and their proficiencies in computer use are also important.

The research problem consists of the effect of the computer access and aim of computer use of 15 year-old students who participated in the computer part of the Programme for International Student Assessment (PISA 2006) over their achievements in science.

Research Model: In this research, it was analyzed whether there is a relationship between the items related to the 15 year-old students' aims of computer use and the results of cognitive tests in the section concerning the computer use of the student questionnaire in the PISA 2006 which was done among OECD countries. Due to this aspect, this research is a relational study which puts forth the levels of relationships, and the relationships between the variants.

Population and Samples: 15 year-old students who study in Turkey represent the universe of this research. The samples of the research consist of 4252 15 year-old students, who have been selected randomly by stratifying according to region and school type, from 7 geographical regions, 51 cities, and 160 schools in total.

Data Gathering Tools: In the study, the cognitive test and the computer questionnaire, which are applied in order to measure the science literacy of students within the scope of PISA 2006, were used. In the cognitive test, various question types were used such as multiple choice, complex multiple choice, open-ended, and closed-ending. Each student answered one of the 13 booklets which were selected randomly. The developed measuring tools is composed of evaluation units, and a unit consists of a series of root questions, which is comprised of texts, tables, and graphics; and these root questions are followed by questions that students may come across with in daily life. Each student is tested with the different combinations of the booklet in a 120-minute long assessment test (Ministry of Education, 2007).

Data Gathering: The data was obtained through the internet from the PISA 2006 data files in the PISA Turkey database of EARGED (Department of Education Research and Development)

Data Analysis: In order to determine the dimensions of the computer use questionnaire, the questions in the questionnaire were analyzed through the principal components factor analysis. In the analysis of the data, first of all, the appropriateness of the data for factor analysis was investigated via KMO (Kaiser-Meyer-Olkin) coefficient and Barlett Sphericity test. Buyukozturk (2006) states that if the KMO is higher than 0.60 and the Barlett test is meaningful, it is indicative of the appropriateness of the data for factor analysis. The calculated KMO coefficient value after the factor analysis of the data was found 0.80. Since this value is higher than 0.60 (0.80>0.60), it was determined that the data was appropriate for factor analysis. The Barlett test was meaningful. The factor weights and the eigenvalues of the factors of the questions were examined. It was seen that the 14 items which were analyzed collected under four factors whose eigenvalues are higher than 1. The total variant values these four factors explain were 47.88. For a modeling study with the determined variants, a structural equation modeling was used which was formed by using LISREL 8.7 program.

The model was tested by using Robust Maximum Likelihood on the 0.05 meaningfulness level. The lost values in the data were erased by using listwise deletion method. In this study, how compatible the suggested relationship patterns are with the real data was determined by determining the variants and the relationships between them by using structural equation modeling.

There are different goodness of fit indexes, and boundary values related to whether these indexes could be acceptable in the determination of the appropriateness of the model. The goodness of fit indexes and their values are as follows (Schermelleh-Engel and Moosbrugger, 2003):

Root-Mean-Square of Error Approximation (RMSEA): values equal to and lower than 0.05 refer to a good fitness, values equal to 0.10 and below refer to an acceptable fitness, and values bigger than 0.10 refer to bad fitness.

The Normed Fit Index (NFI): They take values changing in between the 0-1 range, and 0.95 refers to a good fit, values between 0.90 and 0.95 refer to an acceptable fit.

Comparative Fit Index (CFI): values equal to and bigger than 0.97 refer to a good fit and values between 0.95 and 0.97 refer to an acceptable fit.

Findings and Interpretation

In the study, 3 latent variants, which are thought to be related to students' achievement in science, were determined, namely, their access to computers (ACCESS), the frequency of computer use for fun (SKILL1), and the frequency of advanced computer use (SKILL2). The variants observed in computer use questionnaire and the latent variants processing these variants were defined as follows:

Table 1. Abbreviations for the Latent and Observed Variants Used in the Model

Latent Variants	Observed Variants
Access to Computer (ACCESS)	Having a computer (COMP)
	Having a computer program (COMPROG)
	Having the internet (INTERNET)
	How long have you been using computers? (DURATION)
Student's Computer Use for Fun (SKILL1)	Surfing the internet to learn about people, objects, and ideas (INTERNT1)
	Internet use for collaboration with a group or team (INTERNT2)
	Downloading software (including games) (INTERNT3)
	Downloading music (INTERNT4)
	Playing games (GAMES)
	Communication (e.g. e-mails or "chat rooms") (COMMUN)
Frequency of Student's Advanced Computer Use (SKILL2)	Electronic tabulation (e.g by using Lotus 1 2 3 ® or Microsoft Excel ®) (TABUL)
	Using drawing, painting or graphics programs (GRAPHICS)
	Using education software such as mathematic programs (SOFTWARE)
	Writing computer programs (PROWRI)

When Table 2 was examined, it was seen that the observed variants belonging to the access to computers (ACCESS) are the variants called "Having a computer" (COMP), "Having a computer program" (COMPROG), "Having the Internet (INTERNET), and "How long have you been using the computer?" (DURATION). The observed variants belonging to SKILL1 (Student's frequency of internet use for fun) are called "Surfing the internet to learn about people, objects, and ideas (INTERNT1), "Playing games" (GAMES), "Internet use for collaboration with a group or team (INTERNT2), "Downloading software from the internet (including games)" (INTERNT3), "Downloading music from the Internet" (INTERNT4), and "Communication – for example e-mails or "chat rooms" (COMMUN). The observed variants belonging to SKILL2 (student's advanced computer use) are called "Electronic

Tabulating – for example by using Lotus 1 2 3 ® or Microsoft Excel ®" (TABUL), Using drawing, painting or graphics programs (GRAPHICS), Using education software such as mathematic programs (SOFTWARE), and Writing computer programs (PROWRI).

The structural model which shows the standard coefficients related to the relationship between independent and dependent latent variant, and the relationship between the observed and the independent latent variants in the structural equation model are given in Figure-1. When the model goodness of fit indexes are examined, the fact that the RMSEA value is 0.044 indicates a good fit. The fact that the NFI value is 0.98 and the CFI value is 0.98 also indicate that the model shows a good fit.

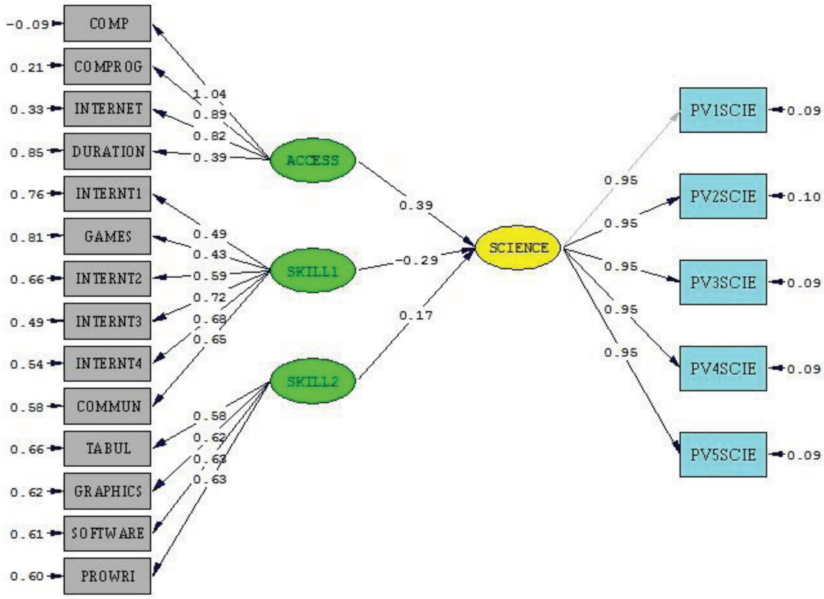

Figure 1. Structural Equation Model Related to Science Achievement (Standard Coefficients)

When Figure 1 was examined, it was determined that the variant that best processes the students' achievement in science and the most important factor that affects achievement is "Students' access to computers" (ACCESS). It was seen that the correlation between students' access to computers and their achievement in science is meaningful ($p<0.05$) and positive. The correlation coefficient is $\gamma=0.39$. This result overlaps with the findings that take place in the report of Education Reform Initiation (ERI), which states that there is a correlation between having a computer at home and achievement in science. The second meaningful correlation in the model is the one between the latent variant SKILL2 (student's frequency of advanced computer use) and SCIENCE (achievement in science). The correlation coefficient is $\gamma=0.17$. The high frequency of students' use of computers to make electronic tables, to use education software, or to write computer programs affect their achievement in science positively. This result of the research is backed up by the results of other studies (Christman E., Badgett J., 1999; Hativa, N, 1994) which also demonstrate a positive correlation between students' academic achievement and computer use. The correlation between SKILL1 (students' use of computers for fun) and students' achievement in science is meaningful but negative. The correlation coefficient is $\gamma=-0.29$. The fact that students have a high frequency of computer use for fun, communication, and surfing affect their science achievement in a negative way.

The interpretation of the model's regression equation is relevant to determine the model's explained variants (R^2).

SCIENCE = 0.39*ACCESS - 0.29*SKILL1 + 0.17*SKILL2, Errorvar.= 0.83, $R_1 = 0.17$

When the regression equation was examined, it was seen that the determination coefficient (R^2) is 0.17. The fact that this value is 0.17 shows that the three variants determined from the computer use questionnaire applied to

15 year-old students who participated in the PISA 2006 in Turkey explained 17% of the science achievement of students.

Conclusion

In this study, it was seen that the effective factors that affect students' achievement in science are students' having a computer, access to the internet, a computer program, and their duration of computer use. This result of the study was backed up by the studies (Fuch and Woessman, 2004; Turmo, 2004; Wen, Barrow and Alspaugh, 2002), which determined that there is a positive correlation between students' having access to computers at home or school and their academic achievement. This result of the study was also backed up by the findings of Erbas's study (2005), which concluded that there is a positive correlation between the science literacy measurements and basic computer knowledge and internet use. Moreover, in his study on the use of computers in science classes, Miller-Whitehead (2002) concluded that the success scores of students who frequently use computers is significantly low compared to the students who use computers less frequently. This finding also overlaps with the findings of this study. It was seen that the use of the internet for entertainment, surfing, playing games, downloading music and software have a negative effect on science achievement.

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