FACTORS AFFECTING SCIENTIFIC LITERACY OF STUDENTS IN TURKEY IN PROGRAMME FOR INTERNATIONAL STUDENT ASSESSMENT (PISA)

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ABSTRACT

FACTORS AFFECTING SCIENTIFIC LITERACY OF STUDENTS IN TURKEY IN PROGRAMME FOR INTERNATIONAL STUDENT ASSESSMENT (PISA)

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The purpose of this study is to examine the factors that are related to scientific literacy of 15-year old students in Turkey in the Programme for International Student Assessment (PISA) data. Two groups of variables were considered for the analyses. In the first group; number of books at home and attendance to preschool, attitudes towards school, student-teacher relation, feeling of loneliness, remedial study and homework and attending out-of-school courses were taken as variables that are related to scientific literacy. In the second group, basically, variables that are related to computer literacy and usage were considered. These variables are: frequency of using internet, frequency of using computer, basic computer skills, advanced computer skills and attitudes towards computer.

The results indicated that quality of student-teacher relation, the number of books at home and attendance to preschool education, use of internet and basic computer skills are positively related to scientific literacy measures of the students.

As expected, student feeling of loneliness has negative impact on literacy skills. Remedial classes conducted by schools and homework assignments have positive effect on school related attitude, but they cannot contribute scientific literacy skills of the students. Outside school private courses has positive relation with the scientific literacy, but this effect rather seems coming from family background characteristics. Use of internet and basic computer skills might have positive relation with both attitudes towards computer and scientific literacy, but use of software programs and advanced computer skills indicated negative relationship with the scientific literacy measures of the students.

Key Words: Programme for International Student Assessment (PISA), Scientific Literacy, Structural Equation Modeling, Attitudes towards School, Attitudes towards Computer

ÖZ

ULUSLARARASI ÖĞRENCİ BAŞARI DEĞERLENDİRME PROGRAMINDA (PISA) TÜRKİYE' DE FEN OKURYAZARLIĞINI ETKİLEYEN FAKTÖRLER

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Bu çalışmanın amacı Uluslararası Öğrenci Başarı Değerlendirme Programının verilerine göre Türkiyede fen okuryazarlığı ile ilgili faktörlerin incelenmesidir. İki değişken grubu analizler için kullanılmıştır. İlk grupta; evdeki kitap sayısı ve okul öncesi eğitime katılma, okula karşı tutumlar, öğretmen öğrenci ilişkisi, yalnızlık duygusu, okuldaki iyileştirici çalışmalar ve ev ödevi sıklığı ve okul dışı özel kurslar gibi fen okuryazarlığı ile ilgili değişkenler alınmıştır. İkinci grupta, temel olarak, bilgisayar kullanımı ve bilgisayar tutumları ile ilgili değişkenler incelenmiştir. Bu değişkenler: internet kullanma sıklığı, bilgisayar kullanma sıklığı, temel bilgisayar bilgileri, ileri bilgisayar bilgileri ve bilgisayar tutumlarıdır.

Araştırmanın sonuçlarına göre; öğretmen öğrenci ilişkisi, evdeki kitap sayısı ve okul öncesi eğitime katılım, internet kullanımı ve temel bilgisayar bilgileri ile fen okuryazarlığı ölçümleri arasında olumlu bir ilişki çıkmaktadır. Beklendiği gibi, öğrencinin yalnızlık duygusunun fen okuryazarlığı becerilerine olumsuz bir etkisi

vardır. Okul tarafından gerçekleştirilen iyileştirici kursların ve ev ödevlerinin okulla ilgili tutumlara olumlu bir etkisi vardır, fakat öğrencinin fen okuryazarlığı becerilerine herhangi bir katkısı yoktur. Okul dışı özel kursların fen okuryazarlığı ile olumlu bir ilişkisi vardır, ama bu etkinin aile geçmişinin özelliklerinden geldiği görülmektedir. İnternet kullanımı ve temel bilgisayar becerilerinin bilgisayar tutumları ve fen okuryazarlığı ile olumlu bir ilişkisi varsa da yazılım programlarının kullanımı ve ileri bilgisayar becerilerinin fen okuryazarlığı ile olumsuz bir ilişkisi olduğu görülmüştür.

Anahtar Kelimeler: Uluslararası Öğrenci Başarı Belirleme Programı (PISA), Fen Okur Yazarlığı, Yapısal Denklem Modellemesi, Okula Yönelik Tutumlar, Kullanımı, Bilgisayar Tutumları

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I would like to thank Prof. Dr. Giray Berberoğlu for his great help and patience.

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LIST OF ABBREVIATIONS

hwmnbook	=	How many books are there in your home?
isced0	=	Attend <ISCED 0>
donlitle	=	School done little
wastetim	=	School waste of time
givconfi	=	School given confidence
scuseful	=	School useful
wellstdn	=	Well with Students
intrstds	=	Interested in Students
listenme	=	Listen to me
givehelp	=	Give extra help
treatme	=	Treat me fairly
outsider	=	Feel an outsider
felawkw	=	Feel awkward
fellone	=	Feel lonely
hrhomewo	=	Hours All homework
hrremedi	=	Hours All <Remedial>
hrenrich	=	Hours All <Enrichment>
hrtutor	=	Hours All tutor
outschol	=	Hours All <out-of-school>
hoftinfo	=	How <u>often</u> do you use: the Internet to look up information about people, things, or ideas?

hofdwnmu	=	How often do you use: the Internet to down-load music?
hoftword	=	How often do you use: Word processing (e.g. <Word ® or WordPerfect®>)?
hofgraph	=	How often do you use: drawing, painting or graphics programs on a computer?
hofedsof	=	How often do you use: educational software such as Mathematics programs?
hoflearn	=	How often do you use: the computer to help you learn school material?
hofprogr	=	How often do you use: the computer for programming?
hwelsave	=	How well can you save a computer document or file.
hwelprin	=	How well can you Print a computer document or file.
hweldele	=	How well can you Delete a computer document or file.
hwelmove	=	How well can you Move files from one place to another on a computer.
hwelprog	=	How well can you Create a computer program (e.g. in <Logo, Pascal, Basic>).
hwelplot	=	How well can you Use a spreadsheet to plot a graph.
hwelppoi	=	How well can you Create a presentation (e.g. using <PowerPoint>).
hwelmult	=	How well can you Create a multi-media presentation (with sound, pictures, video).
hwelwebp	=	How well can you Construct a web page.
feelimpo	=	It is very important to me to work with a computer.
feelfun	=	I think playing or working with a computer is really fun.
feelintr	=	I use a computer because I am very interested.
feelfget	=	I lose track of time when I am working with the computer.
pv1scie	=	1st Plausible Value in Science
pv2scie	=	2nd Plausible Value in Science
pv3scie	=	3rd Plausible Value in Science
pv4scie	=	4th Plausible Value in Science
pv5scie	=	5th Plausible Value in Science

CHAPTER 1

INTRODUCTION

This study is about factors that are related to scientific literacy of the Turkish students through the use of data from Programme for International Student Assessment (PISA 2003). Two groups of variables were considered for the analyses. In the first group; family background characteristics, attitudes towards school, student-teacher relation, feeling of loneliness, remedial study and homework and attending out-of-school courses were taken as variables that are related to scientific literacy. In the second group, basically, variables that are related to computer literacy and usage were considered. These variables are: frequency of using internet, frequency of using computer, basic computer skills, advanced computer skills and attitudes towards computer.

1.1 Programme for International Student Assessment (PISA)

"Programme for International Student Assessment (PISA) is a collaborative effort on the part of the Member countries of the OECD to measure how well young adults, at age 15 and therefore approaching the end of compulsory schooling, are prepared to meet the challenges of today's knowledge societies" (Literacy Skills for the World of Tomorrow, OECD 2003, p11). The assessment focused on young people's ability to use their knowledge and skills to meet real-life challenges, rather than they have mastered a specific school curriculum.

PISA is a programme to assess student performance and family and institutional factors that can help to explain differences in performance. Its investigations are repeated every three years and data are published regularly in order to develop new research studies. In PISA 2000 reading literacy was the major domain but the PISA 2003 focused on mathematical literacy besides the scientific literacy and reading. In PISA 2006, scientific literacy will be the major domain of the assessment. Turkey participated the PISA in 2003.

Even though the PISA studies are basically designed for the OECD countries, non-OECD countries are also interested in the project and participated to get feedback about their educational systems. The three years period in data collection gives opportunities to the countries to actualise educational reform and follow up the trends in various aspects of the school administrations and students. The PISA 2003 is focused on mathematical literacy, but in the present study scientific literacy of the students will be considered.

1.2 Literacy and Scientific Literacy

Literacy refers to the ability to read and understand the language. Scientific literacy means the ability to read and understand basic scientific concepts. In order to be scientifically literate, students should be able to make sense of the science stories they read about in the news, be able to form well-reasoned opinions on basic issues in science that affect their lives, have enough scientific grounding so that they can detect pseudoscientific claims, and so on public (Mahoney, P., Ask A Scientist, Science Archive. NEWTON, Argonne National Laboratory. April 24, 2003).

Scientific literacy is defined as "the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity" (National Science Education Standards, National Academy of Sciences, 1996, page 22). National Science Standards also stated that:

“Scientific literacy means that a person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain, and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. Scientific literacy implies that a person can identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its source and the methods used to generate it. Scientific literacy also implies the capacity to pose and evaluate arguments based on evidence and to apply conclusions from such arguments appropriately” (National Science Education Standards, page 22).

In order to communicate effectively cultures should underscore the differences between scientists and non-scientists because analytical skills and objectivity are the critical differences between scientists and public (Hoffmann, Ask A Scientist, Science Archive. NEWTON, Argonne National Laboratory. April 24, 2003). Today's World it seems more prominent to enhance scientific literacy of the citizens for a successful life span. The American Association for the Advancement of Science (AAAS) defines scientific literacy as;

> "the ability to understand basic science terms and general topics and thereby participate in scientific discussion and debate. One who is scientifically literate as one who is aware "that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; …" (Britannica Student Encyclopaedia, 2005, http://www.britannica.com/ebi/article?tocId=9309811)

"PISA defines scientific literacy as the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and human interactions with it" (Literacy Skills for the World of Tomorrow - Further Results From PISA 2000 , p20).

1.3 The Present Study

In Turkey, there are few studies about scientific literacy. None of them is about factors that are related to students' scientific literacy skills. Instead, they focused on teachers' scientific literacy in Turkey. Bacanak (2002) published his thesis investigating student teachers' scientific literacy and application of science-technology-society course. Akdur (2002) examines "A Study about the evaluation of the science". He also discussed the development of some components of scientific literacy in basic education. Yakmacı (1998) searched science (biology, chemistry and physics) teachers views on the nature of science as a dimension of scientific literacy.

Since PISA project is rather new, not many researches have investigated PISA data base in depth in terms of scientific literacy. Lempke and Limpman (2001) published an article summarizing PISA 2000 results. Their report presents results from the first cycle of the Program for International Student Assessment (PISA). De Jong and Savelsburgh presented an article about scientific and mathematical literacy in PISA. Tamassia, Schleicher and Andreas published an article about Reading, Mathematical and Scientific Literacy. This publication describes the instruments used in the PISA assessment. It introduces the PISA approach to assessing reading, mathematical, and scientific literacy with its three dimensions of processes, content, and context. The document presents tasks from the PISA 2000 assessment and explains how these tasks were scored and how they relate to the conceptual framework underlying PISA.

By analizing the data obtained from the Program for International Student Assessment, Papanastasiou (2003) examined how variables related to computer availability; computer comfort and educational software are associated with higher or lower levels of science literacy in the USA, Finland and Mexico, after controlling for the socio-economic status of the students. He showed that it was not computer use itself that had a positive or negative effect on the science achievement of the students, but the way in which the computers were used within the context of each country.

In Hungary and Turkey, variation in performance between schools is particularly large and is about twice the OECD average between-school variance. "Where there is substantial variation in performance between schools and less variation between students within schools, students tend to be grouped in schools in which other students perform at levels similar to their own. This may reflect school choices made by families or residential location, as well as policies on school enrolment or the allocation of students to different curricula" (Learning for Tomorrow's World - First Results From PISA 2003, page 163).

1.3.1 Purpose of the Study

In this study, some student related variables were considered within the framework of LISREL models to explain the scientific literacy scores of the Turkish students in the PISA 2003. Basically two groups of variables were considered in the

LISREL models. In the first group as perceived by the students trough the Student Questionnaire, student-teacher relation, feeling of loneliness, hours spent for remedial study and homework, hours spent for coaching, attitudes towards school were selected for the first LISREL model. In this group, attendence to preschool education (isced) was also included and a second model for this group was tested With the increased importance and demand of using computers for educational purposes, in the second LISREL model computer related variables such as frequency of using internet, frequency of using computer software, basic computer skills, advanced computer skills, attitudes towards computer were considered to explain the scientific literacy of the Turkish students.

The first hypothetical model tested by LISREL is presented in the Figure 1.1 below:

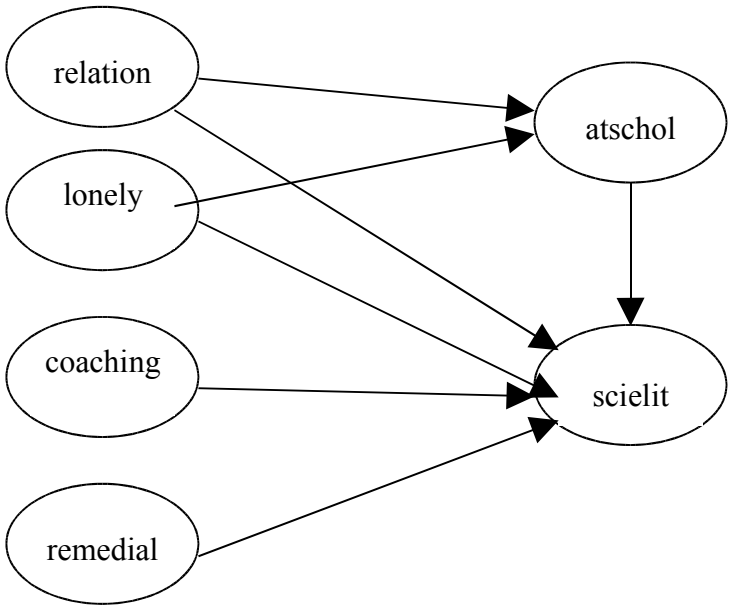

Figure 1.1 Hypothesized Scientific Literacy Model with Student Related Variables

In this hypothetical model to be tested, attitudes toward school (atschol) and scientific literacy of the students (scielit) were used as two dependent latent variables. The other variables such as student-teacher relations (relation), feeling of loneliness (lonely), hours spent for out of school courses (coaching) and hours spent for remedial study and homework (remedial) were taken as independent variables. The impacts of these independent variables on the dependent variables were tested in the LISREL analysis. In the same model, number of years attended to preschool

education and number of books at home (isced) were taken to define an additional independent latent variable, in order to control the effect of these variables and evaluate the impact of home family background characteristics on student scientific literacy skills.

The second hypothetical model by using student questionnaire tested by LISREL is presented in the Figure 1.1 below:

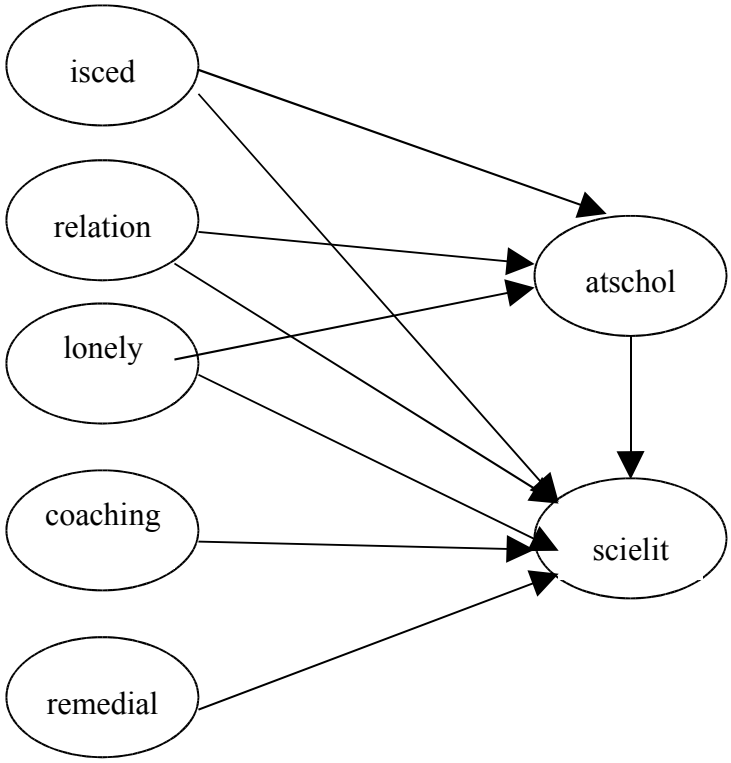

Figure 1.2 Hypothesized Scientific Literacy Model with Student Related Variables with Five Independent Variables

In this hypothetical model to be tested, attitudes toward school (atschol) and scientific literacy of the students (scielit) were used as two dependent latent variables. The other variables such as number of years attended to preschool education and number of books at home (isced), student-teacher relations (relation), feeling of loneliness (lonely), hours spent for out of school courses (coaching) and hours spent for remedial study and homework (remedial) were taken as independent variables. The models proposed above were constituted in line with the literature

survey. The summary of the literature survey was given below to support the models proposed for the LISREL analyses.

The reason of treating the number of books at home and years attended to preschool education has strong support in the literature. The positive impact of kindergarten on educational outcomes in the following years was reported in the related literature (Karweit & Wasik, 1992). Very recently Kağıtçıbaşı et.al (2005) reported supporting findings for the preschool attendance among the Turkish students. Beside this, number of books at home has become a very typical indicator of the family education level in many studies, especially in the international comparative studies, such as TIMSS and PIRLS (Third International Mathematics and Science Study and Progress in international reading Literacy Study). Therefore, in the model tested, a significant relation was expected between the latent variable characterized by the preschool attendance and number of books at home and the scientific literacy of the Turkish students.

In this study student-teacher relations were expected to significantly affect scientific literacy as well. Some research studies indicated that student-teacher relations positively influence students' learning. Miller (2000) found that teacher-student climate does have a significant effect, even after controlling for individual race, gender, poverty, and prior achievement. In Italy, the factors with the strongest relationship with student performance are disciplinary climate at school, the quality of the physical infrastructure, teacher-related factors of school climate, and student-teacher relations (PISA Press Briefing, Briefing Note Italy, OECD, 2001, p4).

Lyons and others (1997) found a significant impact of stressful life events, test anxiety, perception of health, and self esteem on students general achievement level. In the present study students feelings about themselves in terms of peer group relations was taken as one of the latent variables to consider in the LISREL models.

According to Juarez (2001) providing a caring and supportive environment was found to be a necessary component in achieving student academic success. His findings indicated significant relationship between homework and academic achievement; the lower the percentage of homework completed, the lower the test scores. Therefore in the present study a significant relationship between homework assignments and scientific literacy is expected.

New Zealand PISA results indicated a significant link between the performance of 15 years olds and their expressed engagement in school. Students who reported positive attitudes towards school performed better than students who did not report such attitudes (PISA 2000: Overview of Selected New Zealand Findings, 2002, p2).

The third hypothetical model tested is presented in the Figure 1.2 below:

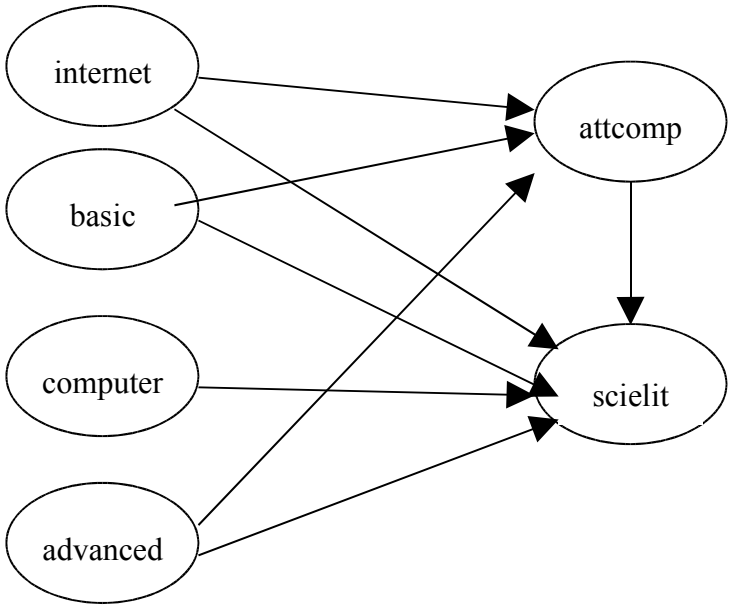

Figure 1.3 Hypothesized Scientific Literacy Model with Computer Related Variables

In this hypothetical model to be tested, attitudes toward computer (attcomp) and scientific literacy of the students (scielit) were used as two dependent latent variables. The other variables such as frequency of using internet (internet), basic computer skills (basic), frequency of using computer (computer) and advanced computer skills (advanced) were taken as independent variables.

According to the results of some researches from the literature, negative relationship was reported between the frequency of computer use and the achievement of the students. For instance based on the 1995 TIMSS results, a negative relationship between the computer use and mathematics achievement of the students was reported in the participating countries (Pelgrum and Plomp, 2002). Miller (2002) reported that standardized mean difference in achievement of students who used computers and those who did not suggested that students who used computers more often for science had significantly lower science achievement scores

than students who used computers less often. According to the report of TIMSS (Third International Mathematics and Science Study), frequency of computer usage has a negative and significant effect on learning achievement.

1.3.2 Significance of the Study

PISA is an important study because it provides comparisons of the educational performance of different countries and gives chance to revise their educational policies. PISA studies are focused on literacy concept therefore they are related to everyday life. It searches new ways to develop the usage of knowledge learned in schools and to prepare students for modern life.

This study examines the factors that are related to scientific literacy of 15-year-old students in Turkey through the use of the data from PISA. In this respect it is original and has not been investigated before. Moreover, a special emphasis was given to computer literacy and skills in the models studied. The results of this particular analysis are expected to enlighten the educators and education policy makers to revise and review the policies about the use of computers at the Turkish school system to enhance student literacy skills. From this perspective, this study is also unique in the literature where the PISA data base is used to develop policy notes for using computers in the Turkish educational system.

1.3.3 Definition of Important Terms

1. Attitudes towards School

Attitudes towards School are the general idea of students about schools. It emphasizes the belief that students are well prepared for adult life or business world by schools. Students may think that school gives confidence to make decisions and they are very useful for their future. Similarly, they may believe that they learn and be informed about professional life so school gives necessary skills which could be useful in a job. All the beliefs or notions of students about schools are named School view in this thesis.

2. *Student-Teacher Relations*

A student-teacher relation is an important factor that can affect students' attitudes towards courses and schools. It includes students' ideas about teacher's treats or approach toward students.

3. *Feeling of Loneliness*

Feeling of Loneliness defines students' feelings about being outsider and out of place at school.

4. *Hours Spent for Remedial Study and Homework*

It defines how many hours students spend for their remedial studies at school and teacher assigned homework each week.

5. *Attending Out of School Classes*

It defines how many hours students attend out-of-school classes in each week.

6. *Number of years attended to preschool education and number of books at home*

Number of years attended to preschool education and number of books at home is defined by the number of books at students' home and attendance of kindergarten (isced0).

7. *The Frequency of Using Internet*

The frequency of internet usage means how often students to use internet to look up information about people, things, or ideas and to download music.

8. *The Frequency of Using Computer*

The frequency of computer usage means how often students to use computer software like word processors, spreadsheets, drawing programs, educational software, computer programming. It also includes students' usage of computers for school subjects.

9. Attitudes towards Computers

This term shows students' positive attitudes towards computers. It means that students think computers are interesting, important and funny.

10. Basic Computer Skills

It is about how well students to make some basic tasks on computer including using a database to produce a list of addresses, listing a computer document or file, printing a computer document or file, deleting a computer document or file.

11. Advanced Computer Skills

It is about how well students to make some advanced tasks on computer including programming, graphing, preparing multimedia presentation.

CHAPTER 2

LITERATURE REVIEW

This chapter summarizes the literature review related to scientific literacy and PISA. Basically, there are some studies about scientific literacy of students in the literature. On the other hand, since the main theme of scientific literacy will be considered in the PISA 2006 cycle, no specific study was found about the scientific literacy of the students as assessed through the PISA project. Thus, in the present chapter, before discussing the related literature, the scientific literacy of the PISA will be explained with some sample questions.

2.1 Scientific Literacy of the PISA

"PISA defines scientific literacy as the capacity to use scientific knowledge, to identify questions and draw evidence based conclusions in order to understand and help make decisions about the natural world and human interactions with it" (Literacy Skills for the World of Tomorrow, 2003, p21). Scientific literacy must be considered as a general competency for life reflecting the growing centrality of scientific question. This definition does not imply that tomorrow's adults must learn huge amount of scientific knowledge, rather they should learn scientific learning. PISA 2000 was developed around three dimensions of scientific literacy:

Scientific concepts. In order to understand certain phenomena of the natural world, students need to understand a number of key concepts. These concepts are the ideas that help people explain the physical phenomena. PISA asks questions about concepts drawn from physics, chemistry, the biological sciences, and earth and space

sciences. More specifically, concepts are drawn from a number of themes including biodiversity, forces and movement, and physiological change.

Scientific processes. PISA assesses the ability to use scientific knowledge and understanding. Five processes are examined by PISA. These are the recognition of scientific *questions*; the identification of *evidence*; the drawing of *conclusions*; the *communication* of these conclusions; and the demonstration of *understanding* of scientific concepts.

Scientific situations and areas of application. PISA scientific literacy concept is related with every day life rather than the classroom. Questions in PISA 2000 were grouped in three areas in which science is applied: science in life and health; science in earth and the environment; and science in technology (Literacy Skills for the World of Tomorrow, 2003).

Desired outcomes of science education for all citizens includes the development of a general understanding of important concepts and explanatory frameworks of science, of the methods by which science derives evidence to support claims for its knowledge, and of the strengths and limitations of science in the real world. It values the ability to apply this understanding to real situations involving science. For example, Millar and Osborne (1998) have identified the focus of a modern science curriculum as being; "the ability to read and assimilate scientific and technical information and assess its significance" (OECD Publications, the PISA 2003 Assessment Framework, 2003). However, the main aim of PISA is not the assessment of science curriculum. The assessment focuses on young people's ability to use their knowledge and skills to meet real-life challenges, rather than mastering a specific school curriculum (Kjearnsli, 2003).

The OECD/PISA definition of scientific literacy comprises three aspects; (OECD Publications, Measuring Student Knowledge and Skills, 1999, page: 61)

1. Scientific knowledge or concepts, which will be assessed by application to specific subject matter;
2. Scientific processes which, because they are scientific, will involve knowledge of science, although in the assessment this knowledge must not form the major barrier to success,

3. Situations or context in which knowledge and processes arc assessed and which take the form of science-based issues.

"The science assessment comprised 35 items. These were the items used to assess scientific literacy in PISA 2000. No new items were added. The items were substantially as used in previously, although some were slightly modified in the light of experience" (Programme for International Student Assessment (PISA) 2003 Initial Report on Scotland's Performance in Mathematics, Science and Reading, 2004, page 31).

A diverse range of items were employed. They varied in difficulty and covered a range of topics. The hardest items required complex conceptual skills, the less difficult required sound scientific thinking, and the easiest required straightforward recall and use of simple scientific knowledge. (Thorpe, 2004).

In designing the assessment framework, the specialist science team took into account: scientific knowledge and concepts; scientific processes; and the science-based situations in which these need to be deployed. The framework covered three specific applications of science that raise issues for today's and tomorrow's citizens: Science in life and health, science in Earth and environment, science in technology (Thorpe, 2004).

As an example of scientific literacy assessment items of PISA 2003, science unit 3 is given below:

Science Unit 3: Corn

Introduction

The following three items are from a unit entitled Corn. The stimulus material is a newspaper report about a man, Auke Ferwerda, who burns corn on his stove as a fuel.

> *...Ferwerda points out that corn, in the form of cattle food, is in fact a type of fuel too. Cows eat corn to get energy out of it. But, Ferwerda explains, the sale of corn for fuel instead of for cattle food might be much more profitable for farmers.*
>
> *Ferwerda knows the environment is receiving increasing attention and government legislation to protect the environment is becoming increasingly elaborate. What Ferwerda does not quite understand is*

the amount of attention being focused on carbon dioxide. Carbon dioxide is regarded as the cause of the greenhouse effect. The greenhouse effect is said to be the main cause of the increasing average temperature of the Earth's atmosphere. In Ferwerda's view, however, there is nothing wrong with carbon dioxide. On the contrary, he argues, plants and trees absorb it and convert it into oxygen for human beings.

He says: ``This is an agricultural area and the farmers grow corn. It has a long growing season, absorbs a lot of carbon dioxide and emits a lot of oxygen. There are many scientists who say that carbon dioxide is not the main cause of the greenhouse effect''.

Science Example 3.1

(Item type: complex multiple choice)

Ferwerda compares corn used as fuel to corn used as food.

The first column of the table below contains a list of things that happen when corn burns as fuel.

Do these things also happen when corn acts as fuel in an animal body?

Circle Yes or No for each.

When corn burns:	Does this also happen when corn acts as fuel in an animal body?
Oxygen is consumed.	Yes/No
Carbon dioxide is produced.	Yes/No
Energy is produced.	Yes/No

Scoring and comments on Science Example 3.1

Full Credit: Answers that specify Yes, Yes, Yes, in that order. (All parts have to be answered correctly, since any one error would indicate some failure in understanding the process of using food in an animal body).

No Credit: Answers which specify any other combination of responses.

Science Example 3.2

(Item type: Open constructed response)

In the article a conversion of carbon dioxide is described: ``...plants and trees absorb it and convert it into oxygen ...".

There are more substances involved in the conversion than carbon dioxide and oxygen only. The conversion can be represented in the following way:

---

carbon dioxide + water --> oxygen + [box]

Write in the box the name of the missing substance.

Scoring and comments on Science Example 3.2

Full Credit: Answers that mention any of the following: glucose; sugar; carbohydrate (s); saccharide(s); starch.

No Credit: Other responses.

Science Example 3.3

(Item type: multiple choice)

At the end of the article Ferwerda refers to scientists who say that carbon dioxide is not the main cause of the greenhouse effect.

Karin finds the following table in which research results about the four most important gases causing the greenhouse effect are listed.

Relative greenhouse effect per molecule of gas

Carbon dioxide	Methane	Nitrous oxide	Chlorofluorocarbons
1	30	160	17000

From this table Karin concludes that carbon dioxide is not the main cause of the greenhouse effect. However, this conclusion is premature. The data in the table need to be combined with other data to be able to conclude whether or not carbon dioxide is the main cause of the greenhouse effect.

Which other data does Karin need to collect?

A. Data about the origin of the four gases.

B. Data about the absorption of the four gases by plants.

C. Data about the size of each of the four types of molecules.

D. Data about the amounts of each of the four gases in the atmosphere.

Scoring and comments on Science Example 3.3

There is a close relationship between the scientific knowledge that the concentration of a substance affects the extent of its action, and the recognition that a valid conclusion cannot be drawn without this extra information.

Full Credit: Response D: Data about the amounts of each of the four gases in the atmosphere.

No Credit: Other responses.

(end of Science Unit 3 from the PISA 2003 Assessment Framework)

(Braams, Review of PISA Sample Science Unit 3: Corn, 2004)

2.2 Studies about PISA

The first PISA survey was conducted in 2000 in 32 countries (including 28 OECD Member countries) using written tasks answered in schools under independently supervised test conditions. Another 11 countries will complete the same assessment in 2002. PISA 2000 surveyed reading, mathematical and scientific literacy, with a primary focus on reading. Measures of attitudes to learning, and information on how students manage their own learning were also obtained in 25 countries as part of an international option. The survey will be repeated every three years, with the primary focus shifting to mathematics in 2003, science in 2006 and back to reading in 2009 (Adams & Wu, 2002).

Tamassia and Schleicher (2002) published an article explaining instruments used in the PISA assessment. They introduced the PISA approach to assessing reading, mathematical, and scientific literacy with its three dimensions of processes, content, and context. Their document presented tasks from the PISA 2000 assessment and explains how these tasks were scored and how they relate to the conceptual framework underlying PISA. They also introduced, in 2000, the PISA approach to comparative measurement and described the PISA 2000 assessment instruments in terms of the content that students need to acquire, the processes that need to be performed, and the contexts in which knowledge and skills are applied. They assess the reading, mathematical and scientific literacy in PISA.

Lemke and Lippman group (2001) presented results from the first cycle of the Program for International Student Assessment (PISA). They said PISA content is not drawn strictly from school curricula, but rather from a framework agreed to nationally on what reading, mathematics, and science literacy mean.

2.3 Scientific Literacy

In order to clarify the connection between courses taken and scientific literacy educational outcomes, Marcus (2004) compared the responses to the National Center for Postsecondary Improvement's (NCPI) 1997 survey of 1360 students as five-year out alumni/alumnae from fifteen different colleges with their respective college transcripts. He also analyzed possible links between postsecondary education experiences and survey results. He concluded that scientific literacy educational outcomes improved as students took a greater number, level, and spread of science courses and the connections were strongest for level and spread of courses.

Westby and Torres (2000) described scientific literacy and the importance of mediated activities for scientific learning. The difference between empirical and theoretical learning was introduced as an important aspect for teachers to understand as they work with students learning scientific concepts. Components of scientific literacy were described, and recommendations for teaching in the zone of proximal development were provided. A conceptual model adapted from ethno mathematics was introduced to demonstrate the effect of theoretical learning on cultural change, using an intergenerational study from Chiapas, Mexico, as an example.

Parsons and Bynner (1998) studied influences on adult basic skills and factors affecting the development of literacy from birth to 37. They subjected the data to multiple regression analysis to determine the extent of the impact of family and home circumstances, education and early schooling, transition from school to work, and adult working life on adults' acquisition of basic skills. They found that early cognitive performance variables proved the most dominant predictors of later reading and math skills in both childhood and adulthood.

Caswell and Lamon (1998) described cognitive and social aspects of children's development of scientific literacy in a School for Thought (SFT) classroom. SFT is an educational reform project that applies cognitive research about the active, reflective, and social nature of learning into classroom practice. The use

of CSILE (Computer Supported Intentional Learning Environment) and Knowledge Forum provided support for students' thinking and learning, and motivated students to write. Students became experts in their areas of interest.

A study conducted by Laugksch (2000) is a survey of the scientific literacy of selected high-school at the secondary/Tertiary educational interface in South Africa revealed that taking Physical Science in grade 12. In contrast to Biology, Physical science plays a more significant role in the achievement of scientific literacy by these students. Students taking Physical Science possessed a better understanding and awareness of all three dimensions of scientific literacy than students taking Biology.

Kemp's study (2000) was a critical examination of the rationales for the goal of scientific literacy for all in the United States. Eleven participants, mostly university-based science educators, were interviewed and their comments were analyzed using the methods of grounded theory. The rationales the participants gave for the goal of scientific literacy for all can be grouped into at least four categories: Social Benefits of Science, Personal Benefits of Science, Promoting Humanity, and Control of Science. The participants seem to feel rationales represent philosophical or value statements and they are not concerned by the lack of research into whether or how scientific literacy actually benefits people.

According to Brekke (2002) scientific literacy is far more than knowing a list of terms and definitions. Scientific literacy is the ability to do processes related to a specific scientific field and knowing, at minimum, basic problem solving. He discussed what students need to know in the different science and mathematics fields and describes process.

Manhart (1998) investigated gender differences with regard to three factors of scientific literacy. His study involved students in Grades 9 and 10. A 100-item multiple choice test based on National Science Education standards was used to assess scientific literacy while gender differences were explored using analysis of variance procedures. Males tended to perform better than females on the constructs of science factor. Females tended to do better than males on the abilities necessary to do scientific inquiry factor and the social aspects of science factor.

In the study of Yates (1999), a qualitative research approach was used to investigate the NASA's educational effects in achieving scientific literacy through mass media and other communication technologies. Six in-depth telephone

interviews were conducted with various NASA education and public affairs officers throughout the country. Findings of the research revealed a distinction between public information and educational efforts. Face-to- face interaction was identified as the most effective information delivery system; however, the Internet and mass media play a prominent role in NASA's educational outreach plan.

Lowe (2000) explained the concept of visual literacy in science and provided a guide to resources for further study. The case was made that the capacities to both understand and generate technical pictures are fundamental to scientific and technological literacy for students at many levels, from early elementary school to the university level.

Research on science attitudes has focused mostly on teacher variables and learning environment variables. Furthermore, in the parent involvement literature, the outcome variable of interest has been mostly science achievement rather than science attitudes. Limited research is available on the joint influence of teacher and parent variables on science attitudes. George and Kaplan (1996) propose a model of parent and teacher influences on the science attitudes of eighth graders using data from the base year survey of the National Educational Longitudinal Study of 1988. They analize the data using structural equation modeling methodology. The results show that the availability of science facilities has a significant direct effect on science experiments. Parental involvement has significant direct as well as indirect effects on science attitudes mediated through science activities and library/museum visits. They found that science activities have a significant direct effect on science attitudes.

2.4 Remedial Studies and Homework

During the elementary school years there is no statistical relationship between the amount of time spent on homework and academic achievement. Much better predictors of elementary achievement include family participation and leisure activities such as reading, eating dinner together, and time spent discussing the day’s events. It is not until high school when the relationship between the amounts of time spent on homework is significantly correlated with academic achievement (Weems, 1998).

Some researchers suggest that larger positive effect of homework are to be expected on the learning of simple skills that require practice and rehearsal than on complex tasks that require higher order problem-solving and integration of skills across disciplines (Weems, 1998).

Very few studies have looked at the ways that homework affects student's attitudes towards school. The research is not conclusive since roughly half of the studies suggest that homework is associated with positive attitudes towards school while the other studies find that homework is associated with negative attitudes towards school (Weems, 1998).

2.5 Kindergarten Effects on Students

According to the review conducted by Karweit and Wasik (1992), there was a favorable result of retention on children's academic achievement in the year of retention, but that the effects did not persist. Two longitudinal studies of developmental kindergartens revealed a similar pattern of positive effects on children's academic achievement in the year spent in developmental kindergarten. The review concluded that children with academic and maturation problems continued to have academic difficulties through the elementary grades whether given an extra year or promoted.

2.6 Computer Uses in Education

With the increased use of computers in education, the impact of computers on educational outcomes became one of the most important research focuses among the educators. In the last quarter of 20th century, a lot of research studies about computer usage in education were carried out. In this study, based on the student answers on computer scale in the PISA, some analyses were conducted to investigate the relationship of computer literacy and advanced skills in using computer with the scientific literacy measures of the students. The following research studies were reported in the literature dealing with the computer use for educational purposes.

Miller and Mary (2002) found that students who used computers more often for science had significantly lower science achievement scores than students who used computers less often. But there was an exception for grade 12 students.

Wainwright (1985) found that the use of the microcomputer materials did not contribute to more effective learning and there were no significant interactions favoring either computer assisted instruction or conventional paper pencil activity for students of differing cognitive levels.

Kulik and Kulik (1985) indicated that computer-based education usually has positive effects on college students and computer based instruction effects were also somewhat lower in the hard, nonlife sciences than in the social and life sciences and education.

According to Clements (1997) educational technology can change the way children think, what they learn, and how they interact with peers and adults. He examined computer use with young children and how computers could be used more effectively. He also described changes in the past decade in computer use, noting the increased number of preschools with computers, the drop in the ratio of students to computers, and increased concern over equity of access. Examples are given of programs allowing development of problem-solving skills. His essay then examines the computer's role in the home and preschool, suggesting that most children use classroom computers occasionally, mostly for drill-and-practice, although more early childhood teachers are selecting more open-ended programs. Children use instructional software even less at home, even if it is present, and far less often than games. Research suggests that computers are potential catalysts for social interaction and cognitive play, with children's interactions affected by the software being used. His paper considers changes in the adult's role as the nature of computer use has changed, and notes that with careful attention to establishing physical arrangements, giving assistance, selecting software programs, and enhancing learning, adults can optimize the computer's advantages.

The negative relationship between the frequency of computer use and learning achievement was also reported in the Third International Mathematics and Science Study. Based on the results of TIMSS (Third International Mathematics and Science Study), it is reported that, as student use computers more often in the mathematics classes, their achievement tend to decrease (International Mathematics Report, TIMSS 1999). Similarly, for the Turkish student the same tendency was also reported in the mathematics and science based on the 1999 TIMSS data (World Bank Report, 2004).

It seems necessary to investigate the impact of computers on student scientific literacy in the PISA 2003, since rather an extensive questionnaire with various dimensions was administered besides the literacy scales.

2.7 Student-teacher Relations

Miller (2000) examined the relationship between the climate of teacher-student relations within a school and individual student's likelihood of freshman year success. Teacher-student climate is a factor which covers a wide range of questions focused on whether students believe teachers treat them with fairness and respect and whether they help them when they struggle with their school work. Results indicates that teacher-student climate does have a significant effect, even after controlling for individual race, gender, poverty, and prior achievement, as well as the school level average achievement. Researchers found a much smaller effect when looking at the effect of teacher-student climate on achievement on a standardized test and a non-significant effect on student absences. Because being on-track is significantly correlated with graduating within 5 years, researchers believe focusing on improving the climate of teacher-student relationships in the schools might be an important component in reducing school failure.

2.8 Attitudes towards School

Boesel (2001) examined changes in student's attitudes towards school over the past 25 years and relates them to educational expectations. He considered how important high school students think their education is for getting a good job and for later life; how well they liked school and the courses they took; and how likely they were to express negative attitudes about school and to engage in anti-social behavior. The trends noted in student enrollment, attitudes, and opinions include: (1) the proportion of high school students who expect to graduate from college has grown remarkably; (2) there is a growing competition for grades; (3) there is an increased awareness of relevance of education to student's occupational future; and (4) there is a growing dissatisfaction with school. Seniors who anticipated some postsecondary education were as likely as high school only groups to support anti-social behavior.

Alvord (2000) designed a research to explore possible relationships between the student and his educational experience. The findings revealed generally

consistent low positive relationships between science achievement and self concept and between science achievement and attitude toward school. For the relationship between science achievement and self concept, he found significant correlations for both boys and girls at all grade levels, for black and non-black pupils (except at grade twelve), and for pupils within each classification of parent education level (except the lowest level in grades four and twelve). He also found significant correlations between self concept subscales and science achievement. When pupils were grouped according to race, significant correlations were found only for black pupils, when examining the relationship between science achievement and attitude toward school.

Regardless of achievement, students in general do not hold positive attitudes toward school. Students classified as high achievers based on achievement data held more positive attitudes toward school than non-high-achieving peers. Findings support addressing academic needs of specific school populations to create more positive learning environments (Moon & Callahan, 1999).

2.9 Summary of the Previous Studies

Attitudes towards School

The findings revealed generally consistent low positive relationships between science achievement and self concept and between science achievement and attitude toward school (Alvord, 2000).

There are significant correlations between self concept subscales and science achievement. When pupils were grouped according to race, significant correlations were found only for black pupils, when examining the relationship between science achievement and attitude toward school (Alvord, 2000).

Students classified as high achievers based on achievement data held more positive attitudes toward school than non-high-achieving peers (Moon & Callahan, 1999).

There is a positive effect of kindergarten on academic achievement (Karweit & Wasik, 1992).

Student-teacher Relations

Teacher-student climate does have a significant effect, even after controlling for individual race, gender, poverty, and prior achievement, as well as the school level average achievement (Miller, 2000).

Researchers found a much smaller effect when looking at the effect of teacher-student climate on achievement on a standardized test and a non-significant effect on student absences (Miller, 2000).

Computer Usages

The use of CSILE (Computer Supported Intentional Learning Environment) and Knowledge Forum provided support for students' thinking and learning, and motivated students to write. Students became experts in their areas of interest (Caswell & Lamon, 1998).

The negative relationship between the frequency of computer use and learning achievement was also reported in the Third International Mathematics and Science Study (World Bank Report, 2004).

Students who used computers more often for science had significantly lower science achievement scores than students who used computers less often (Miller & Mary, 2002).

The use of the microcomputer materials did not contribute to more effective learning and there were no significant interactions favoring either computer assisted instruction or conventional paper pencil activity for students of differing cognitive levels (Wainwrite, 1985).

Computer-based education usually has positive effects on college students and computer based instruction effects were also somewhat lower in the hard, nonlife sciences than in the social and life sciences and education (Kulik & Kulik, 1985).

Remedial Studies and Homework

It is not until high school when the relationship between the amounts of time spent on homework is significantly correlated with academic achievement (Weems, 1998).

Homework is associated with negative attitudes towards school (Weems, 1998).

Larger positive effect of homework is to be expected on the learning of simple skills that require practice and rehearsal than on complex tasks that require higher order problem-solving and integration of skills across disciplines (Weems, 1998).

Scientific Literacy

Scientific literacy educational outcomes improved as students took a greater number, level, and spread of science (Marcus, 2004).

Students taking physical science possessed a better understanding and awareness of all three dimensions of scientific literacy than students taking Biology (Laugksch, 2000).

The science educators seem to feel rationales represent philosophical or value statements and they are not concerned by the lack of research into whether or how scientific literacy actually benefits people (Kemp, 2000).

In this chapter some researches related to the study were presented. The findings helped to make the expectations of the models and to compare with the results of the study. According to the literature, attitudes towards school's effects on achievement are low or nonsignificant (Alvord, 2000). Students-teacher relations have generally positive and significant effect on achievement (Miller, 2000). Effect of frequency of computer usage on achievement is negative and significant (World Bank Report, 2004; Miller & Mary, 2002).

CHAPTER 3

METHODOLOGY

This chapter deals with the methodology of the study. The population and sample selected and the instruments administered in the PISA 2003 project were summarized in this section of the thesis. Also, the constitution of the latent variables for the LISREL models was explained in this section.

3.1 Population and Sample

PISA defined their population with reference to a target age because grades could not be defined as internationally comparable. So PISA covers students who are aged between 15 years 3 months and 16 years 2 months at the time of the assessment, regardless of the grade or type of institution in which they are enrolled and of whether they are in full-time or part-time education (Learning for Tomorrow's World, First Results from PISA 2003, OECD 2004, p27).

Slight variations in the age distribution of students across grade levels often lead to the selection of different target grades in different countries, or between education systems within countries, raising serious questions about the comparability of results across, and at times within, countries. In addition, because not all students of the desired age are usually represented in grade-based samples, there may be a more serious potential bias in the results if the unrepresented students are typically enrolled in the next higher grade in some countries and the next lower grade in others. But some students with higher level of performance in the former countries could be excluded (Education at a Glance, OECD Indicators 2004, p22).

Because all countries tried to maximise the coverage of 15-year-old students in their national samples, PISA reached some standards of population coverage. These standards are given below:

Sampling Standards of PISA:

1. The sample of students must be selected in a way that represents the full population of 15-year-old students in order to provide valid estimates of student achievement.

2. The overall exclusion rate must be kept below 5 per cent.

3. A minimum sample size of 4,500 assessed students must be selected from a minimum of 150 schools. Unless otherwise agreed with the PISA Consortium, schools will be sampled with a probability proportional to a measure of the school size and the students will be randomly (or by using a systematic procedure) sampled within each school.

4. A response rate of 85 per cent is required for initially selected schools. If the initial school response rate is between 65 and 85 per cent, an acceptable school response rate may still be achieved through the use of replacement schools.

5. A response rate of 80 per cent of selected students in the participating schools is required. A student will only be considered as participant if that student participates to the first testing session. Students absent for the first testing session will not be included in the database (PISA 2003 School Sample Preparation Manual, 2002).

According to PISA sampling standards, the target populations and samples for Turkey are given in Table 3.1.

Table 3.1 Target Populations and Samples in Turkey

Total population of 15 year-old	1 351 492
Total enrolled population of 15 year-old at grade 7 or above	725 030
Total in national desired target population	725 030
Total school level exclusions	5 328
Total in national desired target population after all school exclusions and before school exclusions	719 702
Percentage of all school exclusions	0.73
Number of participating students	4 855
Weighted number of participating students	481 279
Number of excluded students	0

Table 3.1 (continued)

Weighted number of excluded students	0
Within school exclusion rate (%)	0.00
Overall exclusion rate (%)	0.73
Coverage of national desired population	0.99
Coverage of national enrolled population	0.99
Percentage of enrolled population	0.54

(Learning for Tomorrow's World, First Results from PISA 2003, OECD 2004, page 321).

The subjects of the study are 15-year old students in Turkey. In order to represent the subjects, 4855 students from Turkey who was born in 1987 were selected. Distribution of the subjects with respect to their gender is given in the table 3.2 below.

Table 3.2 Distribution of Gender of the Subjects in Turkey

	Whole	Using Computer
Female Students	2090	1580
Male Students	2765	2420
Percentage of Female	43 %	39.5 %
Percentage of Male	57 %	60.5 %
Missing	-	-
Percentage of Missing	-	-
Total	4855	4000

According to Table 3.2, females are 43 % of the whole sample while males are 57 % of the whole sample. 39.5 % of students who have used computer are female, 60.5 % of students who have used computer are male.

3.1.1 Sampling Procedures

The PISA sampling procedure ensured that a representative sample of the target population was tested in each country. Most PISA countries employed a two-stage stratified sampling technique. The first stage drew a (usually stratified) random

sample of schools in which 15- year-old students were enrolled, yielding a minimum sample of 150 schools per country. The second stage randomly sampled 35 of the 15-year-old students in each of these schools, with each 15-year-old student in a school having equal probability of selection. Within each country, this sampling procedure typically led to a sample of between 4,500 and 10,000 tested students (Fuchs, 2004).

When the sample of Turkey was prepared, all schools in which 15 year-old students enrolled were regarded then 159 schools were selected from these schools (PISA 2003 Project National Report, 2004, p10). 4855 students from these schools were attended to the PISA 2003 study. The sample selection process was monitored by the experts from PISA consortium.

However, in this study, students who used computer were selected from the sample in order to analyze computer related factors while the whole sample was used for student related factors.

The subjects of the study are 15-year old students in Turkey. In order to represent the subjects, 4855 students from Turkey who was born in 1987 were selected. However for the third model, students who reported that they had used computers before were selected. This lowered the sample size in this respective analysis. Thus the distribution of the subjects with respect to whether they use computer is given in the table 3.3.

Table 3.3 Distribution of Computer Uses of the Subjects in Turkey

	Number	Percent	Valid percent
Students having used computer	4000	82.4	86.6
Students never having used computer	618	12.7	13.4
Missing	205	4.2	

86.6 % of students answering this question have used computer at least once. These students were selected for computer related analysis of this study.

As seen in Table 3.4, there is a wide range in the distribution of grades. In Turkey, 15 year-olds are could be 7^{th} grade, 8^{th} grade, 9^{th} grade, 10^{th} grade, 11^{th} grade and 12^{th} grade.

Table 3.4 Distribution of Grades of Subjects in Turkey

Grades	Frequency	Percentage (%)
7 th Grade	27	0.6
8 th Grade	92	1.9
9 th Grade	191	3.9
10 th Grade	2863	59
11 th Grade	1670	34.4
12 th Grade	12	0.2
Missing	-	-
Total	4855	100

3.2 Instruments

The aim of the PISA is to measure the 15 year-olds' performance of literacy skills. The assessment of PISA is different from that of the other international studies. Most of international studies focus on the achievement of students. However PISA concerns with the ability to use knowledge and skills from schools for real life situations.

In order to measure this ability and to collect information about relating factors, PISA prepared tests and questionnaires for participating countries' students. The selection and sampling criteria was made by experts from participating countries and directed by their governments. So PISA studies have a high degree of validity and reliability.

In PISA assessment, paper-and-pencil tests are used, with assessments lasting a total of two hours for each student. These tests have items which consist of multiple-choice items and questions requiring students' own responses. The items are organized in groups based on a passage setting out a real-life situation. Students answered a background questionnaire, which takes 30 minutes to complete, providing information about themselves and their homes.

3.2.1 Student Questionnaire

In order to collect information about students, a student questionnaire was prepared by PISA. Some of the questions asked are date of birth, birth place, gender, grade, family structure and socioeconomic status. In this study, 19 items from student questionnaire were used.

Before Principal Component Analysis, some questionnaire items were recoded as they measure the corresponding latent variables. For example, 1 recoded as 4, 2 recoded as 3, 3 recoded as 2, 4 recoded as 1. This recoding was made in order to obtain intended meaning from the principal component analysis. For example, a student who marked the item "School has helped give me confidence to make decisions" as 1 actually stated that he strongly agreed with this statement and indicated a positive attitudes. Thus, on the scale used, 1 was recoded as 4 providing that the higher score represented more positive attitudes.

In order to group the observed variables in the data (for determining latent variables) principal component analysis was made for student questionnaire, information communication questionnaire and plausible values of scientific literacy. Principal component analysis in general determines which sets of variables sharing common variance or covariance characteristics (Schumacker & Lomax, 1996). In this study 7 factors were determined out of 23 questions in the student questionnaire. The Varimax rotated solution was interpreted to determine the latent variables. Principle component analysis results of the student questionnaire are shown in Table 3.6.

Table 3.5 Principal Component Analysis Results of Student Questionnaire

	Factor Loadings						
	1	2	3	4	5	6	7
Listen to me Q26c	,727	-,110	-	-	-	-	-
Interested in Students Q26b	,693	-	-,119	-	-	-	-
Give extra help Q26d	,690	-	-	-	,147	-	-
Well with Students Q26a	,672	-	-	,143	,106	-	-
Treat me fairly Q26e	,522	-	-	-	-	-	-
Feel lonely Q27f	-	,765	-	-	-	-	-
Feel an outsider Q27a	-	,754	-	-	-	-	-
Feel awkward Q27d	-	,709	-	-	-	-	-

Table 3.5 (continued)

Hours All <Remedial> Q29b	-	-	,782	-,125	-	,165	-
Hours All homework Q29a	-	-	,742	-	-	-,106	-
Hours All <Enrichment> Q29c	-	-	,704	-	-	,396	-
Mother <ISCED5A or 6> Q12a	-	-	-	-,735	-		-
Attend <ISCED 0> Q20	-	-	-	,710	-	,150	-
How many books at home Q19	-	,131	-	,671	-	-	-
School useful Q24d	,159	-	-	,139	,686	-	,258
School given confidence Q24c	,178	-	-	-	,604	-	,393
School waste of time Q24b	-	,244	-	-	-,588	-	,142
School done little Q24a	-	,105	,115	,117	-,582	-,145	,204
Hours All <out-of-school> Q29e	-	-	-	,199	-	,786	-
Hours All tutor Q29d	-	-	,238	-	-	,780	-
Make friends Q27b	,110	-,383	-	-	-	-,105	,627
Feel I belong Q27c	,243	-,187	-	-	,133		,599
Think I'm liked Q27e	-	,282	-	-,216	-,147	,130	,550

In the previous analysis, the eigenvalues of the seven factors are 3.326, 2.132, 2.003, 1.583, 1.215, 1.156 and 1.015 respectively.

Variables with high factor ladings were selected as latent variables. When the principal component analysis was conducted 100 iterations were set and factor loadings below 0.1 were excluded from the results. Finally the latent variables were obtained. The latent variables, abreviations and their explanations are given in Table 3.7.

Table 3.6 Observed and Latent Variables of Student Questionnaire

Observed	Latent	Question
hwmnbook	Isced *Number of books and attendance to preschool education*	How many books are there in your home? Q19
isced0		Attend <ISCED 0> Q20
donlitle	atschool *Attitudes towards School*	School done little Q24a
wastetim		School waste of time Q24b
givconfi		School given confidence Q24c
scuseful		School useful Q24d
wellstdn	relation *Student-Teacher Relation*	Well with Students Q26a
intrstds		Interested in Students Q26b
listenme		Listen to me Q26c
givehelp		Give extra help Q26d

Table 3.6 (continued)

treatme		Treat me fairly Q26e
outsider	lonely *Feeling of Loneliness*	Feel an outsider Q27a
felawkw		Feel awkward Q27d
fellone		Feel lonely Q27f
hrhomewo	remedial *Remedial Study and Homework*	Hours All homework Q29a
hrremedi		Hours All <Remedial> Q29b
hrenrich		Hours All <Enrichment> Q29c
hrtutor	coaching *attending out of school classes and tutor*	Hours All tutor Q29d
outschol		Hours All <out-of-school> Q29e
pv1scie	scielit *Scientific Literacy*	Plausible value in science
pv2scie		Plausible value in science
pv3scie		Plausible value in science
pv4scie		Plausible value in science
pv5scie		Plausible value in science

Selected questions and their response alternatives of the student questionnaire are given in Tables from 3.7 to 3.13. Question 26, 27 and only third and fourth items of question 24 are recoded. The alternatives of these questions are in recoded form.

Table 3.7 Question 19 and its Items of Student Questionnaire

Q19	How many books are there in your home?
	There are usually about <40 books per metre> of shelving. Do not include magazines, newspapers, or your schoolbooks.
	(Please <tick> only one box.)
	0-10 books ..... ☐1
	11-25 books ..... ☐2
	26-100 books ..... ☐3
	101-200 books ..... ☐4
	201-500 books ..... ☐5
	More than 500 books ..... ☐6

Table 3.8 Question 20 and its Items of Student Questionnaire

Q20 Did you attend <ISCED 0>?

No	☐1
Yes, for one year or less	☐2
Yes, for more than one year	☐3

Table 3.9 Question 24 and its Items of Student Questionnaire (Recoded)

Q24 *Thinking about what you have learned in school:* To what extent do you agree with the following statements?

(Please <tick> only one box on each row.)

	Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
a) School has done little to prepare me for adult life when I leave school.	☐1	☐2	☐3	☐4
b) School has been a waste of time.	☐1	☐2	☐3	☐4
*c) School has helped give me confidence to make decisions.	☐4	☐3	☐2	☐1
*d) School has taught me things which could be useful in a job.	☐4	☐3	☐2	☐1

The items of question 24 are about school views of students. Items marked with asterisk (*) were recoded as *strongly agree* is 4, *agree* is 3, *disagree* is 2, *strongly disagree* is 1.

Table 3.10 Question 26 and Its Items of Student Questionnaire (Recoded)

Q26	*Thinking about the teachers at your school:* To what extent do you agree with the following statements?				
	(Please <tick> only one box in each row.)				
		Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
a)	Students get along well with most teachers.	☐4	☐3	☐2	☐1
b)	Most teachers are interested in students' well-being.	☐4	☐3	☐2	☐1
c)	Most of my teachers really listen to what I have to say.	☐4	☐3	☐2	☐1
d)	If I need extra help, I will receive it from my teachers.	☐4	☐3	☐2	☐1
e)	Most of my teachers treat me fairly.	☐4	☐3	☐2	☐1

The items of question 26 are about relation of students with your teachers.

Table 3.11 Question 27 and its Items of Student Questionnaire (Recoded)

Q27	My school is a place where:				
	(Please <tick> only one box in each row.)				
		Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
a)	I feel like an outsider (or left out of things).	☐4	☐3	☐2	☐1
d)	I feel awkward and out of place.	☐4	☐3	☐2	☐1
f)	I feel lonely.	☐4	☐3	☐2	☐1

The items of question 27 are about feeling of loneliness.

Table 3.12 Items of Question 29 of Student Questionnaire in the Hours Spent for Remedial Study and Homework Factor

*The following question asks about the time you spend studying and doing different kinds of homework outside of your regular classes. This should include **all of your studying and homework**.*
Q29 On average, how many hours do you spend *each week* on the following? *When answering include time at the weekend too.*
a) Homework or other study set by your teachers ..... _____ hours per week
b) <Remedial classes> at school ..... _____ hours per week
c) <Enrichment classes> at school ..... _____ hours per week

Table 3.13 Items of Question 29 of Student Questionnaire in the Hours Spent for out-of-School Factor

d) Work with a <tutor> ..... _____ hours per week
e) Attending <out-of-school> classes ..... _____ hours per week

The items of question 29 are related with the time students spend studying and doing different kinds of homework outside of school. Items a, b and c define remedial study or homework frequency, but items d and e define the frequency of coaching activities.

3.2.2 Information Communication Technology Questionnaire

Information Communication Technology Questionnaire contains questions to measure students' views or level of computers, how often to use computers and how to learn computer usage. Although it consists of 9 questions and 61 items, in this study, 2 questions and 12 items were included.

The Information Communication Technology Questionnaire was also analyzed through the principle component analysis. Out of 39 Questions, 6 factors extracted. Principle Component Analysis Results of the Information Communication Technology Questionnaire are shown in the Table 3.14.

Table 3.14 Principal Component Analysis Results of Information Communication Technology Questionnaire

	Factor Loadings					
	1	2	3	4	5	6
How well save IC6h	,832	-	,112	,124	,109	,131
How well delete IC6j	,824	,114	,126	,108	-	,194
How well print IC6i	,813	,132	,149	,174	-	-
How well move IC6k	,758	,123	,149	,138	,112	,216
How well copy IC6g	,738	,137	,160	,160	,140	,133
How well edit IC6d	,723	,189	,127	,244	-	-
How well scroll IC6e	,719	-	,102	,123	,108	,213
How well open file IC6c	,674	,154	-	,103	,148	,328
How well addresses IC6f	,554	,155	,232	,384	,135	-
How often spreadsheets IC5e	,189	,720	-	,179	-	-
How often programming IC5k	-	,712	-	,198	,114	-
How often graphics IC5g	,127	,711	-	-	,103	,238
How often Word IC5c	,268	,690	-	,127	,127	-
How often educ software IC5h	-	,678	,148	,177	-	-
How often learning IC5i	-	,670	,164	,123	-	-
How often group IC5d	-	,555	,459	,111	-	-
How often games IC5b	-	,465	,320	-,130	,205	,385
How often chatrooms IC5l	,154	,369	,694	,100	,129	
How often download music IC5j	-	,445	,612	-	,116	,161
How often information IC5a	,111	,465	,575	-	-	-
How often Internet software? IC5f	-	,540	,569	-	,104	-
How well attach IC6n	,384	-	,557	,440	,116	-
How well emails IC6v	,340	-	,547	,448	,106	,223
How well download file IC6m	,485	-	,544	,320	,135	,148
How well Internet IC6l	,392	-	,516	,204	,125	,387
How well download music IC6s	,247	-	,501	,353	,136	,476
How well program IC6o	,126	,301	-	,696	-	,101
How well web page IC6w	,217	,147	,316	,647	,120	,121
How well spreadsheet plot IC6p	,336	,307	-	,623	-	,194
How well multimedia IC6t	,283	,201	,299	,569	,138	,150
How well PowerPoint IC6q	,445	,237		,547	-	,109
How well antiviruses IC6b	,375	,273	,255	,382	,143	-
Feel fun IC7b	,128	-	-	-	,781	,200
Feel important IC7a	,136	,168		,191	,744	-
Feel forget time IC7d	,159	-	,144	-	,739	,198
Feel interested IC7c	,216	,251	,222	,132	,686	-
How well games IC6r	,319	-	-	,187	,138	,745
How well draw IC6u	,406	-	-	,259	-	,629
How well start game IC6a	,336	,128	,124	-	,179	,561

In the previous analysis, the eigenvalues of the seven factors are 14.039, 3.792, 1.985, 1.806, 1.416, 1.223 respectively.

Variables with high factor ladings were selected as latent variables. When the principal component analysis was conducted 100 iterations were set and factor loadings below 0.1 were excluded from the results. Finally the latent variables were obtained. The latent variables and their explanations are given in Table 3.15.

Table 3.15 Latent Variables of Information Communication Questionnaire

Observed	Latent		Question
hoftinfo	internet *Frequency of Using Internet*	IC5a	How often do you use: the Internet to look up information about people, things, or ideas?
hofdwnmu		IC5j	How often do you use: the Internet to down-load music?
hoftword	computer *Frequency of Using Computer*	IC5c	How often do you use: Word processing (e.g. <Word ® or WordPerfect®>)?
hofgraph		IC5g	How often do you use: drawing, painting or graphics programs on a computer?
hofedsof		IC5h	How often do you use: educational software such as Mathematics programs?
hoflearn		IC5i	How often do you use: the computer to help you learn school material?
hofprogr		IC5k	How often do you use: the computer for programming?
hwelsave	basic *Basic Computer Skills*	IC6h	How well can you save a computer document or file.
hwelprin		IC6i	How well can you Print a computer document or file.
hweldele		IC6j	How well can you Delete a computer document or file.
hwelmove		IC6k	How well can you Move files from one place to another on a computer.
hwelprog	advanced *Advanced Computer Skills*	IC6o	How well can you Create a computer program (e.g. in <Logo, Pascal, Basic>).
hwelplot		IC6p	How well can you Use a spreadsheet to plot a graph.
hwelppoi		IC6q	How well can you Create a presentation (e.g. using <PowerPoint>).
hwelmult		IC6t	How well can you Create a multi-media presentation (with sound, pictures, video).
hwelwebp		IC6w	How well can you Construct a web page.

Table 3.15 (continued)

feelimpo	attcomp *Attitudes towards Computer*	IC7a	It is very important to me to work with a computer.
feelfun		IC7b	I think playing or working with a computer is really fun.
feelintr		IC7c	I use a computer because I am very interested.
feelfget		IC7d	I lose track of time when I am working with the computer.
pv1scie	scielit *Scientific Literacy*		1st Plausible Value in Science
pv2scie			2nd Plausible Value in Science
pv3scie			3rd Plausible Value in Science
pv4scie			4th Plausible Value in Science
pv5scie			5th Plausible Value in Science

Selected questions and their response alternatives of the information communication questionnaire are given in Tables from 3.16, 3.17 and 3.18. The questions are recoded and the alternatives of these questions are in recoded form.

Table 3.16 Question 5 and its Items of Information Communication Questionnaire

Q5 How often do you use:

(Please <tick> one box on each row.)

	Almost every day	*A few times each week*	*Between once a week and once a month*	*Less than once a month*	*Never*
a) the Internet to look up information about people, things, or ideas?	☐5	☐4	☐3	☐2	☐1
c) Word processing (e.g. <Word ® or WordPerfect®>)?	☐5	☐4	☐3	☐2	☐1
g) drawing, painting or graphics programs on a computer?	☐5	☐4	☐3	☐2	☐1
h) educational software such as Mathematics programs?	☐5	☐4	☐3	☐2	☐1
i) the computer to help you learn school material?	☐5	☐4	☐3	☐2	☐1
j) the Internet to down-load music?	☐5	☐4	☐3	☐2	☐1
k) the computer for programming?	☐5	☐4	☐3	☐2	☐1

Question 5 is about the frequency of students' usage of computers or computer programs.

Table 3.17 Question 6 and its Items of Information Communication Questionnaire

Q6	How well can you do each of these tasks on a computer? *(Please <tick> one box on each row.)*				
		I can do this very well by myself.	*I can do this with help from someone.*	*I know what this means but I cannot do it.*	*I don't know what this means.*
h)	Save a computer document or file.	☐4	☐3	☐2	☐1
i)	Print a computer document or file.	☐4	☐3	☐2	☐1
j)	Delete a computer document or file. ……..	☐4	☐3	☐2	☐1
k)	Move files from one place to another on a computer.	☐4	☐3	☐2	☐1
o)	Create a computer program (e.g. in <Logo, Pascal, Basic>).	☐4	☐3	☐2	☐1
p)	Use a spreadsheet to plot a graph.	☐4	☐3	☐2	☐1
q)	Create a presentation (e.g. using <PowerPoint>).	☐4	☐3	☐2	☐1
t)	Create a multi-media presentation (with sound, pictures, video).	☐4	☐3	☐2	☐1
w)	Construct a web page.	☐4	☐3	☐2	☐1

Question 6 is about students' computer skills.

Table 3.18 Question 7 and Its Items of Information Communication Questionnaire

Q7	Thinking about your experience with computers: To what extent do you agree with the following statements?				
	(Please <tick> one box on each row.)				
		Strongly agree	*Agree*	*Disagree*	*Strongly disagree*
a)	It is very important to me to work with a computer.	☐4	☐3	☐2	☐1
b)	I think playing or working with a computer is really fun.	☐4	☐3	☐2	☐1
c)	I use a computer because I am very interested.	☐4	☐3	☐2	☐1
d)	I lose track of time when I am working with the computer.	☐4	☐3	☐2	☐1

Question 7 determines students' attitudes towards computer.

3.3 Data Collection

PISA 2003 assessments prepared questions and tests in order to gather information about students and measure their literacy levels. Therefore students answered the written passages and diagrams.

PISA 2000 was carefully designed by an international network of leading institutions and experts to serve the purposes described above. Each student participated in a written assessment session of two hours, and spent about half an hour responding to a questionnaire. School principals were asked to give further information on school characteristics in another 30-minute questionnaire (Literacy Skills for the World of Tomorrow, OECD 2003).

The student assessments followed the same principles in each of the three domains and will do so from one survey to the next, although the amount of assessment material in each domain will differ in each three-year cycle. In PISA 2000, where the main focus was reading literacy, PISA was implemented in the following ways (for details, see the *PISA 2000 Technical Report*)

3.4 Procedure

PISA studies were started in the year 2000. In this year, first PISA assessment was performed. PISA attempted to assess 15 year-old students' literacy performance and focused on reading literacy first. Detailed information from OECD countries were gathered and published. PISA organized new study in the year 2003. Its main focus was then mathematical literacy. Turkey was included in this study. Students and administrators were asked written questions and the answers were tabulated.

By the help of PISA publishing, this study was developed. Recording of the questionnaires and test were downloaded from the site www.pisa.oecd.org first. Then the data about Turkey was eliminated. After selection of the items and recoding some answers, principal component analysis was conducted. The determined factors were processed by Lisrel with Prelis Command Language for Windows in order to make desired structural equation modelling. Finally, the factors affecting scientific literacy had been modelled for student related factors and computer related factors. Then literature review was done from internet and library.

3.5 Structural Equation Modelling with Lisrel

Lisrel 8.30 and Prelis 2.30 for Windows were used in this study in order to obtain structural equation modelling for the latent variables derived from principal component analysis. Structural equation modelling is a general statistical modelling technique. The structural equation model implies a structure for the covariance between the observed variables. It is usually represented by matrix equations, but it can be visualized by a graphical path diagram (Hox and Bechger, 1998). In the present study path analytic model with latent variables was used.

When the covariance file was prepared, listwise deletion method was used. It means that all "don't know" and "no answer" cases were excluded through the analysis (Jöroskog, 2002). After the covariance file was obtained, the SPL files (simplis command files) were written. Because the variable "hrtutor" gave negative error variance, it is dismissed from the SIMPLIS Commands and Lisrel was run (for SPL file contents, see Appendix B). Finally the path diagrams were obtained (Figures 4.1, 4.2, 4.3, 4.4, 4.5 and 4.6).

In this study, four fit indices: GFI (goodness of fit index), AGFI (adjusted GFI), standardized RMR (root mean residual) and RMSA (root mean square error of

approximation) were used. These indices provided the acceptance conditions. Usually if the values of GFI and AGFI are greater than 0.90 and the values of RMSA and standard RMR are smaller than 0.05, the model is acceptable (Hox and Bechger, 1998).

CHAPTER 4

RESULTS

This chapter includes the results of the study. Three different LISREL methods will be tested and model-data fit will be evaluated.

4.1 Structural Equation Modeling

According to the factors mentioned in the previous chapter, three structural equation models were conducted. Two of them were obtained by using the factors from student questionnaire; the other was obtained by using information communication questionnaire. In the student related models, one model was tried with and without the inclusion of preschool attendance and number of books at home. For the third model tested, students who reported that they used computer before were used in the analysis.

4.1.1 Modeling with Student Related Factors

After the factor analysis was done, necessary files for structural modeling such as covariance or SPL files were created. Variables and factors were introduced to the LISREL 8.30 for Windows with Simplis Command Language. Then LISREL calculated the factor loadings and drew the structural model by using the listwise deletion and maximum likelihood methods. These analyses were conducted with significance level of 0.05. The Simplis syntax for this analysis can be found in Appendix B.

The first model consists of four independent and two dependent latent variables. Independent latent variables are relation (student-teacher relation), lonely (feeling of loneliness), remedial (remedial study and homework) and coaching

(attending out of school classes) and dependent latent variables are scielit (scientific literacy) and atschool (attitudes towards school) in this particular analysis.

The variables of lowercase lambda sub x (λ_x), lowercase lambda sub y (λ_y), lowercase epsilon (ε) and lowercase delta (δ) are shown in Table 4.1. These parameters measure the relationship between variables. (λ_x) and (λ_y) defines the relationship between observed and latent variables. However ε and δ explain the measurement errors of the relationship for independent and dependent variables respectively. The full model with observed variables is given in Appendix C. However, the loadings of the observed variables on respective latent variables and the error terms are indicated in the Table 4.1 below.

Table 4.1 Measurement Coefficients of Scientific Literacy Model for Student Related Variables

Observed	(λ_x)	Latent	Measurement Error (δ)
wellstdn	0.60 (λ_x)	relation *Student-Teacher Relation*	0.64 (δ)
intrstds	0.57 (λ_x)		0.68 (δ)
listenme	0.64 (λ_x)		0.59 (δ)
givehelp	0.65 (λ_x)		0.57 (δ)
treatme	0.39 (λ_x)		0.85 (δ)
outsider	0.71 (λ_x)	lonely *Feeling of Loneliness*	0.50 (δ)
felawkw	0.54 (λ_x)		0.71 (δ)
fellone	0.60 (λ_x)		0.64 (δ)
hrhomewo	0.36 (λ_x)	remedial *Remedial Study and Homework*	0.87 (δ)
hrremedi	0.73 (λ_x)		0.46 (δ)
hrenrich	0.75 (λ_x)		0.43 (δ)
Outschol	1.00 (λ_x)	coaching *attending out of school classes and tutor*	0.00 (δ)
donlitle	0.38 (λ_y)	atschool *Attitudes towards School*	0.85 (ε)
wastetim	0.42 (λ_y)		0.83 (ε)
givconfi	0.62 (λ_y)		0.62 (ε)
scuseful	0.65 (λ_y)		0.58 (ε)
pv1scie	0.92 (λ_y)	scielit *Scientific Literacy*	0.15 (ε)
pv2scie	0.93 (λ_y)		0.14 (ε)
pv3scie	0.92 (λ_y)		0.15 (ε)
pv4scie	0.92 (λ_y)		0.15 (ε)
pv5scie	0.93 (λ_y)		0.14 (ε)

The observed variables “wellstdn”, “intrstds”, “listenme”, “givehelp” and “treatme” are positively and significantly loaded on “relation” with the coefficients

(λ_x) of 0.60, 0.57, 0.64, 0.65 and 0.39 respectively. Their measurement errors (δ) are 0.64, 0.68, 0.59, 0.57 and 0.85 respectively.

The observed variables "outsider", "felawkw" and "fellone" are positively and significantly loaded on lonely with the coefficients (λ_x) of 0.71, 0.54, and 0.60 respectively. Their measurement errors (δ) are 0.50, 0.71 and 0.64 respectively.

The observed variables "hrhomewo", "hrremedi" and "hrenrich" are positively and significantly loaded on remedial with the coefficients (λ_x) of 0.36, 0.73, and 0.75 respectively. Their measurement errors (δ) are 0.87, 0.46 and 0.43 respectively.

The latent variable coaching consists of a variable "outschol". Therefore its (λ_x) and (δ) values are 1 and 0 respectively.

The observed variables "donlitle", "wastetim", "givconfi" and "scuseful" are positively and significantly loaded on "atschool" with the coefficients (λ_y) of 0.38, 0.42, 0.62 and 0.65 respectively. Their measurement errors (ε) are 0.85, 0.83, 0.62 and 0.58 respectively.

The observed variables "pv1scie", "pv2scie", "pv3scie", "pv4scie" and "pv5scie" are positively and significantly loaded on "scielit" with the coefficients (λ_y) of 0.92, 0.93, 0.92, 0.92, and 0.93 respectively. Their measurement errors (ε) are 0.15, 0.14, 0.15, 0.15, and 0.14 respectively.

The diagram with observed variables is given in Appendix C for the first model tested. Figure 4.1 and 4.2 indicate the structural models with standardized coefficients and t-values respectively for the first model.

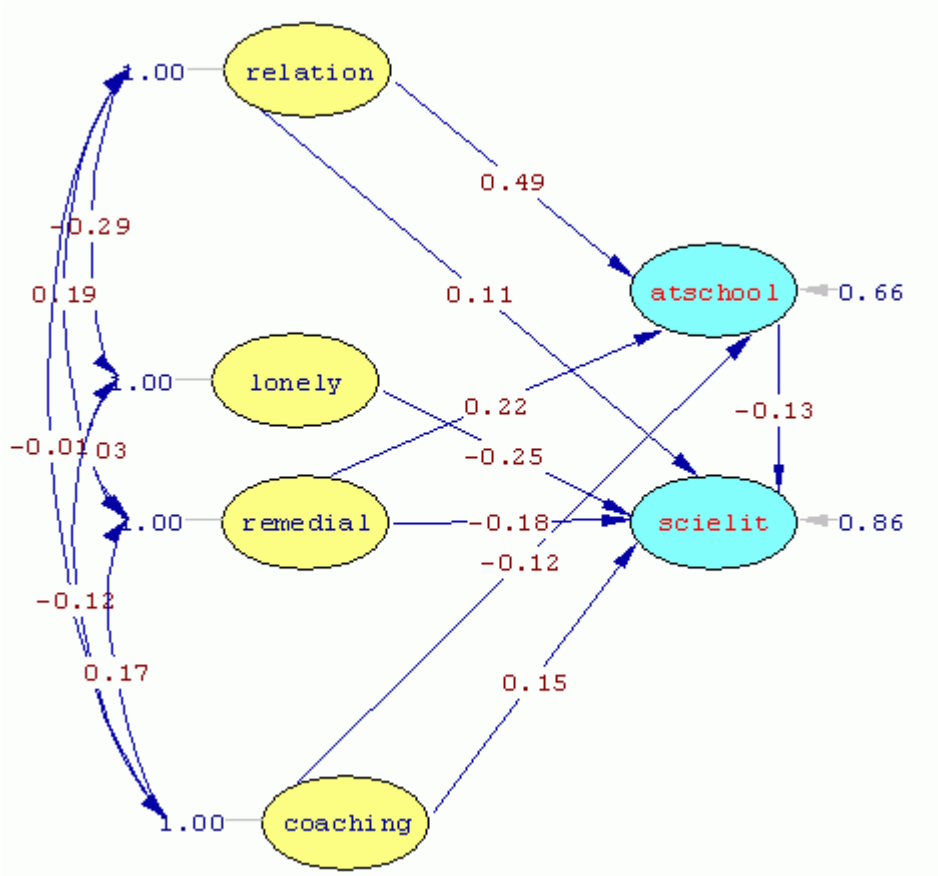

Figure 4.1 Structural Model of Student Related Factors for Turkey (Coefficients in Standardized Value)

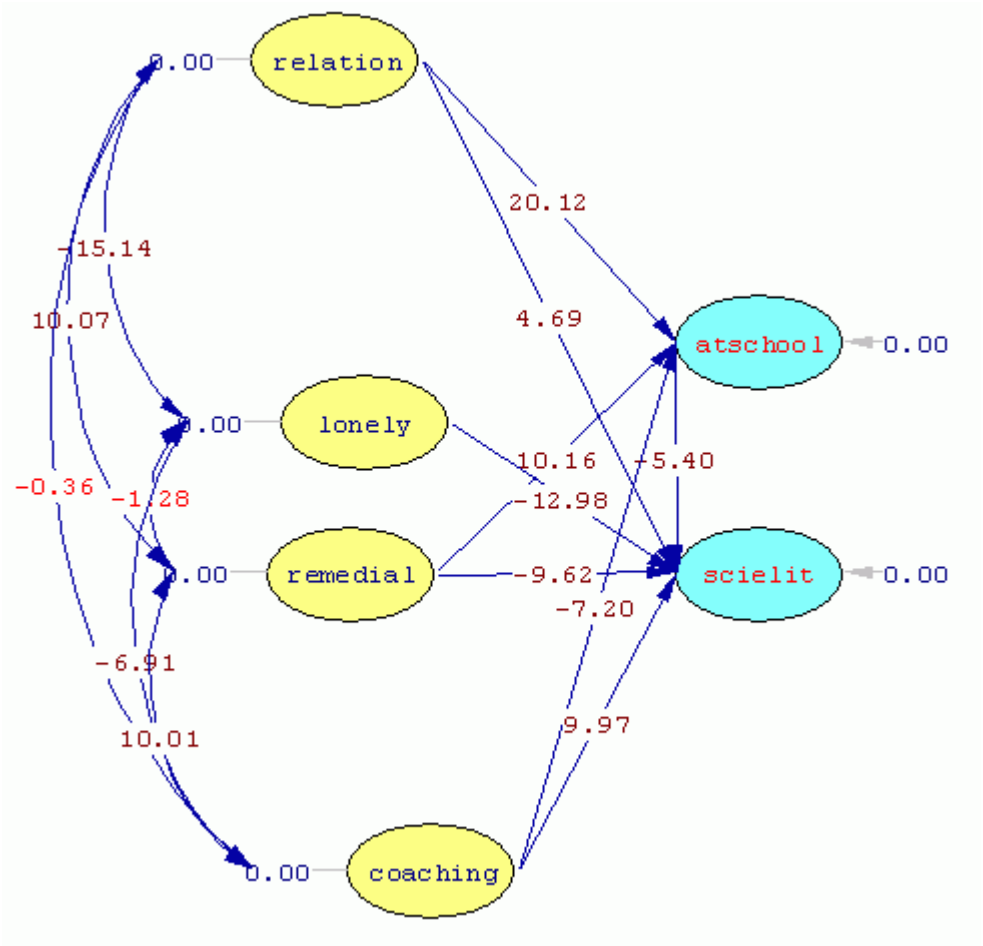

Figure 4.2 Structural Model of Student Related Factors for Turkey (Coefficients in t-Values)

The goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) are 0.97 and 0.96 respectively for the first model tested. The values of RMSEA and Standard RMR are 0.044 and 0.044 respectively. This model explains 0.34 percent of variance on attitudes towards school, and 0.14 percent variance of scientific literacy skills.

The variable gamma (γ) indicates the ralationship between latent independent and latent dependent variables. All the variables' gamma coefficients are shown in the Table 4.2. These coefficients are the standardized coefficients indicated in the path diagram above.

Table 4.2 Structure Coefficients of Scientific Literacy Model for Student Related Variables

Latent Independent Variables	γ	Latent Dependent Variables
relation	0.49	atschool
remedial	0.22	
coaching	-0.12	
relation	0.11	scielit
lonely	-0.25	
remedial	-0.18	
coaching	0.15	

Table 4.3 Structure Coefficients of Scientific Literacy Model for Student Related Variables

Latent Dependent Variables	β	Latent Dependent Variables
attschol	-0.13	scielit

According to Table 4.2, the total effect of "relation" on "atschool" is positive and significant (γ=0.49, $p<0.05$). The effect of "remedial" on "atschool" is positive and significant with the coefficient of 0.22 ($p<0.05$). Coaching has a negative and significant effect on "atschool" (γ=-0.12, $p<0.05$). Relation has positive and significant effect on "scielit" (γ=0.11, $p<0.05$). Lonely has negative and significant effect on "scielit" (γ=-0.25, $p<0.05$). The total effect of "remedial" on "scielit" is negative and significant (γ=-0.18, $p<0.05$). Finally, there are positive and significant relationship between "coaching" and "scielit" (γ=0.15, $p<0.05$).

According to Table 4.3, the total effect of "atschool" on "scielit" is negative and significant (β =-0.13, $p<0.05$).

The squared multiple correlations (R^2) give the proportion of explained variance of a variable by another variable. Table 4.4 and 4.5 shows the squared multiple correlations for observed variables.

Table 4.4 Squared Multiple Correlations of the Student Related Observed Variables

Observed Variables	R^2
Wellstdn	0.36
Intrstds	0.32
Listenme	0.41
Givehelp	0.43
Treatme	0.15
Outsider	0.50
Felawkw	0.29
Fellone	0.36
hrhomewo	0.13
Hrremedi	0.54
Hrenrich	0.57
Outschol	1

Table 4.5 Squared Multiple Correlations of the Student Related Observed Variables

Observed Variables	R^2
donlitle	0.15
wastetim	0.17
givconfi	0.38
scuseful	0.42
pv1scie	0.85
pv2scie	0.86
pv3scie	0.85
pv4scie	0.85
pv5scie	0.86

LISREL Outputs also give direct and indirect effects of the latent independent variables on latent dependent variables. Table 4.6 and 4.7 show the indirect and total effects of the latent independent variables on the latent dependent variables respectively.

When the indirect effects of the independent latent variables are considered on the dependent latent variables, the coefficients given in Table 4.6 were obtained.

Table 4.6 Indirect Effects of Latent Independent Variables on Latent Dependent Variables of Scientific Literacy Model for Student Related Variables

	relation	lonely	remedial	coaching
attschool	-	-	-	-
scielit	-0.06	-	-0.03	0.02

The latent variables "relation", "remedial" and "coaching" has a significant indirect effects on "scielit" (γ=-0.06, γ=-0.03, γ=0.02, $p<0.05$) respectively.

Table 4.7 Total Effects of Latent Independent Variables on Latent Dependent Variables of Scientific Literacy Model for Student Related Variables

	relation	lonely	remedial	coaching
attschool	0.49	-	0.22	-0.12
scielit	0.04	-0.25	-0.21	0.17

The latent variable "relation" has a positive and significant total effect on "atschool" (γ=0.49, $p<0.05$) and positive and significant total effect on "scielit" (γ=0.04, $p<0.05$). The latent variable lonely has a nonsignificant total effect on "atschool" but negative and significant total effect on "scielit" (γ=-0.25, $p<0.05$). The latent variable remedial has a positive and significant total effect on "atschool" (γ=0.22, $p<0.05$) but negative and significant total effect on "scielit" (γ=-0.21, $p<0.05$). The latent variable coaching has a negative and significant total effect on "atschool" (γ=-0.12, $p<0.05$) but positive and significant total effect on "scielit" (γ=0.17, $p<0.05$).

In Figure 4.3, the model consists of five independent and two dependent latent variables. Independent latent variables are "isced" (number of books and attendance to preschool education), "relation" (student-teacher relation), "lonely" (feeling of loneliness), "remedial" (remedial study and homework) and "coaching" (attending out of school classes) and dependent latent variables are "scielit" (scientific literacy) and "atschool" (attitudes towards school) in this particular analysis.

The variables of lowercase lambda sub x (λ_x), lowercase lambda sub y (λ_y), lowercase epsilon (ε) and lowercase delta (δ) are shown in Table 4.1. These

parameters measure the relationship between variables. (λ_x) and (λ_y) defines the relationship between observed and latent variables. However ε and δ explain the measurement errors of the relationship for independent and dependent variables r"espectively. The full model with observed variables is given in Appendix C. However, the loadings of the observed variables on respective latent variables and the error terms are indicated in the Table 4.8 below.

Table 4.8 Measurement Coefficients of Scientific Literacy Model for Student Related Variables

Observed	(λ_x)	Latent	Measurement Error (δ)
hwmnbook	0.67 (λ_x)	Isced	0.55 (δ)
Isced0	0.56 (λ_x)	*Number of books and attendance to preschool education*	0.69 (δ)
wellstdn	0.60 (λ_x)	relation *Student-Teacher Relation*	0.64 (δ)
intrstds	0.57 (λ_x)		0.67 (δ)
listenme	0.64 (λ_x)		0.59 (δ)
givehelp	0.65 (λ_x)		0.57 (δ)
treatme	0.41 (λ_x)		0.83 (δ)
outsider	0.71 (λ_x)	lonely *Feeling of Loneliness*	0.49 (δ)
felawkw	0.53 (λ_x)		0.72 (δ)
fellone	0.61 (λ_x)		0.63 (δ)
hrhomewo	0.36 (λ_x)	remedial *Remedial Study and Homework*	0.87 (δ)
hrremedi	0.73 (λ_x)		0.47 (δ)
hrenrich	0.76 (λ_x)		0.43 (δ)
outschol	1.00 (λ_x)	coaching *attending out of school classes and tutor*	0.00 (δ)
donlitle	0.39 (λ_y)	atschool *Attitudes towards School*	0.85 (ε)
wastetim	0.44 (λ_y)		0.81 (ε)
givconfi	0.62 (λ_y)		0.61 (ε)
scuseful	0.65 (λ_y)		0.57 (ε)
pv1scie	0.93 (λ_y)	scielit *Scientific Literacy*	0.14 (ε)
pv2scie	0.93 (λ_y)		0.14 (ε)
pv3scie	0.93 (λ_y)		0.14 (ε)
pv4scie	0.92 (λ_y)		0.15 (ε)
pv5scie	0.93 (λ_y)		0.14 (ε)

The observed variables "hwmnbook" and "isced0" are positively and significantly loaded on "isced" with the coefficients (λ_x) of 0.67 and 0.56 respectively. Their measurement errors (δ) are 0.55 and 0.69 respectively.

The observed variables “wellstdn”, “intrstds”, “listenme”, “givehelp” and “treatme” are positively and significantly loaded on relation with the coefficients (λ_x) of 0.60, 0.57, 0.64, 0.65 and 0.41 respectively. Their measurement errors (δ) are 0.64, 0.67, 0.59, 0.57 and 0.83 respectively.

The observed variables outsider, “felawkw” and “fellone” are positively and significantly loaded on “lonely” with the coefficients (λ_x) of 0.71, 0.53, and 0.61 respectively. Their measurement errors (δ) are 0.49, 0.72 and 0.63 respectively.

The observed variables “hrhomewo”, “hrremedi” and “hrenrich” are positively and significantly loaded on “remedial” with the coefficients (λ_x) of 0.36, 0.73 and 0.76 respectively. Their measurement errors (δ) are 0.87, 0.47 and 0.43 respectively.

The latent variable coaching consists of a variable “outschol”. Therefore its (λ_x) and (δ) values are 1 and 0 respectively.

The observed variables “donlitle”, “wastetim”, “givconfi” and “scuseful” are positively and significantly loaded on “atschool” with the coefficients (λ_y) of 0.39, 0.44, 0.62 and 0.65 respectively. Their measurement errors (ε) are 0.85, 0.81, 0.61 and 0.57 respectively.

The observed variables “pv1scie”, “pv2scie”, “pv3scie”, “pv4scie” and “pv5scie” are positively and significantly loaded on “scielit” with the coefficients (λ_y) of 0.93, 0.93, 0.93, 0.92, and 0.93 respectively. Their measurement errors (ε) are 0.14, 0.14, 0.14, 0.15, and 0.14 respectively.

A second model related to student questionnaire was also tried. In the model variables about ISCED0 status of students and number of books at home were included as a latent variable named “isced” (Number of books and attendance to preschool education) (see Table 3.7).

The model with this specific variable is seen in Figure 4.3. The t- values are given in the Figure 4.4.

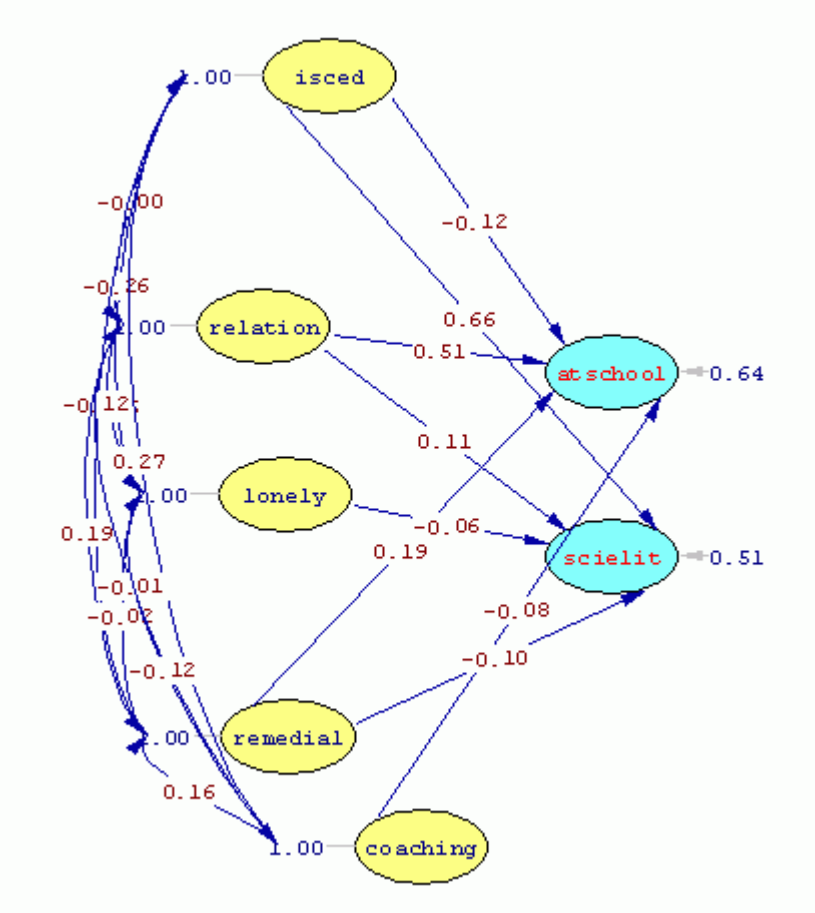

Figure 4.3 Structural Model of Student Related Factors with number of books and attendance to preschool education factor for Turkey (Coefficients in Standardized Value)

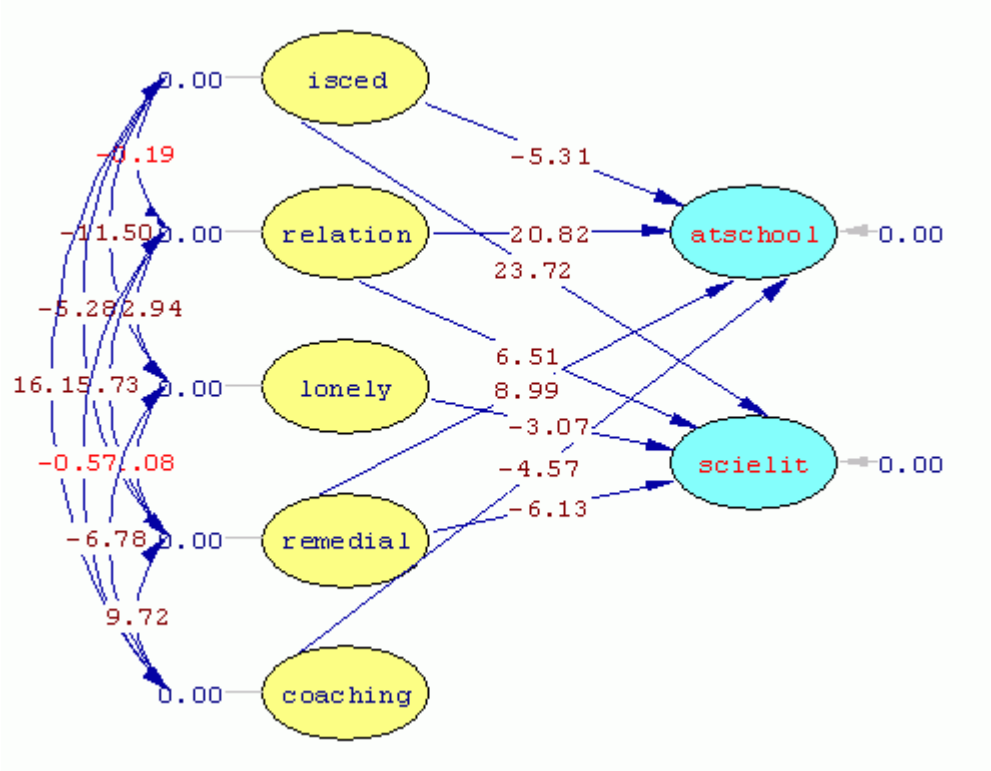

Figure 4.4 Structural Model of Student Related Factors with number of books and attendance to preschool education Factor for Turkey (Coefficients in t-Values)

The goodness of fit index (GFI) and adjusted goodness of fit index (AGFI) are 0.97 and 0.96 respectively for the first model tested. The values of RMSEA and Standard RMR are 0.041 and 0.041 respectively. This model explains 0.36percent of variance on attitudes towards school, and 0.49 percent variance of scientific literacy skills.

The variable gamma (γ) indicates the ralationship between latent independent and latent dependent variables. All the variables' gamma coefficients are shown in the Table 4.9.

Table 4.9 Structure Coefficients of Scientific Literacy Model for Student Related Variables

Latent Independent Variables	γ	Latent Dependent Variables
isced	-0.12	atschool
relation	0.51	
remedial	0.19	
coaching	-0.08	

Table 4.9 (continued)

isced	0.66	scielit
relation	0.11	
lonely	-0.06	
remedial	-0.10	

According to Table 4.9, the total effect of "isced" on "atschool" is negative and significant (γ=-0.12, $p<0.05$). The total effect of "relation" on "atschool" is positive and significant (γ=0.51, $p<0.05$). The effect of "remedial" on "atschool" is positive and significant with the coefficient of 0.19 ($p<0.05$). Coaching has a negative and significant effect on "atschool" (γ=-0.08, $p<0.05$). "Isced" has positive and significancant effect of "scielit" (γ=0.66, $p<0.05$). "Relation" has positive and significant effect on scielit (γ=0.11, $p<0.05$). "Lonely" has negative and significant effect on scielit (γ=-0.06, $p<0.05$). The total effect of "remedial" on scielit is negative and significant (γ=-0.10, $p<0.05$).

According to Table 4.6, the total effect of "atschool" on "scielit" is negative and significant (β =-0.13, $p<0.05$).

The squared multiple correlations (R^2) give the proportion of explained variable. Table 4.10 4.11 shows the squared multiple correlations for observed variables.

Table 4.10 Squared Multiple Correlations of the Student Related Observed Variables

Observed Variables	R^2
hwmnbook	0.45
Isced0	0.35
wellstdn	0.36
intrstds	0.33
listenme	0.41
givehelp	0.43
treatme	0.17
outsider	0.51
felawkw	0.28
fellone	0.37
hrhomewo	0.13
hrremedi	0.53
hrenrich	0.57
outschol	1

Table 4.11 Squared Multiple Correlations of the Student Related Observed Variables

Observed Variables	R^2
donlitle	0.15
wastetim	0.19
givconfi	0.39
scuseful	0.43
pv1scie	0.86
pv2scie	0.86
pv3scie	0.86
pv4scie	0.85
pv5scie	0.86

4.1.2 Modeling with Computer Related Factors

The computer related model consists of four independent and two dependent latent variables. Independent latent variables are "internet" (frequency of using internet), "basic" (basic computer skills), "computer" (frequency of computer usage), "advanced" (advanced computer skills) and dependent latent variables are "scielit" (scientific literacy) and "attcomp" (attitudes towards computer) in this particular analysis.

The variables of lowercase lambda sub x (λ_x), lowercase lambda sub y (λ_y), lowercase epsilon (ε) and lowercase delta (δ) for computer related variables are shown in Table 4.12. These parameters measure the relationship between variables. (λ_x) and (λ_y) defines the relationship between observed and latent variables. However ε and δ explain the measurement errors of the relationship for independent and dependent variables respectively. The model with latent variables was given in the appendix C.

Table 4.12 Measurement Coefficients of Scientific Literacy Model for Computer Related Variables

Observed	λ	Latent	Measurement Errors
hoftinfo	0.66 (λ_x)	internet *Frequency of Using Internet*	0.56 (δ)
hofdwnmu	0.70 (λ_x)		0.50 (δ)
hoftword	0.67 (λ_x)	computer *Frequency of Using Computer*	0.54 (δ)
hofgraph	0.67 (λ_x)		0.55 (δ)
hofedsof	0.67 (λ_x)		0.56 (δ)
hoflearn	0.66 (λ_x)		0.56 (δ)
hofprogr	0.73 (λ_x)		0.46 (δ)
hwelsave	0.86 (λ_x)	basic *Basic Computer Skills*	0.25 (δ)
hwelprin	0.88 (λ_x)		0.22 (δ)
hweldele	0.88 (λ_x)		0.23 (δ)
hwelmove	0.81 (λ_x)		0.35 (δ)
hwelprog	0.63 (λ_x)	advanced *Advanced Computer Skills*	0.60 (δ)
hwelplot	0.72 (λ_x)		0.48 (δ)
hwelppoi	0.75 (λ_x)		0.44 (δ)
hwelmult	0.72 (λ_x)		0.48 (δ)
hwelwebp	0.69 (λ_x)		0.53 (δ)
feelimpo	0.66 (λ_y)	attcomp *Attitudes towards Computer*	0.56 (ε)
feelfun	0.67 (λ_y)		0.56 (ε)
feelintr	0.79 (λ_y)		0.37 (ε)
feelfget	0.73 (λ_y)		0.47 (ε)
pv1scie	0.92 (λ_y)	scielit *Scientific Literacy*	0.16 (ε)
pv2scie	0.91 (λ_y)		0.17 (ε)
pv3scie	0.92 (λ_y)		0.16 (ε)
pv4scie	0.91 (λ_y)		0.17 (ε)
pv5scie	0.91 (λ_y)		0.18 (ε)

The observed variables hoftinfo and hofdwnmu are positively and significantly loaded on internet with the coefficients (λ_x) of 0.66 and 0.70 respectively. Their measurement errors (δ) are 0.56 and 0.50 respectively.

The observed variables “hoftword”, “hofgraph”, “hofedsof”, “hoflearn” and “hofprogr” are positively and significantly loaded on computer with the coefficients (λ_x) of 0.67, 0.67, 0.67, 0.66 and 0.73 respectively. Their measurement errors (δ) are 0.54, 0.55, 0.56, 0.56 and 0.46 respectively.

The observed variables “hwelsave”, “hwelprin”, “hweldele” and “hwelmove” are positively and significantly loaded on basic with the coefficients (λ_x) of 0.86,

0.88, 0.88 and 0.81 respectively. Their measurement errors (δ) are 0.25, 0.22, 0.23 and 0.35 respectively.

The observed variables “hwelprog”, “hwelplot”, “hwelppoi”, “hwelmult” and “hwelwebp” are positively and significantly loaded on “advanced” with the coefficients (λ_y) of 0.63, 0.72, 0.75, 0.72 and 0.69 respectively. Their measurement errors (ε) are 0.60, 0.48, 0.44, 0.48 and 0.53 respectively.

The observed variables “feelimpo”, “feelfun”, “feelintr” and “feelfget” are positively and significantly loaded on advanced with the coefficients (λ_y) of 0.66, 0.67, 0.79 and 0.73 respectively. Their measurement errors (ε) are 0.56, 0.56, 0.37 and 0.47 respectively.

The observed variables “pv1scie”, “pv2scie”, “pv3scie”, “pv4scie” and pv5scie are positively and significantly loaded on “scielit” with the coefficients (λ_y) of 0.92, 0.91, 0.92, 0.91, and 0.91 respectively. Their measurement errors (ε) are 0.16, 0.17, 0.16, 0.17, and 0.18 respectively.

The path diagram for the modeling of computer related factors with observed variables is given in Appendix C. Figure 4.5 and 4.6 indicate the structural models with standardized coefficients and t-values respectively.

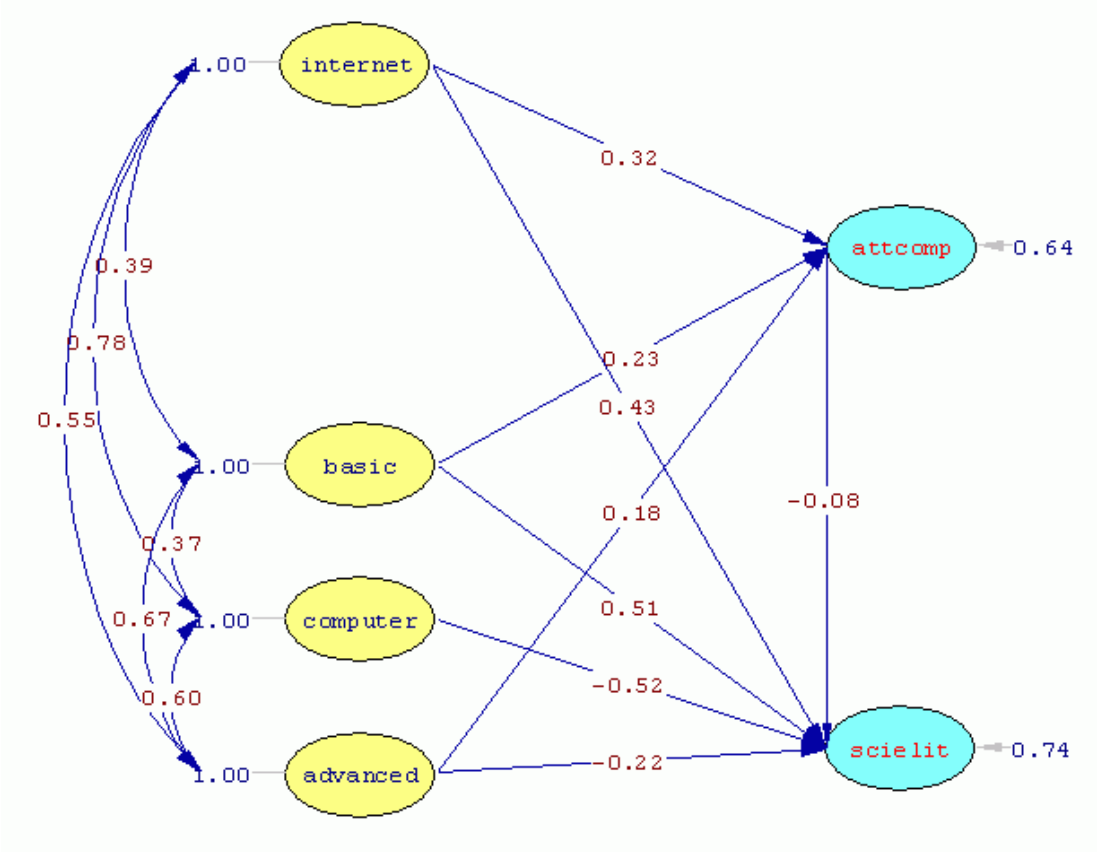

Figure 4.5 Structural Model of Computer Related Factors for Turkey (Coefficients in Standardized Value)

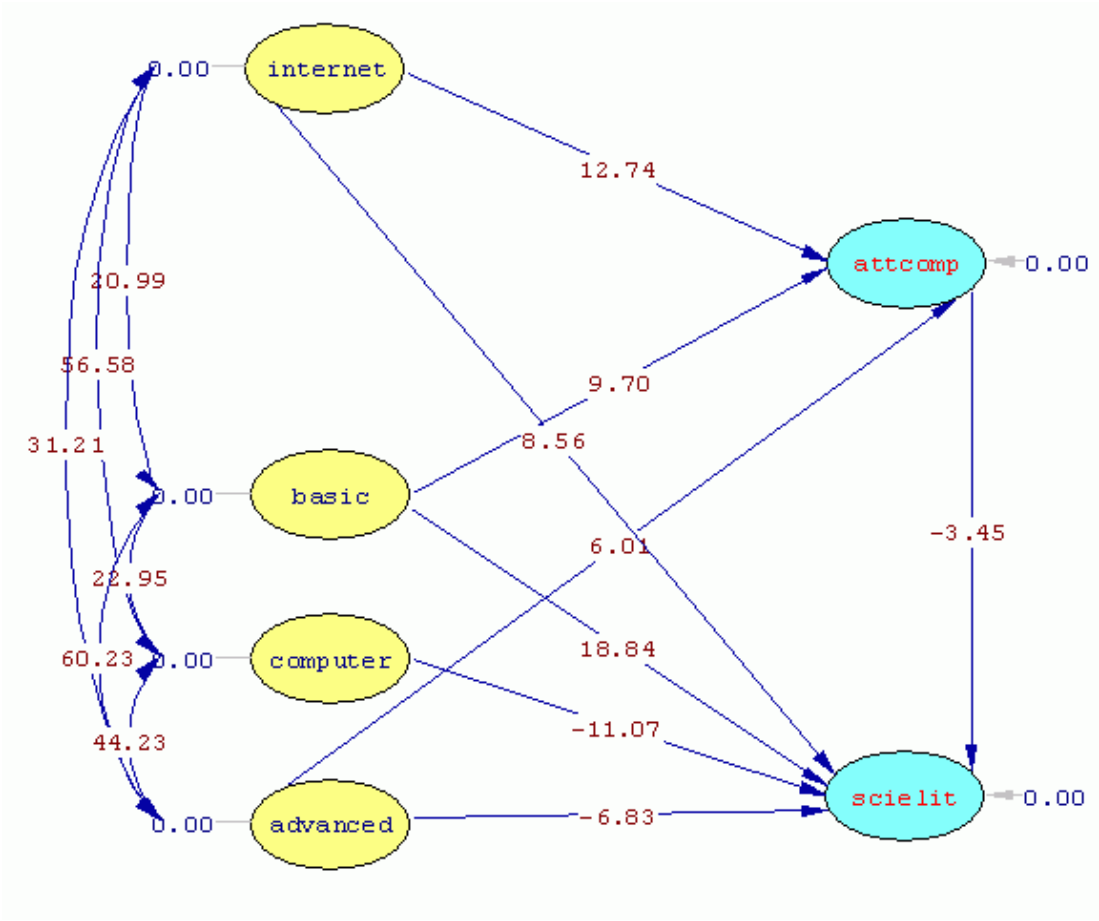

Figure 4.6 Structural Model of Computer Related Factors for Turkey (Coefficients in t-Values)

The goodness of fit indices of GFI and AGFI of the model in Figure 4.3 and 4.4 are 0.95 and 0.93 which are greater than 0.90. The values of RMSEA and Standard RMR are 0.050 and 0.049 and smaller than 0.05. This model explains 0.36 percent of variance on attitudes towards school, and 0.26 percent variance of scientific literacy skills.

Table 4.13 Structure Coefficients of Scientific Literacy Model for Computer Related Variables

Latent Independent Variables	γ	Latent Dependent Variables
Internet	0.32	atschool
Basic	0.23	
Advanced	0.18	
Internet	0.43	scielit
Basic	0.51	
Computer	-0.52	
Advanced	-0.22	

According to Table 4.13, the total effect of "internet" on "atschool" is positive and significant (γ=0.32, $p<0.05$). The effect of "basic" on "atschool" is positive and significant with the coefficient of 0.23 ($p<0.05$). "Advanced" has a positive and significant effect on "atschool" (γ=0.18, $p<0.05$). "Internet" has positive and significant effect on "scielit" (γ=0.43, $p<0.05$). "Basic" has positive and significant effect on "scielit" (γ=0.51, $p<0.05$). The total effect of "computer" on "scielit" is negative and significant (γ=-0.52, $p<0.05$). Finally, there are negative and significant relationship between "advanced" and "scielit" (γ=0.15, $p<0.05$).

Table 4.14 Structure Coefficients of Scientific Literacy Model for Computer Related Variables

Latent Dependent Variables	β	Latent Dependent Variables
Attcomp	-0.08	scielit

According to Table 4.14, the total effect of "attcomp" on "scielit" is negative and significant (β =-0.08, $p<0.05$).

Table 4.15 and 4.16 show squared multiple correlations of the computer related observed variables

Table 4.15 Squared Multiple Correlations of the Computer Related Observed Independent Variables

Observed	R^2
hoftinfo	0.44
hofdwnmu	0.46
hoftword	0.45
hofgraph	0.44
hofedsof	0.44
hoflearn	0.50
hofprogr	0.54
hwelsave	0.75
hwelprin	0.78
hweldele	0.77
hwelmove	0.65
hwelprog	0.40
hwelplot	0.52
hwelppoi	0.56
hwelmult	0.57
hwelwebp	0.47

Table 4.16 Squared Multiple Correlations of the Computer Related Observed Dependent Variables

Variables	R^2
feelimpo	0.44
feelfun	0.44
feelintr	0.63
feelfget	0.53
pv1scie	0.84
pv2scie	0.83
pv3scie	0.84
pv4scie	0.83
pv5scie	0.82

4.2 Summary of the Results

The models presented above indicate some expected relationships among the latent variables.

In general the teacher student relation has positive impact on both school related attitudes and scientific literacy of the students. Similarly feeling of loneliness has negative relationship with the literacy measures. Outside school coaching courses has positively related to scientific literacy skills. However, when preschool attendance and number of books at home introduced into the model this effect disappears. On the contrary, this particular variable indicated negative relationship with the attitudes toward school.

In the models presented before, remedial courses conducted by the school indicated positive relationship with the attitudes toward school but negative relationship with the scientific literacy. Also, attitudes toward school indicated a negative relation with the scientific literacy.

One of the most important findings of this research is the impact of preschool attendance and number of books at home. It is positively related to scientific literacy measures but its impact on attitudes towards school is negative.

For the model related to computer use, the frequency of internet use, and basic computer skills indicated a positive relationship with the literacy measures. However, while advanced skills in computer are positively related to computer

attitudes, it has negative relation with the scientific literacy measures. In the same way, frequency of using internet and basic computer skills indicate positive relationships with computer attitudes. However frequency of computer uses and attitudes towards computer have negative relationship with scientific literacy.

CHAPTER 5

CONCLUSION

This chapter summarizes and discusses the results of the study with respect to the analysis of the structural equation modeling.

5.1 Results of the Study

The results of this study are summarized below.

1. Student-teacher relations are positively related to attitudes towards school among 15 year-old Turkish students. Better relation between students and their teacher, positively influence attitudes towards school.

2. Student-teacher relations are positively related to scientific literacy of 15 year-old Turkish students. Better relation between students and their teacher enhance scientific literacy scores of the students.

3. Student who feel lonely and outsider at school are the ones with low scientific literacy scores.

4. Hours spent in remedial study and homework are positively related to attitudes towards school. The students spending more time in remedial and enrichment classes or homework develop more positive attitudes towards school.

5. Hours spent in remedial study and homework are negatively related to scientific literacy. The students spending more time in remedial and enrichment classes or homework assignment achieve less in scientific literacy tests.

6. Out of school private courses are negatively related with attitudes towards school. The students spending more time in out-of-school courses develop more negative attitudes towards school.

7. Out-of-school courses are positively related to scientific literacy. The students spending more time in out-of-school courses have high scientific literacy level. However when preschool attendance and number of books at home considered in the model (that is controlled) the influence of private out of school courses disappears.

8. The frequency of using internet is positively related to attitudes towards computer of 15 year-old Turkish students. Students spending more time in internet develop more positive attitudes towards computer.

9. The frequency of using internet is positively related to scientific literacy of Turkish 15 year-old students. Students spending more time in internet have higher scientific literacy level.

10. Basic computer skills significantly and positively influence attitudes towards computer of 15 year-old Turkish students. Students who have basic computer skills such as deleting, moving, copying, printing a file develop more positive attitudes towards computer.

11. Basic computer skills significantly and positively influence scientific literacy of 15 year-old Turkish students. Students who have basic computer skills such as deleting, moving, copying, printing a file have higher scientific literacy level.

12. The frequency of using computer is negatively related to scientific literacy of 15 year-old Turkish students. As students use word processors, drawing, painting or graphics programs and educational programs more frequently they have lower scientific literacy scores.

13. Advanced computer skills significantly and positively influence attitudes towards computer of 15 year-old Turkish students. As students create a computer program,

presentation or multimedia presentation and construct a web page they develop more positive attitudes towards computer.

14. Advanced computer skills significantly and negatively influence scientific literacy of 15 year-old Turkish students. As students create a computer program, presentation or multimedia presentation and construct a web page they have more scientific literacy measures.

15. Number of books at home and attendance to preschool are negatively related to attitudes towards school. Students attending kindergarten and having many books at home develop more negative attitudes towards school.

16. Number of books at home and attendance to preschool are positively related to scientific literacy. Students attending kindergarten and having many books at home are more scientifically literate.

5.2 Discussions of the Results

In this study, as seen from the results given above, in general most important variable that is positively related to attitudes toward school and scientific literacy measures is student teacher relations. As student teacher interaction improves positively, that might have positive impact on both affective and cognitive measures. This finding is supported by the literature review where positive relationship between teacher-student interaction and cognitive measures was reported (Miller, 2000). This influence is still very strong when the preschool attendance and number of books at home are controlled in the LISREL model. This finding of the study has very important policy implications that in any school organization the quality of the teacher-student relation should be improved.

Another important finding of the study is the strong impact of preschool attendance and number of books at home on scientific literacy skills of the students. (Wasik & Karweit, 1992). In this particular latent variable, two variables such as number of books at home and preschool attendance might be reflecting socio-economic status of the families. However, considering preschool education as a

compulsory education level might be one of the policy implications that educators may focus on.

It has also been found that an affective measure such as feelings of loneliness has a negative effect on scientific literacy skills of the students. As students feel lonelier and outsider in the school they are less successful. This is an expected outcome where in the TIMSS 1999 it was found that negative self confidence in mathematics had negative effect on mathematics achievement (Yayan & Berberoğlu, 2003).

One contradictory finding was obtained in line with the remedial courses conducted at school. This particular variable enhances the attitudes toward school, however, it gives negative relationship with the scientific literacy measures. The reason might be related to the curriculum based content of the remedial courses at school and teacher assigned homework. As was explained before scientific literacy measures are not reflecting curriculum based learning achievement.

Another surprising result of the study is the negative relationship between attitudes toward school and the scientific literacy measures of the students. That means students who indicate negative attitudes toward school are the ones with higher scientific literacy measures. On the other hand even though the path coefficient is significant for this particular variable, the coefficient itself is rather weak compared to the impacts of other variables in the model.

Out of school private courses are influential on scientific literacy skills, but negatively related to attitudes toward school. These courses are somehow developing negative feelings about the school among the students. Students might believe that they are more successful as they attend private courses, but not the school they are formally belong to. Fraser (1979) found that students who enrolled in out-of-school courses differ from the formal school population in their scientific thinking, i.e., they out-performed a control school group on all the skills measured by Test of Enquiry Skills. This founding is consistent with this study's results. However, when number of books at home and preschool attendance are considered in the model, the effect of outside school private courses disappears. This finding strongly suggests the impact of socio-economic status on success in the scientific literacy skills. That is, when students' preschool education level and the parental support at home (as number of books at home) are controlled, the outside school

private courses have no effect on the success of scientific literacy measures of the students.

The findings of the research related to computer are also supported by the literature. Students who used computers more often for science had significantly lower science achievement scores than students who used computers less often (Miller & Marry, 2002). The negative relationship between the frequency of computer use and learning achievement was also reported in the Third International Mathematics and Science Study (World Bank Report, 2004). These findings are consistent with the results of the study, where repetitive relationship between advanced computer skills and use of software and scientific literacy was observed in the LISREL model tested.

5.3 Implications

According to the results of the study, some implications can be stated as follows:

- The families, school administrators and teachers should be careful about student's computer usage. What students do with computers seems more important than frequency of using it.
- Preschool attendance seems an important policy decision to foster higher learning and cognitive skills in the further years.
- The interaction between teacher and students is one of the most important variables that foster both school related attitudes and scientific literacy skills of the students. Thus, any quality enhancement program should consider that dimension seriously in the school system.

5.4 Suggestions for Further Studies

In this study, factors that are related to scientific literacy in Turkey were examined. Students' attitudes towards school, relations with teachers, attitudes towards computer, frequency of computer usage and basic and advanced computer skills were selected as independent variables. Further research studies can consider other student related factors in the PISA questionnaires.

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APPENDIX A

Table A.1 The Frequency of How many books at home Q19

		Frequency	Percent
Valid	0-10 books	1128	23,2
	11-25 books	1281	26,4
	26-100 books	1436	29,6
	101-200 books	446	9,2
	201-500 books	276	5,7
	More than 500 books	144	3,0
	Total	4711	97,0
Missing	N/A	2	,0
	Invalid	10	,2
	Miss	132	2,7
	Total	144	3,0
Total		4855	100,0

Table A.2 The Frequency of Attend <ISCED 0> Q20

		Frequency	Percent
Valid	No	3614	74,4
	Yes, one year or less	763	15,7
	Yes, more than one year	359	7,4
	Total	4736	97,5
Missing	N/A	2	,0
	Invalid	2	,0
	Miss	115	2,4
	Total	119	2,5
Total		4855	100,0

Table A.3 The Frequency of School done little Q24a

		Frequency	Percent
Valid	Strongly agree	585	12,0
	Agree	1314	27,1
	Disagree	1679	34,6
	Strongly disagree	778	16,0
	Total	4356	89,7
Missing	N/A	2	,0
	Invalid	7	,1
	Miss	490	10,1
	Total	499	10,3
Total		4855	100,0

Table A.4 The Frequency of School waste of time Q24b

		Frequency	Percent
Valid	Strongly agree	135	2,8
	Agree	187	3,9
	Disagree	1181	24,3
	Strongly disagree	2847	58,6
	Total	4350	89,6
Missing	N/A	2	,0
	Invalid	7	,1
	Miss	496	10,2
	Total	505	10,4
Total		4855	100,0

Table A.5 The Frequency of “School Given Confidence” Q24c

		Frequency	Percent
Valid	Strongly agree	1456	30,0
	Agree	2291	47,2
	Disagree	523	10,8
	Strongly disagree	211	4,3
	Total	4481	92,3
Missing	N/A	2	,0
	Invalid	5	,1
	Miss	367	7,6
	Total	374	7,7
Total		4855	100,0

Table A.6 The Frequency of “School Useful” Q24d

		Frequency	Percent
Valid	Strongly agree	1985	40,9
	Agree	2055	42,3
	Disagree	441	9,1
	Strongly disagree	167	3,4
	Total	4648	95,7
Missing	N/A	4	,1
	Invalid	9	,2
	Miss	194	4,0
	Total	207	4,3
Total		4855	100,0

Table A.7 The Frequency of “Well with Students” Q26a

		Frequency	Percent
Valid	Strongly Agree	1089	22,4
	Agree	2613	53,8
	Disagree	771	15,9
	Strongly disagree	177	3,6
	Total	4650	95,8
Missing	N/A	2	,0
	Invalid	6	,1
	Miss	197	4,1
	Total	205	4,2
Total		4855	100,0

Table A.8 The Frequency of “Interested in Students” Q26b

		Frequency	Percent
Valid	Strongly Agree	550	11,3
	Agree	2107	43,4
	Disagree	1432	29,5
	Strongly disagree	425	8,8
	Total	4514	93,0
Missing	N/A	2	,0
	Invalid	4	,1
	Miss	335	6,9
	Total	341	7,0
Total		4855	100,0

Table A.9 The Frequency of “Listen to Me” Q26c

		Frequency	Percent
Valid	Strongly Agree	863	17,8
	Agree	2468	50,8
	Disagree	929	19,1
	Strongly disagree	227	4,7
	Total	4487	92,4
Missing	N/A	2	,0
	Invalid	6	,1
	Miss	360	7,4
	Total	368	7,6
Total		4855	100,0

Table A.10 The Frequency of “Give Extra Help” Q26d

		Frequency	Percent
Valid	Strongly Agree	1074	22,1
	Agree	2264	46,6
	Disagree	914	18,8
	Strongly disagree	272	5,6
	Total	4524	93,2
Missing	N/A	2	,0
	Invalid	3	,1
	Miss	326	6,7
	Total	331	6,8
Total		4855	100,0

Table A.11 The Frequency of Treat me fairly Q26e

		Frequency	Percent
Valid	Strongly Agree	834	17,2
	Agree	2168	44,7
	Disagree	1033	21,3
	Strongly disagree	431	8,9
	Total	4466	92,0
Missing	N/A	2	,0
	Invalid	2	,0
	Miss	385	7,9
	Total	389	8,0
Total		4855	100,0

Table A.12 The Frequency of Feel awkward Q27d

		Frequency	Percent
Valid	Strongly Agree	133	2,7
	Agree	337	6,9
	Disagree	1712	35,3
	Strongly disagree	2315	47,7
	Total	4497	92,6
Missing	N/A	2	,0
	Invalid	5	,1
	Miss	351	7,2
	Total	358	7,4
Total		4855	100,0

Table A.13 The Frequency of Feel lonely Q27f

		Frequency	Percent
Valid	Strongly Agree	415	8,5
	Agree	737	15,2
	Disagree	1775	36,6
	Strongly disagree	1622	33,4
	Total	4549	93,7
Missing	N/A	2	,0
	Invalid	2	,0
	Miss	302	6,2
	Total	306	6,3
Total		4855	100,0

Table A.14 The Frequency of How often information IC5a

		Frequency	Percent
Valid	Almost every day	434	10,9
	A few times each week	818	20,5
	Between 1 pwk & 1 pmn	606	15,2
	Less than 1 pmn	467	11,7
	Never	1003	25,1
	Total	3328	83,2
Missing	Invalid	5	,1
	Miss	667	16,7
	Total	672	16,8
Total		4000	100,0

Table A.15 The Frequency of How often Word IC5c

		Frequency	Percent
Valid	Almost every day	440	11,0
	A few times each week	1011	25,3
	Between 1 pwk & 1 pmn	549	13,7
	Less than 1 pmn	426	10,7
	Never	887	22,2
	Total	3313	82,8
Missing	Invalid	2	,1
	Miss	685	17,1
	Total	687	17,2
Total		4000	100,0

Table A.16 The Frequency of How often graphics IC5g

		Frequency	Percent
Valid	Almost every day	447	11,2
	A few times each week	1040	26,0
	Between 1 pwk & 1 pmn	647	16,2
	Less than 1 pmn	534	13,4
	Never	659	16,5
	Total	3327	83,2
Missing	Invalid	10	,3
	Miss	663	16,6
	Total	673	16,8
Total		4000	100,0

Table A.17 The Frequency of How often educ software IC5h

		Frequency	Percent
Valid	Almost every day	251	6,3
	A few times each week	591	14,8
	Between 1 pwk & 1 pmn	527	13,2
	Less than 1 pmn	528	13,2
	Never	1385	34,6
	Total	3282	82,1
Missing	Invalid	7	,2
	Miss	711	17,8
	Total	718	18,0
Total		4000	100,0

Table A.18 The Frequency of How often learning IC5i

		Frequency	Percent
Valid	Almost every day	321	8,0
	A few times each week	687	17,2
	Between 1 pwk & 1 pmn	518	13,0
	Less than 1 pmn	449	11,2
	Never	1266	31,7
	Total	3241	81,0
Missing	Invalid	9	,2
	Miss	750	18,8
	Total	759	19,0
Total		4000	100,0

Table A.19 The Frequency of How often download music IC5j

		Frequency	Percent
Valid	Almost every day	630	15,8
	A few times each week	887	22,2
	Between 1 pwk & 1 pmn	520	13,0
	Less than 1 pmn	380	9,5
	Never	896	22,4
	Total	3313	82,8
Missing	Invalid	7	,2
	Miss	680	17,0
	Total	687	17,2
Total		4000	100,0

Table A.20 The Frequency of How often programming IC5k

		Frequency	Percent
Valid	Almost every day	447	11,2
	A few times each week	792	19,8
	Between 1 pwk & 1 pmn	458	11,5
	Less than 1 pmn	478	12,0
	Never	1121	28,0
	Total	3296	82,4
Missing	Invalid	5	,1
	Miss	699	17,5
	Total	704	17,6
Total		4000	100,0

Table A.21 The Frequency of How well save IC6h

		Frequency	Percent
Valid	Can do well	2011	50,3
	Can do with help	760	19,0
	Cannot do	292	7,3
	Don't know	227	5,7
	Total	3290	82,3
Missing	Invalid	6	,2
	Miss	704	17,6
	Total	710	17,8
Total		4000	100,0

Table A.22 The Frequency of How well print IC6i

		Frequency	Percent
Valid	Can do well	1765	44,1
	Can do with help	954	23,9
	Cannot do	309	7,7
	Don't know	254	6,4
	Total	3282	82,1
Missing	Invalid	3	,1
	Miss	715	17,9
	Total	718	18,0
Total		4000	100,0

Table A.23 The Frequency of How well delete IC6j

		Frequency	Percent
Valid	Can do well	2131	53,3
	Can do with help	700	17,5
	Cannot do	239	6,0
	Don't know	221	5,5
	Total	3291	82,3
Missing	Invalid	6	,2
	Miss	703	17,6
	Total	709	17,7
Total		4000	100,0

Table A.24 The Frequency of How well move IC6k

		Frequency	Percent
Valid	Can do well	2030	50,8
	Can do with help	786	19,7
	Cannot do	261	6,5
	Don't know	196	4,9
	Total	3273	81,8
Missing	Invalid	9	,2
	Miss	718	18,0
	Total	727	18,2
Total		4000	100,0

Table A.25 The Frequency of How well PowerPoint IC6q

		Frequency	Percent
Valid	Can do well	1280	32,0
	Can do with help	1030	25,8
	Cannot do	445	11,1
	Don't know	440	11,0
	Total	3195	79,9
Missing	Invalid	7	,2
	Miss	798	20,0
	Total	805	20,1
Total		4000	100,0

Table A.26 The Frequency of How well multimedia IC6t

		Frequency	Percent
Valid	Can do well	1118	28,0
	Can do with help	1218	30,5
	Cannot do	489	12,2
	Don't know	390	9,8
	Total	3215	80,4
Missing	Invalid	2	,1
	Miss	783	19,6
	Total	785	19,6
Total		4000	100,0

Table A.27 The Frequency of How well web page IC6w

		Frequency	Percent
Valid	Can do well	881	22,0
	Can do with help	1349	33,7
	Cannot do	538	13,5
	Don't know	457	11,4
	Total	3225	80,6
Missing	Invalid	3	,1
	Miss	772	19,3
	Total	775	19,4
Total		4000	100,0

Table A.28 The Frequency of Feel Important IC7a

		Frequency	Percent
Valid	Strongly agree	1826	45,7
	Agree	1147	28,7
	Disagree	350	8,8
	Strongly disagree	75	1,9
	Total	3398	85,0
Missing	Invalid	2	,1
	Miss	600	15,0
	Total	602	15,1
Total		4000	100,0

Table A.29 The Frequency of Feel forget time IC7d

		Frequency	Percent
Valid	Strongly agree	1822	45,6
	Agree	1077	26,9
	Disagree	322	8,1
	Strongly disagree	124	3,1
	Total	3345	83,6
Missing	Invalid	1	,0
	Miss	654	16,4
	Total	655	16,4
Total		4000	100,0

APPENDIX B

THE SIMPLIS SYNTAX FOR THE FIRST STUDENT RELATED MODEL

Observed Variables
donlitle wastetim givconfi scuseful wellstdn intrstds listenme givehelp treatme outsider felawkw fellone
hrhomewo hrremedi hrenrich outschol pv1scie pv2scie pv3scie pv4scie pv5scie
Covariance Matrix from file: RECODED3.COV
Sample Size = 4855
Latent Variables relation lonely remedial atschool coaching scielit
Relationships
wellstdn intrstds listenme givehelp treatme = relation
outsider felawkw fellone = lonely
hrhomewo hrremedi hrenrich = remedial
outschol = coaching
pv1scie pv2scie pv3scie pv4scie pv5scie = scielit
donlitle wastetim givconfi scuseful = atschool
scielit = relation lonely remedial coaching
atschool = relation remedial coaching
scielit = atschool

Set Error Variance of outschol to 0

Admissibility Check = 2000
Iterations = 5000
Method of Estimation: Maximum Likelihood
Path Diagram
End of Problem

THE SIMPLIS SYNTAX FOR THE SECOND STUDENT RELATED MODEL

Observed Variables
hwmnbook isced0 donlitle wastetim givconfi scuseful wellstdn intrstds listenme givehelp treatme outsider felawkw fellone
hrhomewo hrremedi hrenrich outschol pv1scie pv2scie pv3scie pv4scie pv5scie
Covariance Matrix from file: RECODED2.COV

Sample Size = 4855
Latent Variables isced relation lonely remedial atschool coaching scielit
Relationships

hwmnbook isced0 = isced
wellstdn intrstds listenme givehelp treatme = relation
outsider felawkw fellone = lonely
hrhomewo hrremedi hrenrich = remedial
outschol = coaching
pv1scie pv2scie pv3scie pv4scie pv5scie = scielit
donlitle wastetim givconfi scuseful = atschool
scielit = relation lonely remedial isced
atschool = relation remedial coaching isced

Set Error Variance of outschol to 0

Admissibility Check = 2000
Iterations = 5000
Method of Estimation: Maximum Likelihood
Path Diagram
End of Problem

THE SIMPLIS SYNTAX FOR THE COMPUTER RELATED MODEL

Observed Variables
hoftinfo hoftword hofgraph hofedsof hoflearn hofdwnmu hofprogr
hwelsave hwelprin hweldele hwelmove hwelprog hwelplot hwelppoi hwelmult hwelwebp
feelimpo feelfun feelintr feelfget pv1scie pv2scie pv3scie pv4scie pv5scie
Covariance Matrix from file: COMP2.COV
Sample Size = 4000
Latent Variables internet basic computer advanced attcomp scielit
Relationships

hoftinfo hofdwnmu = internet
hoftword hofgraph hofedsof hoflearn hofprogr = computer
hwelsave hwelprin hweldele hwelmove = basic
hwelprog hwelplot hwelppoi hwelmult hwelwebp = advanced
feelimpo feelfun feelintr feelfget = attcomp
pv1scie pv2scie pv3scie pv4scie pv5scie = scielit
scielit = internet basic computer advanced
attcomp = internet basic advanced
scielit = attcomp

Admissibility Check = 1000
Iterations = 5000
Method of Estimation: Maximum Likelihood
Path Diagram
End of Problem

APPENDIX C

LISREL ESTIMATES OF PARAMATERS IN MEASUREMENT MODELS FOR TURKEY

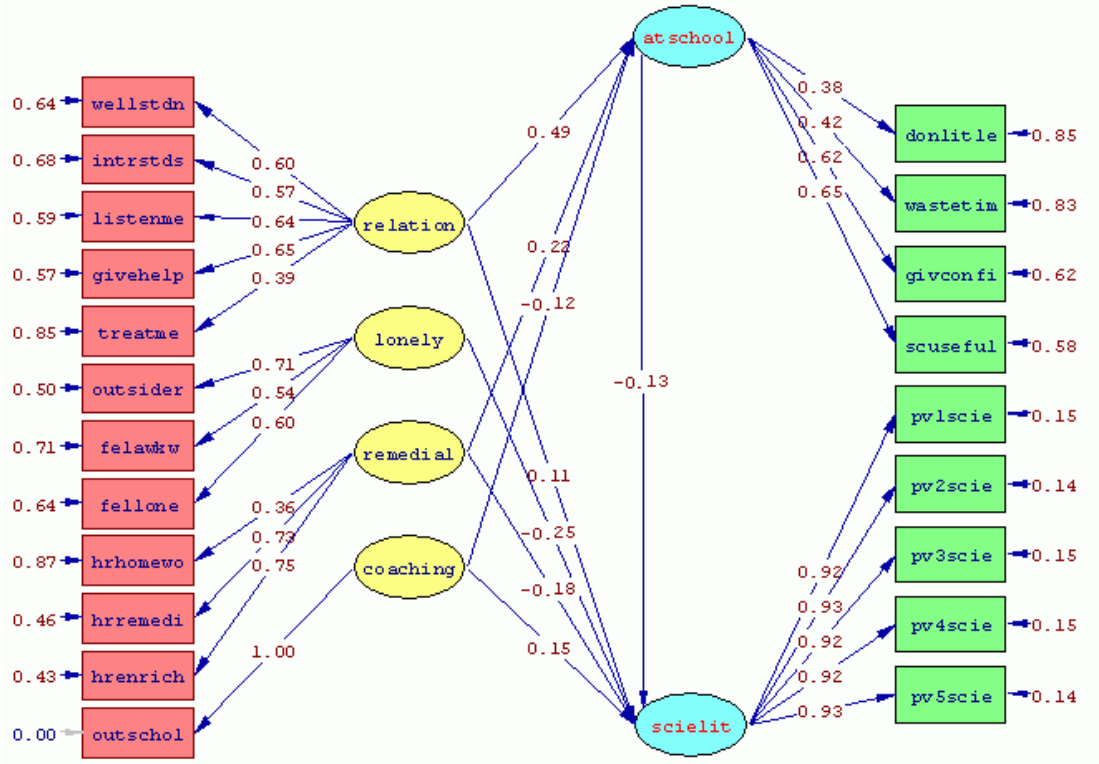

Figure C.1 Full Model of the First Student Related Factors for Turkey (Coefficients in Standardized Value)

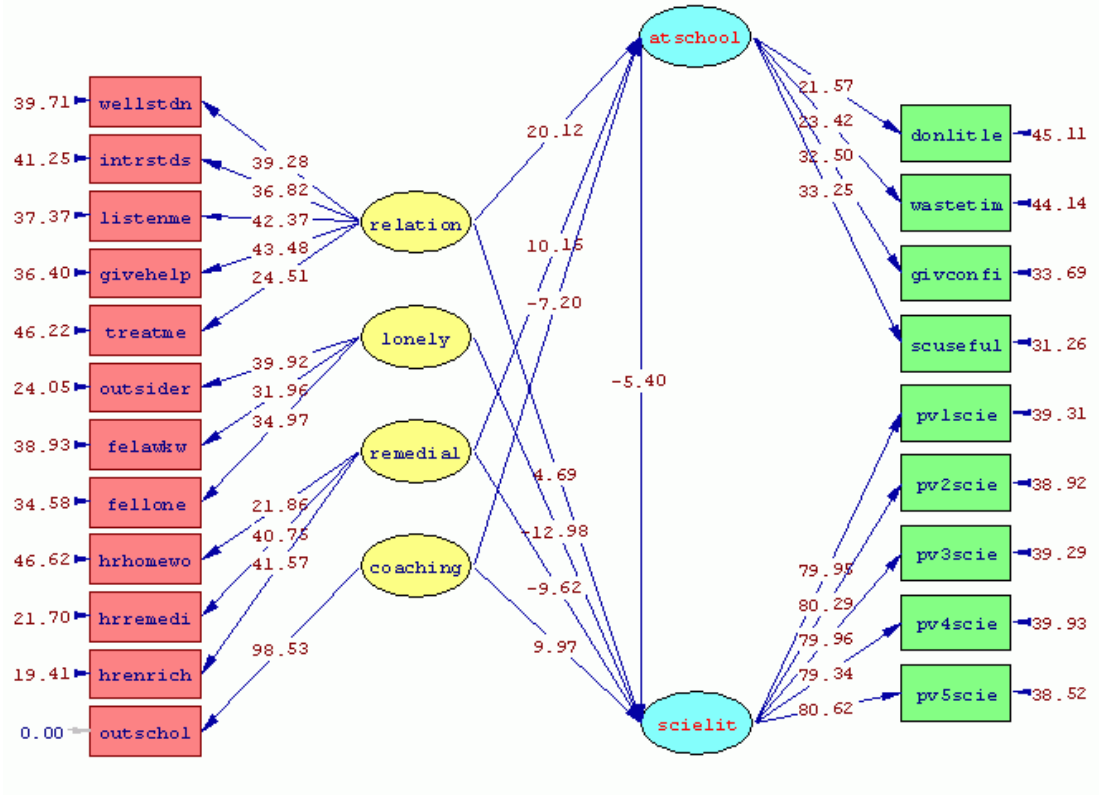

Figure C.2 Full Model of the First Student Related Factors for Turkey (Coefficients in t- Value)

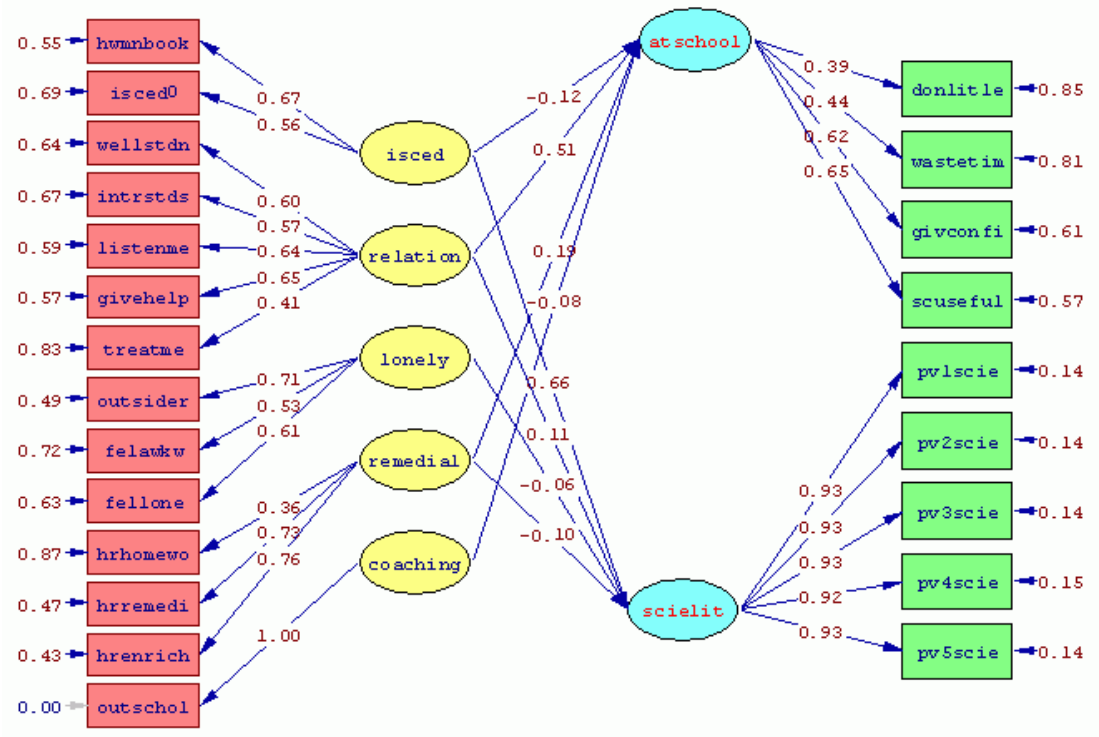

Figure C.3 Full Model of the Second Student Related Factors for Turkey (Coefficients in Standardized Value)

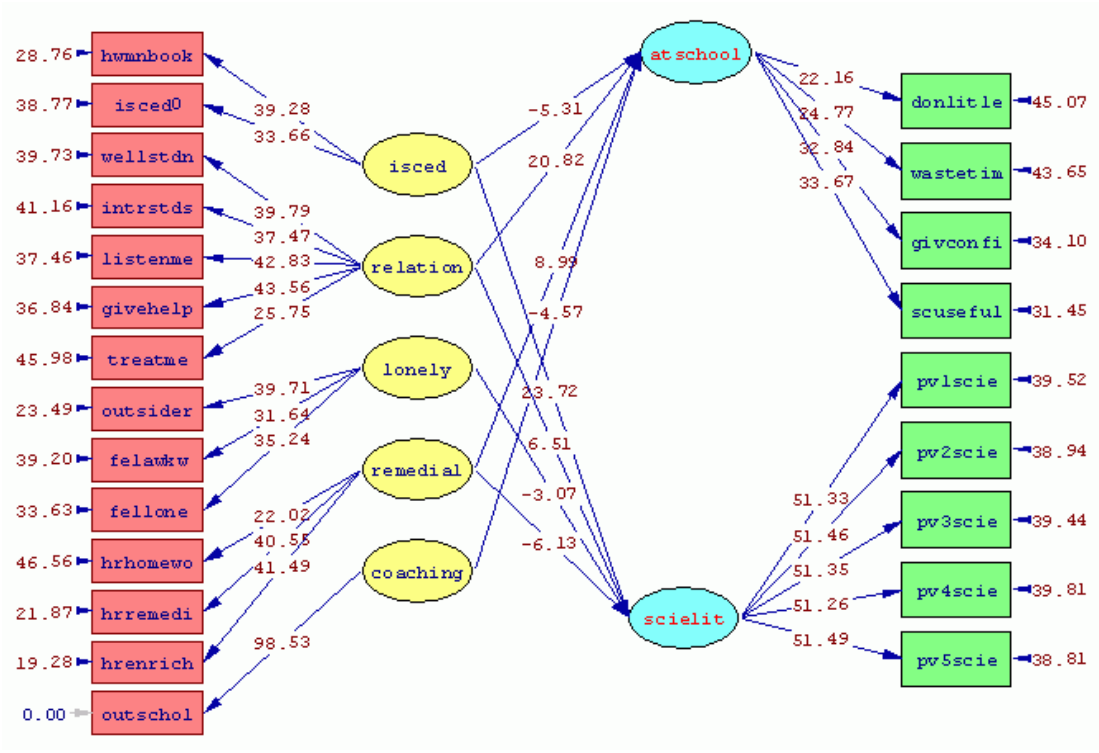

Figure C.4 Full Model of the Second Student Related Factors for Turkey (Coefficients in t- Value)

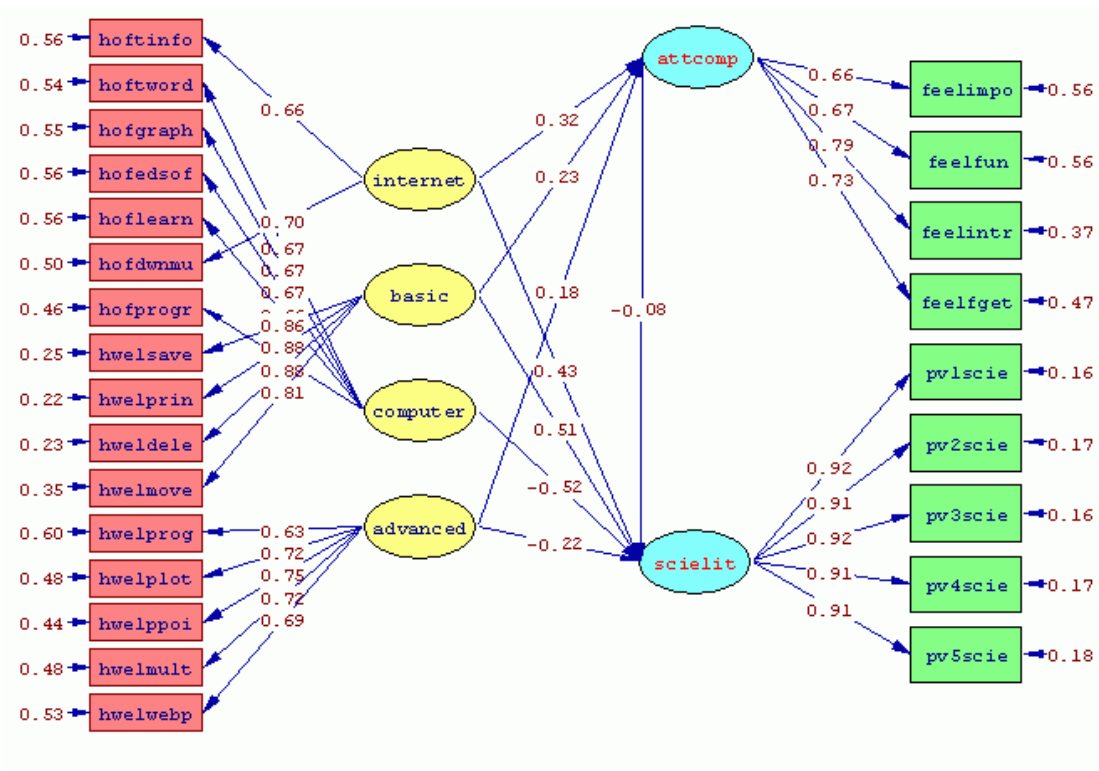

Figure C.5 Full Model of the Computer Related Factors for Turkey (Coefficients in Standardized Value)

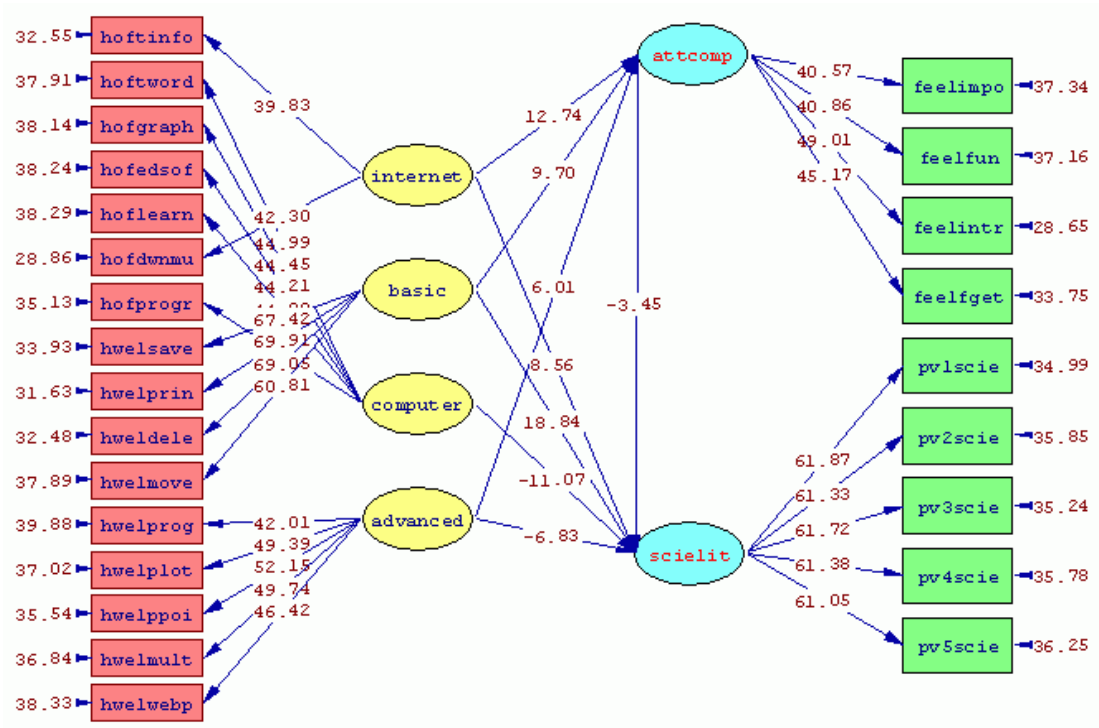

Figure C.6 Full Model of the Computer Related Factors for Turkey (Coefficients in t- Value)