A STRUCTURAL EQUATION MODELING STUDY: FACTORS AFFECTING SCIENCE ACHIEVEMENT BASED ON OBBS-2002 ACROSS GRADE LEVELS AND SCHOOL TYPES

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İLKER KALENDER

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Approval of the Graduate School of Natural and Applied Sciences

_____

Prof. Dr. Canan Özgen

Director

I certify this thesis satisfies all requirements as a thesis for the degree of Master of Science.

_____

Prof. Dr. Ömer Geban

Head of the Department

This is to certify that I have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

_____

Prof. Dr. Giray Berberoglu

Supervisor

Examining Committee Members

Prof. Dr. Füsun AKKÖK	(METU, EDS)	_____
Prof. Dr. Giray BERBEROGLU	(METU, SSME)	_____
Prof. Dr. Ömer GEBAN	(METU, SSME)	_____
Assoc. Prof. Dr. Fitnat KAPTAN	(Hacettepe Üniv.)	_____
Assist. Prof. Dr. Esen UZUNTIRKAYI	(METU, SSME)	_____

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Ilker Kalender

ABSTRACT

A STRUCTURAL EQUATION MODELING STUDY:
FACTORS AFFECTING SCIENCE ACHIEVEMENT BASED ON OBBS-2002
ACROSS GRADE LEVELS AND SCHOOL TYPES

KALENDER, Ilker

M.S., Department of Secondary Sciences and Mathematics Education
Supervisor: Prof. Dr. Giray Berberoglu

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In this study, factors that affect students' science achievement were modeled based on the data which was obtained from Study for Determination of Student Achievement – 2002 (Ogrenci Basarisinin Belirlenmesi Calismasi – OBBS). First, using principle components analysis technique, dimensions of the student questionnaires and science achievement tests were found out. Using these dimensions for student questionnaires, latent variables socioeconomic status, student-centered activities, teacher-centered activities, private tutoring, experiments/technological material usage, and perception of interest and success were selected to be included in this study. Then, a reference model was proposed for factors affecting students' science achievement. Lastly, this reference model was tested across three grade levels (6^{th}, 7^{th}, and 8^{th}) and three school types (state, boarding, and private) and comparisons among them were made.

As a result of modeling which was conducted by structural equation modeling technique (SEM) using LISREL 8.30, the study yielded the followings: Socioeconomic status has a strong effect on science achievement for all grade levels investigated. While teacher-centered activities generally affect students' science achievement in a positive way, student-centered activities show a negative effect. Teacher-centered activities affect perception of interest and success as much as nearly they do for science achievement. Direct effect of teacher-centered activities is not significant for state and boarding schools, but their indirect effects strengthen the effect of teacher-centered activities on science achievement. Effect of experiments and technological material on perception of interest and success is negative for all grade levels and school types, except state schools in which it is positive.

Keywords: Factors Affecting Science Achievement, Structural Equation Modeling, OBBS-2002, Comparison across Grade Levels and School Types.

ÖZ

BIR YAPISAL DENKLEM MODELLEMESI ÇALISMASI:
ÖBBS-2002 VERILERINE DAYALI OLARAK SINIF DÜZEYLERI VE OKUL TÜRLERINE GÖRE FEN BASARISINI ETKILEYEN FAKTÖRLER

KALENDER, Ilker

Yüksek Lisans, Ortaögretim Fen ve Matematik Alanlari Egitimi Bölümü
Tez Yöneticisi: Prof. Dr. Giray Berberoglu

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Bu çalismada ögrencilerin fen basarilarini etkileyen faktörlerin Ögrenci Basarisinin Belirlenmesi Çalismasi – 2002 (ÖBBS) verilerine dayali olarak modellemesi yapilmistir. Önce temel bilesenler analizi kullanilarak, ögrenci anketlerinin ve fen basari testlerinin boyutlari ortaya çikartilmistir. Ögrenci anketinin boyutlarindan olusturulan, sosyoekonomik düzey, ögrenci ve ögretmen merkezli etkinlikler, özel ders, deney/teknolojik araç-gereç kullanma ile ilgi ve basari algisi örtük degiskenleri çalismaya dahil edilmistir. Daha sonra, ögrencilerin fen basarisini etkileyen faktörler için bir referans model öne sürülmüs ve bu model üç sinif düzeyinde (6, 7, 8) ve üç okul türünde (devlet, yatili ve özel) test edilip karsilastirmalar yapilmistir.

LISREL 8.30 kullanilarak gerçeklestirilen yapisal denklem modellemesi sonucunda su bulgular elde edilmistir: Sosyoekonomik düzey tüm sinif düzeyleri için güçlü bir etkiye sahiptir. Ögretmen merkezli etkinlikler fen basarisi üzerinde genellikle basarisi üzerinde olumlu etkiye sahipken, ögrenci merkezli etkinlikler olumsuz bir etki

göstermektedir. Ögretmen merkezli etkinliklerin basari ve ilgi algisi üzerindeki etkileri yaklasik olarak fen basarisindaki etkileri kadar yüksektir. Devlet okullari ve yatili okullar için ögretmen merkezli etkinliklerin fen basarisi üzerindeki dogrudan etkisi anlamli çikmazken, dolayli etkileri bu etkiyi güçlendirmektedir. Deney/teknolojik araç-gereç kullaniminin basari ve ilgi algisi üzerindeki dogrudan etkisi tüm sinif düzeyleri ve devlet okullari hariç tüm okul türlerinde olumsuz yöndedir.

Anahtar Kelimeler: Fen Basarisini Etkileyen Faktörler, Yapisal Denklem Modellemesi, ÖBBS-2002, Sinif Düzeyleri ve Okul Türlerine Göre Karsilastirma.

To mom, grandmother and grandfather

for all…

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LIST OF ABBREVIATIONS

SES	:	Socioeconomic status
STUD_CEN	:	Student-centered activities
TEAC_CEN	:	Teacher-centered activities
TUTOR	:	Private tutoring
EXPRMT	:	Experiments/technological material usage
INT&SUCC	:	Perception of interest and success
SCI_ACHV	:	Science achievement
GFI	:	Goodness-of-fit index
AGFI	:	Adjusted goodness-of-fit index
RMSEA	:	Root-mean square error of approximation
SRMR	:	Standardized root mean square residual

CHAPTER 1

INTRODUCTION

This study aims to model the factors affecting science achievement across 6^{th}, 7^{th} and 8^{th} grade students and state primary schools, primary regional boarding schools (YIBO), and private primary schools through use of data set obtained from Study for Determination of Student Achievement – 2002 (Ogrenci Basarisinin Belirlenmesi Calismasi - OBBS) conducted by the collaboration of Directorate of Educational Research and Development (EARGED), General Directorate of Educational Technologies (EGITEK) and General Directorate of Primary Education.

Objective of science education in primary education is, in a general manner, to make the nature known for pupils in a scientific way. As a result of science education, pupils gain abilities of questioning, researching, stating problems, observing, analyzing and synthesizing. From intellectual perspective, science education has some objectives such as securing objective thinking, rather than fatalistic attitude, developing of curiosity, and making students free thinking (Esme, 2004).

Different implementations in science education can be seen in the past in Turkey. A brief summary on the history of science education can be informative:

- *Between 1932-1937* High-quality science text books were translated into Turkish, books were designed to give knowledge on daily life as well as theory.
- *Between 1937 and 1951* It was decided to write original text books, but quality of these books was not as much as expected.

- *1950s* Objectives of science education was re-stated by collaboration of Turkish and foreign educators. Scientists and researchers were assigned to examine educational system of foreign countries.
- *1960s and 1970s* A project for a new curricula preparation was launched. Two different curricula were prepared. Science high schools entered into the system.
- *1980s* A curricula was adapted but outcomes were not as expected After the abolishment of the implementation foreign curricula, a Council in the Board of Education was established to develop the new curricula. The syllabus for the new curricula was published in the official newspaper (Tebligler Dergisi) of the MoNE in 1985 (Ayas et al, 1993; Turgut,1990).

Though first studies on science education in Turkey have its roots in 1930s and since then there has been a huge knowledge and experience accumulation on the issue, science education in Turkey has not achieved to the expected level and has still been far from its objectives.

Recently, results of Third International Mathematics and Science Study (TIMSS) yielded information that confirmed the bad run of science education in Turkey. TIMSS provided a chance to find out educational system's situation for countries. Turkey's rank is 33 in science achievement out of 38 countries. TIMSS reported definitions and student distributions of 90^{th}, 75^{th}, 50^{th}, and 25^{th} percentiles in science achievement and according to these reports 87% of Turkish students are at or below 50^{th} percentile, which is defined by the following sentences: "Students can notice basic scientific knowledge and express them (50^{th} percentile)" and "Students express some basic phenomena related to earth, life and physical sciences that they know in non-scientific terms" (25^{th} percentile) (National Report, 2003). Similarly, science item averages of Student Selection Examination (OSS), which is approximately 5 out of 45 items, this also show low level of science education (OSYM, Official web page). It is obvious that something is wrong in science education of Turkish national education system.

A recent study, Study for Determination of Student Achievement (OBBS) data set, about students' achievement across grade levels and subject areas will be

investigated in this study and the results which will be obtained at the end will be interpreted.

1.1 Study for Determination of Student Achievement (OBBS)

Study for Determination of Student Achievement (in Turkish, Ogrenci Basarisinin Belirlenmesi Calismasi; OBBS) was conducted in April, 2002 as a part of Basic Education Project in 47 provinces to 4th, 5th, 6th 7th and 8th grade, a total of 112,000 students from state, private and primary regional boarding school by the collaboration of Directorate of Educational Research and Development (EARGED), General Directorate of Educational Technologies and General Directorate of Primary Education in 2002.

Purposes of the OBBS can be summarized as follows:

- to determine students' achievement in Turkish, Mathematics, Science and Social Sciences across gender and regions,
- to make a starting point for monitoring trends in students' achievement in different ages and grades,
- to find out thinking skills that students possess in Turkish, Mathematics, Science and Social Sciences,
- to gather information on socioeconomic status, classroom activities, perception and interest towards Turkish, Mathematics, Science and Social Sciences, leisure time activities and study and reading habits through student questionnaire.

Results of the Study for Determination of Student Achievement 2002 are expected to provide information about Turkish educational system's profile and to lay the scientific groundwork for policy-making studies. Study for Determination of Student Achievement gathered information through an achievement test and a questionnaire. The achievement test items have two dimensions, one for curricula and one for thinking skill to be measured. This test was developed to be used for improving education quality rather than ranking.

There may be many factors that can be related to such low levels of students' science achievement, for example social context of the country, physical requirements, teaching staff, philosophy of the country etc. It is also known that many factors concerning students such as socioeconomic status, instruction methods affects achievement. Moreover, school types show different achievement levels. While private schools have greater achievement, state schools have lower. In this context, this study tries to model factors affecting students' science achievement by using data obtained from achievement test and student questionnaire of OBBS-2002. This modeling study provides an opportunity to investigate the relationships between factors and achievement simultaneously. When final model obtained, it was tested across three different grade level (6^{th}, 7^{th}, 8^{th}) and three different school types (state primary schools, primary regional boarding schools, and private primary schools). At the end of the study, interpretations and recommendation will be given based on the results of the study concerning the science achievement. Results of this study are expected to be contributive for policy and decision making.

1.2 Research Problem of the Study

Research problems of the study can be expressed as follows: "What is the general model explaining factors affecting students' science achievement according to the OBBS-2002 data set?" and "How the proposed model explains the science achievement across in 6^{th}, 7^{th} and 8^{th} grade students and three school type – state primary school, private primary schools and primary regional boarding schools?"

In this study, items in student questionnaire were grouped using principle components analysis technique to find out latent variable structure of students' responses. Then many different models were proposed and tested using Lisrel software. Socioeconomic status, private tutoring, student-/teacher-centered activities, experiments/technological material usage, and perception of interest / success were taken as factors which were expected to affect science achievement.

1.3 Hypothesized Science Achievement Model

In this study a model will be proposed for comparisons ends. In this model several variables and relationships among them exists. These variables and relationships will be investigated across grade levels and school types.

Researcher selected socioeconomic status, private tutoring, student- and teacher-centered activities, experiments/technological material usage and perception of interest and success as the factors of interest for this study. Figure 1.1 shows the proposed model for this study.

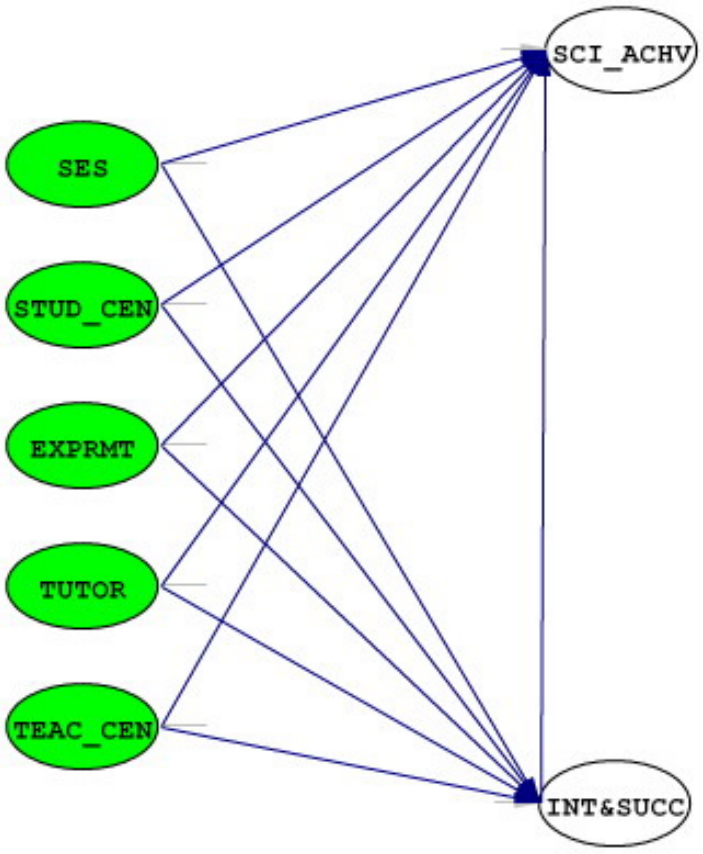


Figure 1.1 Hypothesized Science Achievement Model

In this study, effects of SES, STUD_CEN, TEAC_CEN, TUTOR and EXPRMT on SCI_ACHV was supposed to be significant. Also SES, STUD_CEN, TEAC_CEN, TUTOR and EXPRMT were supposed to have indirect effects on SCI_ACHV by INT&SUCC. In short, hypothesis of this study can be expressed as following: there is no significant effect of SES, STUD_CEN, TEAC_CEN, TUTOR and EXPRMT directly and by INT&SUCC indirectly on science achievement. Significance level was set to be 0.05 in all phases of the study.

1.4 Definitions of Important Terms

In this section definitions and observed variables of the latent variables used in this study will be given. Also this section presents brief and essential information on structural equation modeling, a mathematical method which this study is based on.

Socioeconomic Status (SES)

This latent variable includes items related to students' parental education levels, home possessing, etc. Higher socioeconomic status scores mean better educated parents, more books at home etc. In this study, socioeconomic status latent variables include following items: mother's education level, father's education level, number of sibling in the family, number of book at home excluding text books.

Private Tutoring (TUTOR)

Items related to private tutoring were grouped in this latent variable. While in OBBS-2002 items on private tutoring receiving for science, mathematics, social sciences and Turkish were included, in this study latent variable private tutoring consists of the following items in this study: frequency of receiving private tutoring from science, frequency of receiving private tutoring from mathematics, frequency of receiving private tutoring from Turkish.

Student-Centered Activities (STUD_CEN)

Student-centered activities include those in which students participate to actively, such as group working, discussion in the class, etc. These kinds of items were taken in one latent variable. This factor has a special importance in that there is a current trend favoring student-centered activities in educational policies and it is argued that student-centered activities have strong positive

effect on science achievement. And findings of this study are expected to show the situation in Turkey. Items that were grouped in this latent variable are: frequency of lessons given by students, frequency of that students make discussions, frequency of that teacher discusses with students.

Teacher-Centered Activities (TEAC_CEN)

Also this latent variable was especially included in this study to see its effects on science achievement and to make comparisons with student-centered activities. In teacher-centered activities or instruction, teacher is dominant and student are just passive listeners in the classroom. Teacher talks, solves problems, make experiments, etc. Students are those who only watch, listen and write down. This kind of instruction is a characteristic for Turkish education system. As a tradition coming from the past, students are not expected to be active participants to the lessons. Items of this latent variable are frequency of lessons given by teacher and frequency of that teacher gives examples from daily life.

Experiments and Technological Material (EXPRMT)

Use of instructional material and making experiments in the classroom were grouped in this latent variable. Educational materials such as overhead projector, calculators, maps, diagrams, etc. can be used in the educational settings in order to increase students' perceptions by audio-visual ways. Items constituted this latent variable are the followings: frequency of experiments made by students, frequency of experiments made by teachers, frequency of use of technological materials used in the class.

Perception of Interest and Success for Science and Mathematics (INT&SUCC)

Perceptions of success and interest for courses were thought to be as an important factor on students' achievement and were included as a latent variable in this study. Only perception of interest and success of science and mathematics were taken as a latent variable. Items that were grouped in this latent variable are: how much interest do you have in mathematics, how much interest do you

have in science, how successful do you perceive yourself in mathematics, how successful do you perceive yourself in science.

Science Achievement (SCI_ACHV)

In OBBS-2002, students were given an achievement test including items on science, mathematics, social sciences and Turkish. Science subtest were taken as a factor for representing science achievement. Items that constituted this latent variable were taken from science achievement tests according to the results of principal factor analysis. Each factor obtained from PCA was represented in this latent variable.

Structural Equation Modeling (SEM)

This is a multivariate modeling technique that includes specialized versions of a number of other analysis methods as special cases. Primary purpose of the SEM is to test of casual theories using non experimental data. SEM has two parts: measurement model and structural model. (Biddle & Martin, 1987)

1.5 Significance of the Study

There is no study related to OBBS except few reports and booklets published by Directorate of Educational Research and Development (EARGED). Therefore this study will be first on this issue. It is worthwhile to explore the current situation in science education for obtaining a panorama of education system.

One of the most important expected findings of this study is that it will show the effects of factors such as student-centered, teacher-centered instruction, socioeconomic status, etc. on science achievement in present implementation and in a combined picture, rather than in a controlled experimental study. So it will make possible to see how implementing situation is effective in Turkish education system in a single picture using a very large sample (approx. 30.000 students), instead of giving information on how student-centered or teacher-centered activities are effective in science education in a single experimental study in which there is highly controlled educational settings.

There are items in the student questionnaire related to student- and teacher-centered activities. Relationship between these items and student science achievement

will yield important results in that it provides information on educational implementations in Turkey. There is a trend both in world and Turkey favoring of student-centered activities. Results of the study will revealed how effective student-centered teaching and teacher-centered activities (as in its present situation) in Turkey and will cast a new light on educational policies of Turkey.

Furthermore, this study is a comparative study across different grades and different school types. It is expected that this study will explain the differences and similarities of effects for factors used in the study across grade levels and school types and provide information on achievement-affecting factors for them.

It is important to note that this study is not related to effectiveness of methods such as teacher- and/or student-centered activities or material usage in class. In this study, current implementations of these will be investigated and results will be presented. Another point that should be underlined is that OBBS make measurement based on the items that cover curriculum of MoNE. No information is available about students' background knowledge and/or their possessing of basic skills. Results of this study should be interpreted accordingly.

Information on the three school types, state primary schools, private primary school and primary regional boarding schools (YIBO) in which the proposed model was investigated as follows: there are 8.804.947 students in state primary schools, 140.779 students in YIBOs and 155.868 private primary schools (Ministry of National Education, Sayisal Veriler, 2003). Structures, student profiles and other characteristics of these school types vary sharply. This variation, in turn, affects students' achievement. Therefore, it will be useful to examine the characteristics of the school types in the study.

Also this study has an importance in that it will provide a replication for the previous large educational researchs in Turkey such as TIMSS-R (Third International Mathematics and Science Study - Repeat) and PIRLS (The Progress in International Reading Literacy Study). If this study yields findings parallel with previous studies of Ozdemir (2003) and Yayan (2003), findings of these studies will gain greater importance since replicative findings exist for each other.

To sum up, results of this study are expected to reveal a model explaining effects of some factors on science achievement, to provide comparison opportunity for factors and to be used in policy making and decision making for Turkish education system.

CHAPTER 2

LITERATURE REVIEW

In this chapter, important points and major findings of previous studies related to this study will be presented. Similar modeling studies aimed to explain achievement will be given. Also studies related to factors included in the study (socioeconomic level, teacher- and student-centered activities, tutoring, experiments/technological material usage, perception of interest and success) were scanned and will be summarized in this chapter.

Large-scale quantitative studies have an importance on education systems since they provide educators, policymakers, and researchers with information about the performance of the education systems. Also they provide information for developing policies, fostering public accountability, monitoring improvement and declination in a part of the system, etc. (International Science Report, 2000). If the study is international, this makes comparisons with different countries possible.

Turkey participated to some international studies such as TIMSS (Third International Mathematics and Science Study), PISA (Program for International Student Assessment) and PIRLS (The Progress in International Reading Literacy Study). All these studies were international and Turkey had a chance to see its situation in an international perspective. TIMSS, conducted by International Association for The Evaluation of Educational Achievement, was the greatest educational comparison study and was implemented in forty-one countries to mathematics and science achievement of eight grade students. TIMSS was first implemented in 1995 and repeated in 1999 and 2003. Turkey only participated in 1999 session and results were significantly lower than international average (Ministry of National Education, ERDD, 2003). National Report for Turkey was published and findings showed that Turkey had a very low achievement

level among participating countries. Also there are many other studies that have been carried out using TIMSS data set. (Yayan, 2003; Ozdemir, 2003; Smyth, 2001; Cho, 2002; Bos and Kuiper, 1999). TIMSS results showed that Turkish students were at lowest ranks in both mathematics and science (Turkish National Report for TIMSS, 2003).

Another international study which Turkey participated to was Program for International Student Assessment (PISA) by OECD. PISA aimed to assess students' reading, mathematics and science literacy in fifteen years old. PISA is a three-yearly study, first of which was in 2000 and in forty-three countries (OECD, 2004). Results of Turkey are not published at the writing time of this study.

The Progress in International Reading Literacy Study (PIRLS) is another study which aimed to measure reading abilities, reading literacy, instructional activities for reading etc. and to make comparison among participating countries. PIRLS was implemented in 2001 to 9 years olds. National Report of the PIRLS for Turkey was published by MoNE, ERDD (2003) and results showed that Turkish students were 28th out of 35 participating countries in reading abilities (Turkish National Report for PIRLS, 2003).

2.1 Modeling

Ozdemir (2003) modeled Third International Mathematics and Science Study (TIMSS) data to explore the factors affecting the science achievement of Turkish students. Ozdemir used a sample of 7841 eight grade Turkish students. Latent factors used in the study were student-centered activities, teacher-centered activities, socioeconomic status, perception of success, science enjoyment, and importance of science. Ozdemir proposed a model for student's science achievement with the latent factors described above using structural equation modeling. Results showed that socioeconomic status had the strongest relationship to science achievement of Turkish students. Socioeconomic status latent variable consisted of parental education level and number of the books at home. Perception of success also had a significant relationship to science achievement. While teacher-centered activities showed a positive effect, student-centered activities indicated a negative relationship. Ozdemir's study showed

some important points for Turkish education system. Student-centered activities (class discussion at the beginning of a new topic, experiments by students, small group discussions) were found to have negative relationship with students' science achievement. Although literature state that student-centered activities increase student achievement, there is an opposite situation occuring in Turkey. Unlike, student-centered activities, teacher-centered activities had a positive relationship with science achievement. There is a paradigm shift from teacher-centered to student-centered activities in the world (Unesco, 2002) but in Turkey it seems that student-centered activities do not improve achievement.

Also Yayan (2003) had similar results for mathematics achievement. Using TIMSS data set for Turkey and the Netherlands and Italy, Yayan compared factors affecting students' mathematics achievement. For Turkey, similar results were obtained. Socioeconomic status had a strong positive relationship with achievement, however, student-centered activities had not. These findings can be explained by some reasons. First, Turkish society has some traditions that elders now everything therefore younger should follow them. This has also a reflection on Turkish education system. Turkish students expected from their teacher to transmit knowledge (Ayas et al., 1993). Second, teacher may have some difficulties in guiding to students in student-centered activities (Durusoy, 1984). Teachers prefer traditional activities when they lack of required knowledge and/or training.

Smyth (2001) investigated the effects of policies and practices on eighth-grade science achievement using TIMSS data. Smyth formed school level and classroom level factors. School factors covered that average socioeconomic status, tracking, and instructional time and classroom factors which include average academic press of peers, teacher collaboration, and instructional strategies. Researcher used hierarchical linear modeling (HLM) with data collected fom eighth grade students, science teachers, and administrators in 1995 as a part of the Third International Mathematics and Science Study (TIMSS). The major findings of this research revealed that although average eighth grade science achievement in a school was primarily associated with the contextual characteristics of the classroom and the school (e.g., average socioeconomic status and average academic press), both the academic differentiating influence of prior

achievement and the social differentiatin g influence of parental education on the science achievement of eighth grade students were related not only to contextual characteristics of the classroom and the school, but also to the instructional policies of the classroom.

Singh (2002) explored the effects of motivation, interest, and academic engagement for mathematics and science achievement using structural equation modeling. The sample of 8th graders (24,599 students) drawn from the National Education Longitudinal Study 1988 was constituted data set of the study. Latent variables formed for the study were as follows: motivation1 (Number of days missed school in past 4 weeks, Number of times cut classes, etc), motivation2 (Frequency of that student come to class without paper/pencil, Frequency of that students come to class without books, etc), mathematics attitude/interest, (Math useful in my future, looks forward to math class, etc), academic time (mathematics) (Time spent on math homework per week, Number of hours for watching TV per day, etc), mathematics achievement (Grades earned in mathematics), Science attitude/interest (Looks forward to science class, Science useful in my future, etc), academic time (science) (Time spent on science homework per week, Number of hours for watching TV per day, etc), science achievement (Grades earned in science). Findings revealed that mathematics model, academic time and motivation1 latent variables had the strongest relationship with science achievement, while motivaton2 was the largest indirect relationship through attitude. For science model, academic time and attitude toward science were found to be the strongest factors affecting science achievement of the students.

Cho (2002) made a study on attitude factors, home background, home environment and school characteristics on mathematics achievement using Third International Mathematics and Science Study (TIMSS) for comparing students from United States and Korea. Cho used structural equation modeling to relate the mathematics achievement to the factors mentio ned above. Cho determined the factors to be used in the study as followings: student background factor (extra lesson, watching TV or video, expectant education level, etc.), teacher background factor (teacher's education level, importance of remembering formulas and procedures and importance of thinking creatively), home background factor (mother education level, father education level, number of books at home, etc.), school characteristics (class size). As the results

of the modeling conducted by Lisrel 8.51, findings revealed the followings: for American students, home background factor was the strongest factor contributing to the achievement. For Korean students, student background factor had highest path coefficient to the achievement. Also tutoring had positive effect on USA, but negative for Korea. Likewise, school characteristics had positive in USA, but negative in Korea.

Bos and Kuiper (1999) made modeling study for comparing European countries. Researchers used TIMSS data set to explore the effects of factors on mathematics achievement of students. The study covered western (8) and central (2) European countries, a total of ten countries. Percentage of achievement was in 19% average. Factors used is this study are: homework, teaching style, school climate, maternal expectation, friends' expectation, success a ttribution mathematics, instructional formats, instructional formats, instructional formats, home educational background, class size, effective learning time, assessment (evaluation, feedback, and corrective instruction), out-of-school activities. Among the major findings of the study: home educational background factors, out-of-school activities and attitude toward mathematics were found to be stronger factors than others. While home educational background and attitude toward mathematics had positive effect, out-of-school activities had a negative effect on achievement. Furthermore, factor of class climate as perceived by the students, assessment usage, instructional formats (co-operative learning), and effective learning time showed generally no significant relationship to achievement.

In a study which explored differentiation due to locality in science attitudes and science achievement using TIMSS data in Australia, Cyprus, and the USA (Papanastasiou and Zembylas, 2004), using structural equation modeling, researchers investigated the relationship between parental, self, and peer group influences on attitudes and achievement of high school seniors. Researchers used ten observed variables (self-perceived ability, science achievement, like physics, like chemistry, like chemistry, science importance, importance for father, importance for mother, importance for self, importance for friends) to form two latent variables (science attitude and science achievement). Results showed that pattern of the relationship between achievement and attitudes varied among countries. For Australia, science achievement factor was found to affect attitude strongly, but attitude did not predict science

achievement. In Cyprus, science attitudes affected achievement but achievement did not predict attitude. Unlike the two other countries, USA science attitude affected science achievement strongly, but science achievement showed a negative relationship with science attitude.

2.2 Socioeconomic Status

In social sciences, effect of socioeconomic status on students' achievement has been a great interest since 1960s. Socioeconomic status of individual has a strong effect on achievement (Coleman et al, 1966). Results showed that socioeconomic status had an effect on student achievement and socioeconomic status (Caldas, 2003, Rumberger & Willms, 1992, as cited in Caldas & Bankston III, 2001). Socioeconomic status was the one of the most important factor in student's own inputs (Caldas & Bankston III, 2001).

Many researchers stated that degree of relationship between socioeconomic status and student achievement was around 0.30. (White, 1982; Hagtvet & Undheim, 1988, as cited by Yang). If school is used in analysis rather than student, the degree of relationships increases up to 0.60 between 0.80 (as cited by Yang). But Robinson (1950) and Burstein (1980) stated that correlation calculated using data from a group tended to be higher than correlation calculated on individual level. This is called ecological effect.

Yildirim & Eryilmaz (1999) carried out a study in which 35 10^{th} grade physics were participated for examining effects of gender, cognitive development and socioeconomic status on physics achievement. In this study Yildirim & Eryilmaz used questionnaires to obtain data from students. One of the tests was socioeconomic questionnaire which consists of parental educational levels, occupation, family size, etc. As a result of this study, researchers found that socioeconomic status of students significantly affected students' physics achievement in positive way, that is, students from higher economic status levels tend to get higher scores from physics.

Schiller (2002) investigated the effects of family characteristics on academic achievement. In her study, Schiller gave an explanation on why family structure had impacts on students' achievement. Sewell & Hauser (1980, as cited by Schiller) argued that students' willingness of achievement can be due to expectations provided by family. If family have higher degree of education, willingness of achievement will be greater

than those who have a lower degree. Parents with higher education tend to be more interested in their children's homework, courses, grades, school and/or peer problems, etc (Muller & Kerbow, 1993, as cited by Schiller). Also parents with higher socioeconomic status have better economic situations. Children from this kind of families may have better opportunities, private tutoring, computers, and educational materials. Another point is that parents with higher education may transmit their experiences on education to their children and this may be helpful for children to form his/her education (Baker & Stevenson, 1986).

Schiller investigated the economic development and effects of family characteristics on mathematics achievement using Third International Mathematics and Science Study (TIMSS) data. In this study, she examined 34 countries, among which Turkey was not included. In the study hierarchical linear modeling was used to find out the relationships between family structure / parents education and mathematics education and nation levels of economic development. At the end of the study, parents' educational levels were found to be positively related to students' achievement. Also there were no differences on the patterns of effect of student's achievement. She argued that parents with higher education used education to pass their status to children and these parents had more economic resources for helping their children in education.

Caldas & Bankston III (1997) examined the role of socioeconomic status from a different point. In their study, researchers examined the effects of socioeconomic status of the peers in schools on academic achievement as well as examining individual characteristics of the students. The study covered 42,041 students from 10^{th} grade from Louisiana Graduation Exit Examination (GEE) and ordinary least square regression analysis was used. Findings of the study showed that family socioeconomic status of the parents (parental education and occupation) had the greatest positive impact on students' achievement. Another point that can be drawn from the findings that socioeconomic status of the peers had also a significant relationship which is very near to socioeconomic status of the family. An interesting point is that for students who are attaining to schools where students are higher socioeconomic status, effect of socioeconomic status of peer is stronger that those of family.

Berberoglu et al. (2003) examined the factors that affect students' mathematics and science achievement using TIMSS-R data for Turkey. In this study, structural equation modeling was used to determine relationships between factors simultaneously. Number of students included for mathematics and science achievement is 5382 and 5297, respectively. Factors of socioeconomic status were formed by items about parental education levels and number of books at home. Researchers found that socioeconomic status was the most dominant positive-effect factor in achievement.

A structural equation modeling study (Yang, 2003), which was carried out by TIMSS data and covered 17 countries, investigated dimensions of socioeconomic status and their relationships to mathematics and science achievement. Young stated that the way for measuring socioeconomic status was problematic. Young formed different dimension both at school and student level using TIMSS data (in student level, economic and cultural dimensions; school level only economic dimension). He argued that socioeconomic status was not unidimensional, rather it is multidimensional. Also information provided by students about parents may be unreliable. As a solution to this situation, Yang suggested a new way to measure the socioeconomic status. Two-level structural equation modeling was used to relate the dimensions of socioeconomic status with students' achievement simultaneously. At the end of the study, for most countries economic capital and a narrow cultural factor were identified at student level. At school level, a general socio-demographic factor was identified. Results showed that cultural factor both in student and school level had a strong effect on science and mathematics achievement factor. Socio-demographic factor had a variable effect on science and mathematics achievement.

2.3 Teacher- and Student-Centered Instruction

The National Science Education Standards (NSE) called a change in pedagogical approach from teacher-centered to student-centered, giving a rationale which says that "What students learn is greatly influenced by *how* they are taught" (National Research Council, 1996). NSE argued that teacher-centered education did not meet the requirements of 21st science education such as higher order thinking and problem

solving skills, etc. Furthermore, NSE stated that student-centered education provided students with opportunity for socializing in class.

Welch (2004) lists basic features of teacher-centered and student-centered classrooms as follows:

Teacher-centered classrooms:

- The teaching mode is mostly lecture.
- There are few questions from students.
- Even if questions are asked, they are generated by the instructor.
- The main source of notes is the blackboard and/or overhead transparencies.
- The course policies and rules are all dictated and governed by the instructor.
- The course material is controlled by the instructor.
- The instructor rarely knows if the students understand the material until the exam is evaluated and the grades are reviewed.

Student-centered classrooms:

- The teaching mode is mostly discussion and group-work.
- The instructor remains relatively quiet so that the students can learn.
- Most of the questions are generated by students.
- The students take notes during the discussions.
- The course policies and rules are dictated by the students and the students tell the instructor how to enforce them.
- The course material is flexible and depends on what the students want to learn.
- The instructor is very conscientious of what students understand.

Aytac (2003) underlined the importance of student-centered education and listed some of its important points: it takes students' values and backgrounds into consideration, increases social interactions in class, and encourages independent study and creativity, etc. Aytac defined teachers' new role in student-centered education as following: teacher should be able to diagnose students' gaps, encourage creative

thinking, make contacts between different disciplines, take into consideration students' individual differences, etc.

House (2000) examined the efficacy of different instructional methods using TIMSS data set. House identified some instructional activities related to science achievement as following; new and different activities at the beginning of new chapters, questions as to find out what student know about the new subject, carrying out experiments. These instruction practices were found to increase the students' science achievement. House also investigated these factors simultaneously and found that interesting activities at the beginning of topic were significantly affect student achievement in a positive way. Findings also showed that cooperative learning had significantly positive effect on students' science achievement, but when cooperative learning was used for introducing new subjects it lowered science achievement.

In a report prepared by UNESCO named Information and Communication Technology in Teacher Education, A Planning Guide (2002), new paradigm of output of student in 21st century was stated. According to this report, students should be able to have an expertise on new developing areas, master decision-making, have ability of analysis and synthesis, and cope with huge information sets. To attain such a student output expectation, teacher-centered education should be left and student-centered education adopted (as cited by Aytac, 2003). Student-centered classroom was defined as a small unit, in which there is independent work, socializing studies, improve creativity.

Also Esme (2004) argued that teacher-centered education should be left, especially for science education since teacher-centered instruction is not suitable for science courses. Esme stated that in science education teacher should be a guided, facilitator.

Brown (2003) examined transition from teacher-centered to student-centered education for improving learning. According to Brown, in a teacher-centered classroom, teachers' main point is to transmit knowledge and in such an environment, content tends to be important than students' progress. Even tough achievement have an importance in teacher-centered approach, teachers are expected to meet some pre-defined unites or some standards. As a result, students' needs are given less importance. In teacher-

centered education, teachers try to transmit his/her knowledge to students, but how student progress is not given importance so much.

In teacher centered environments, teachers are expected to follow some schedules and there is an urgency to keep class parallel with curriculum. Thus teachers do not have time to use different instruction approaches such as open ended questions, projects, etc. Boyer (as cited in Brown, 2003) stated only one percent of total instruction time was allocated for questions or discussion that could be deepen students' thinking skills. Brown defined student-centered approach was one in which characteristics of students were given importance and students' learning backgrounds, differentiations, interests and capacities are were on the focus. In such environment, students' differentiations are very most factor to form instruction (adjusting pace of instruction, providing support to those who requires, etc.) (Tomlinson, 2000, as cited by Brown). Teacher should encourage students to think and make connections, and make them form their knowledge on the subject.

In another study that compared different types of instructional activities on students' science achievement of seventh grade students twenty-three class, randomly chosen classes were exposured student-centered and teacher-centered activities (Kilburn, 1972). While student-centered activity covered a discovery method with experiments, teacher-centered activity included discovery teaching with demonstration. Findings showed that teacher-centered activity was found to be more effective in improving students' learning; a difference in science perception arose between groups and experienced teachers were found to be more effective.

Hayes (1998) compared teacher-centered and student-centered instruction by three 3-week units. In the class, Hayes used student-centered instruction in first and third periods, and in the second period teacher centered instruction was implemented. In this study, teacher-centered instruction lectures were given by teacher and mainly textbook was used. In student-centered instruction students worked independently and were given group assignments and also audio-visuals were used. At the end of the three periods, results of the tests given after student-centered instruction periods were found to be higher than those given after teacher-centered instruction period. Researcher also observed that in student-centered instruction, students became more social, they had

enjoyed lessons more and morale of the class was higher. Siller (as cited by Hayes, 1998) stated that teachers who provided their students with an opportunity to become an active participant of the lesson were more effective.

Ozdemir (2003) examined TIMSS data set as to determine the factors affecting science achievement with TIMSS data set of Turkey. In his study, Ozdemir formed a latent variable of teacher-centered activities from the items about frequency that teacher solves science problems, frequency of that teacher solves related to new topic and frequency of that teacher explains rules and definitions at the beginning of the chapter. Student-centered activities were formed from the items on frequency of that students do experiment, and frequency of that students work in small groups and frequency of that students make discussions. Findings of this study revealed that while teacher-centered activities had a strong positive effect on students' science achievement, student-centered activities had a negative effect on achievement.

Yayan (2003) had a similar study on TIMSS data on mathematics achievement but science in Turkey. She obtained similar results on teacher-centered activities. In Turkey, student-centered activities had a negative impact on mathematics achievement, and however teacher-centered activities had a strong positive effect on achievement.

Huffman & Lawrenz (2001) carried out a study to explore relationships between instruction and science/mathematics achievement in Minnesota, USA using TIMSS data set. The study covered 2000 students from grades 3-4, 7-8 and 12 and student and teacher questionnaires were used. Results of the study revealed that student-based teaching strategies had no effect on students' achievement in grade 3-4 and 7-8, but grade in 12 a positive relationships was found. These findings are not parallel with Lokan & Greenwood's (2000) study in which they found a negative relationship between student achievement and student-centered instruction for Australian students.

2.4 Private Tutoring

Private tutoring is a shadowy phenomenon that is hard to gather information on. Parties of the private tutoring are not willing to give information. Students do not want that their friends learn that they receive tutoring. In a similar way, private tutors do not want to reveal how many students they have and how much they earn from tutoring.

Moreover school administrators are unwilling since in the presence of tutoring, school's success can be made ambiguous. It is hard to predict how much of students' achievement results from activities in schools and from private tutoring (Bray & Kwok, 2003). Therefore it is hard to find studies examining the effects of private tutoring on achievement, rather than those studies about situation of private tutoring in countries and prevalence of tutoring can be found easily.

To see the scale of the private tutoring, some examples will be useful. In Japan, a survey carried out in 1993 revealed that percentages of the students receiving private lessons in primary and middle school are 76.9% and 28.3%. 23.6% of the students in primary education and 59.5% of the students in middle school attain tutorial institutions. When the same figure is compared to findings from 1985 data, an increasing trend is seen, especially on attaining tutorial institutions (Japanese Education System). 10.9% of thirteen-year-olds and 13.3% of the sixteen-year Canadian students are received at least one hour out-of-school lessons or tutoring. Also Czech Republic, (50%), Russia, and Slovak Republic (exceeded 90%) are countries where prevalence of tutoring are worse (as cited by Bray).

In Malaysia most students think that private tutoring is inevitable in some courses. Like Malaysian students, majority of students in Sri Lanka have positive opinions on private tutoring and they stated that receiving private tutoring had improved their achievements. Students from Hong Kong generally stated an improvement in achievement after receiving private tutoring. Thailander students also said that private tutoring were required. (as cited by, Bray & Kwok, 2003, Marimuthu, et al, 1991; de Silva et al, 1991; Children and Private Tutoring, 1996; The Nation, 1995).

Unlike these findings, there are students who stated that negative attitudes on private tutoring. In a study, following was reported; "there was a just little improvement and 3.4 percent of students said that there was none at all." (Times Education Supplement, 1996).

Stevenson and Baker (1992) carried out a longitudinal study to determine allocation of private tutoring in education system in Japan. Researchers defined private tutoring (shadow education, as defined by researchers) as all activities made outside the school to improve students' achievement. Main types of shadow education are practice

examinations, correspondence courses, private tutoring, private after-school classes, and full-time preparation. Data used in this study was collected from high schools seniors of Youth Research Institute of Tokyo in 1980 and 1982. And public and private schools, academic and vocational curriculum were used in the study. Findings of the study revealed that receiving shadow education in high school had a positive effect on attaining university. Practice examinations and correspondence courses had a strong affect on likelihood on attaining university. Shadow education received from a tutor decreased the university chance of the students. After-school classes had no significant effect on entering university.

Valdez (2003) examined the effectiveness of tutoring services on Chicago Public schools at the secondary grade level. Study was conducted in 2001-2002 academic year, including 4211 students. And surveys were used to gather information. Results showed several points; focus group of the study stated that they did not attend tutoring courses since they though that tutoring can not help them or students are not capable of helping them. Just six percent of the students indicated that tutor had helped him/her if they were failing a class.

Hussein (as cited by Bray, 2003) stated that private tutoring caused the lack of interest in the classrooms. Tutors can show them tips & tricks to be used in examinations. Therefore students start to not recognize the school and courses as a factor required for achievement. Sawada and Kobayashi (as cited by Bray, 2003) found that students attended private tutoring centers had an improvement in computational skills, but they started to think mechanically and did not try to deepen the meanings of the concepts. De Silva (1994, as cited by Bray, 2003) stated that if supplementary tutoring is used suitable to students' needs, it can improve students strongly. De Silva said the following:

> *"Sometimes large gaps in students' learning are created due to a number of factors such as student and teacher absence, frequent closure of school, ineffective teaching and negligence on the part of the teachers. It is not every school that can boast a full complement of specialist teachers in curicial areas like mathematics, science and English. Immature, inexperienced or unqualified teachers handling these subjects may not be*

able to lead the students to a proper understanding of the sections tought. Effective private tutoring may help overcome these gaps or deficiencies in students' learning and build their confidence enabling them to compete with others and experience a happy and pleasant life."

2.5 Perception of Interest & Success

Tamir (2001) examined effects of the home and school factors of 12 years-old Israeli students' achievement. This study was carried out within the framework of Evaluation of Education Achievement and Science Study (IEA). Tamir used a Student Background Questionnaire, Science Test and Specialized Achievement Test. Sample covered for this study had two sub samples: one for students who majored in at least one science course and who planned to take a high-level matriculation examination in either biology (n=953), chemistry (n=312) and physics (n=469); and one for nonscience majors (n=469). In this study, nine variables such as liking to study science more, making homework at home, reading more than assigned, trying to answer teacher' questions, etc. were used. As a result of the study, a strong relationship was found between interest / motivation factor and science achievement. Researchers also stated that instruction affected students' interest / motivation, which in turn affected students' achievement.

IEA (2000) was stated that, among the major findings of Third International Mathematics and Science Study, the fact that for middle school grades in almost every country the majority of students agreed that they did well in mathematics and science. Interestingly, some of the countries with the highest achievement were those whose students had the most negative perception of success, namely Japan, Korea, and Hong Kong.

Students' interest in science is not a sufficient predictor of students' achievement in science (Onwumere, 2003). In this study, researcher investigated relationship between urban middle school students' interest in science, perceptions of science teachers, and achievement in science. The Scientific Attitude Inventory II (SAI II) and Questionnaire for Teacher Interactions (QTI) were used to gather information from teachers and

students. As a measurement of student's achievement, student's teacher-assigned grades were taken. Findings of the study can be summarized as follows: student interest factor was found not to be strong for predicting achievement; students' teacher perception was found to be a strong factor on achievement; combined effects of these two factors had a significant effect on students' science achievement. For male students main predictor of achievement was interest in science and for female students main factor was students' teacher perception.

Paolucci (2001), in his dissertation, had supportive findings with literature. 566 high school students were used in this study and participants received a questionnaire about science interest, gender role perceptions, and views about science background and math and science achievement. Results of the study revealed followings: there is a high relationship between science interests and science and math achievement and masculinity both for boys and girls; mathematics and science achievement was a strong predictor of science interest both for boys and girls.

A trend analysis study (Lin, 2002) among primary, junior, and senior high school students in Taiwan revealed that students' science interest among different grade levels stayed stable. Study covered 380 primary, 511 junior, and 366 senior high school students selected via stratified random sampling procedure. Factors that contributed to the variation of students' science interest stated in the study were time on task, hours of homework, hours of laboratory, school location, and gender. These factors just explained the 3-10% of the variance of the science attitudes. Researcher added three more factors, wanting to take more science courses, interest in science-related careers, and T.V. watching, and explained variance of the science attitudes increased by 10-15%. Junior high school students' attitudes toward science could be explained with 48% variation explanation rate by adding the following factors time on task, attitudes toward science, gender, school location, and hours of homework.

Parental beliefs affect children's self-perceptions of capability (Fouad & Smith, 1996), and can be a more important determinant of children's conceptions than actual performance in school (Jacobs & Eccles, 1992). The perception that much effort is needed to succeed at science may then affect the subjective utility of science study, which decreases among women but increases for men (Fouad & Smith, 1996).

Berberoglu et al (2003) examined perception of failure / success factor using TIMSS data set for Turkey. Perception of failure / success included the items; if science courses were not difficult so much, I would be more succesful; science courses are difficult for me comparing my classmates; I am not talented in science; science is not one of my favorites. Findings revealed that perception of failure / success was one of strongest factor influencing the science achievement both for mathematics and science courses and it was stated that science achievement factor and perception of failure / success had reciprocal relationship. Also while socioeconomic status had a relationship with student achievement, student-centered activities had not.

A study on students' academic efficacy that are related to achievement and achievement Jinks and Morgan (1999) revealed that there were positive relationship between students' science grades and sense of academic efficacy.

2.6 School Types

In Turkish education system, there are nearly 10 million students attending primary schools. State primary schools differ from each other sharply in instruction quality, student profile, crowdedness of classrooms, facilities etc. Number of the state primary schools is above 35.000 and they are distributed all over the Turkey (Milli Egitim, Sayisal Veriler, 2003). Number of students per classroom is between 25 and 45 in rural regions, 47 and 70 in urban areas (DPT, 2001).

Primary regional boarding schools (YIBO) were established long before but expansion of them in number was due to extension studies of primary education to all country. Student profile of YIBOs includes those from regions with low population and distributed housing and those from no transportation is available. All needs of the students – accommodation, books, stationery, medical care, etc. – are provided by the state (Ari, 2004). Ari (2002) made a study for comparing normal, with transportation and boarding education. Ari examined three kinds of primary education implementation via questionnaires in Usak. Findings of the study can be summarized as follows: YIBOs are schools where the highest rate of psychological disturbances, the lowest rate of parental interest, and the lowest rate of perception of achievement were observed. Given

locations of YIBOs, one can conclude that student of the schools are generally from low or middle socioeconomic status level.

Private primary schools have only 150.000 students and many of these schools are established in developed cities. They have qualified teachers, nice classrooms and laboratories and sport facilities. They also provide students with low-population classes, out-of-class activities (theatre, painting, playing. etc) and counseling services. Private schools are some kind of businesses and they aim to make profits. Prices of private schools are higher than that many families couldn't afford. Therefore student profile of private schools consists of those from families with higher socioeconomic status living in developed cities.

2.6 Summary for Literature Review

As a result of the literature review, following points were considered as important: there are lots of modeling studies investigating factors of science achievement in the literature. Different factors such as socioeconomic status, in-class and out-of-class activities, perceptions etc. and relationships among them were investigated in these studies.

Socioeconomic status has a strong effect on achievement, especially on science achievement. Generally its effect is about 0.30, but school is taken as a unit of measurement, this effect increases up to 0.80. Parents in higher socioeconomic status have more interested in their children's education, they have better economic conditions to provide their children, quality school, tutoring, computers, etc. Parents' expectation for further education can affect children' achievement. Also parent can transmit their experiences on education to their children.

Student- and teacher-centered activities are a controversial topic on which there is no clear opinion. In public there is a general trend for leaving teacher-centered activities and for adopting student-centered activities. It is argued that teacher-centered activities limit students' developments in both intellectual and contextual perspectives. On the other hand, student-centered activities are favored in that they make students free, open-minded, successful, etc. In the literature there are studies which favors of

both student-centered and teacher-centered activities. While a lot of studies reporting high achievement levels as a result of student-centered activities, large-scale education studies in Turkey revealed that student-centered activities had a negative effect on science achievement. This situation can be interpreted that even if studies conducted by small groups with a high degree of researcher manipulation yield good results, it is obvious that there is a problem with student-centered activities.

There is no so much clear information private tutoring that its effect on science achievement can be estimated. But it is known that private tutoring is an extensive and huge sector. In the literature, while some students said that private tutoring is inevitable for some courses and it increases their achievement, there are many stating the opposite. They argued that private tutoring make student think mechanically and lowers the schools' importance in the system. Students are have accustomed to testing techniques, and they do not deepen on the subjects.

For perception of interest and success, it is stated that perception of interest and success affect student achievement in a positive way. On the hand, results of TIMSS revealed that most successful students were those who reported lowest perception of success. Also it is reported that there was a reciprocal relationship between achievement and perception of success. This means that when students become more successful, their achievements increase and vice versa.

In Turkey, there are huge differences among school types. Their student profiles are very different from each other. These differences were stared above. Because of these differences, it is expected that there would be differences in models affecting science achievement of different school types.

CHAPTER 3

METHODOLOGY

This chapter is devoted to methodology of this study. Population and sample, instruments, validity and reliability, etc. will be presented. Also statistical methods – structural equation modeling and principal components analysis – used in this study will be given.

3.1 Population and Sample

Population of OBBS-2002 can be stated as the students from grade levels 4^{th} to 8^{th} in state primary schools, primary regional boarding schools, and private primary schools. Sample of OBBS-2002 includes a total of 112.000 students of 4^{th}, 5^{th}, 6^{th}, 7^{th}, and 8^{th} grades from 573 primary schools in 47 provinces including 7 geographical regions. Although OBBS-2002 includes grade levels between 4 and 8, this study examined only 6^{th}, 7^{th}, and 8^{th} grade levels which covered totally 29.952 students. Sampling was made using stratified random sampling. Number of students participated to OBBS-2002 are given in Table 3.1

Table 3.1 Student Distribution in Grade Levels

Grade Level	Frequency	Valid Percentage	Cumulative Percent
6	10307	34.4	34.4
7	9985	33.3	67.7
8	9660	32.3	100.0

In determining the provinces, points such as development status and representative characteristics of the geographical region, and number of students per class were considered. Schools covered in sampling included state primary schools, primary regional boarding schools, and private primary school. When sampling the schools, random sampling was used. While determining the number of school in provinces to be included in OBBS-2002, number of schools both in city center and rural area, schooling rate, and student per school were taken into consideration. Classes in the schools were also selected using random sampling, but in the school in which number of students was low, all students were included. Table 3.2 shows the provinces in which OBBS-2002 was conducted. Some regions include more provinces than others. This is due to student densities in the schools, for example since Karadeniz region has low student density, more schools included to reach the representative number of population.

Table 3.2 Provinces where OBBS-2002 Conducted

Marmara	Ege	Akdeniz	Ic Anadolu	Karadeniz	Dogu Anadolu	G.Dogu Anadolu
Balikesir	Afyon	Adana	Ankara	Artvin	Agri	Adiyaman
Bursa	Aydin	Antalya	Eskisehir	Bolu	Bingol	Diyarbakir
Canakkale	Izmir	Hatay	Kayseri	Corum	Bitlis	G. Antep
Edirne	Kutahya	Isparta	Konya	Gumushane	Elazig	S. Urfa
Istanbul	Manisa	K.Maras	Nevsehir	Ordu	Erzurum	Sirnak

Table 3.2 (cont.)

Sakarya	Mugla	Sivas	Samsun	Hakkari
Tekirdag			Sinop	Kars
			Trabzon	Malatya
			Zonguldak	Van

In sampling the school types the following method was used. If there is primary regional boarding school (YIBO), at least one was taken for sampled province. Also private primary schools were taken in one for ten state schools using random sampling. Table 3.3 shows the number of student in school types. As can be seen, 85.4% of the sample includes students from state primary schools. The rest is shared with the ratios of 7.9% and 6.6% by regional boarding and private schools by respectively.

Table 3.3 Number of Students in School Types

School Type	Frequency	Valid Percent	Cumulative Percent
State	25593	85.4	85.4
Regional Boarding	2379	7.9	93.4
Private	1980	6.6	100.0
Total	29952	100.0	

OBBS-2002 was conducted to both female and male students. Gender distributions according to the school types are given in Table 3.4.

Table 3.4 Gender Distributions in School Types and Grade Levels

	School Type	Grade Levels		
		6th	7th	8th
Male	State	4797	4513	4580
	Regional Boarding	547	626	551
	Private	394	412	355
Female	State	4025	3942	3700
	Regional Boarding	234	217	201
	Private	238	259	270
	Missing	22	16	3
	Total	10307	9985	9660

3.2 Instruments

In OBBS-2002, all students were given achievement tests for mathematics, science, social sciences and Turkish. Also 6th, 7th, and 8th grades students received a questionnaire to gather information about socioeconomic status, classroom activities, perception of success and interest, etc.

3.2.1 Science Achievement Test

Achievement tests were designed to measure two different dimensions. First one is curricula in each subject area and the second is thinking processes that students possess. In this study only science achievement test was used. Tests have 4 multiple choice items. For each grade level, there were two parallel test booklets used. Table 3.5 shows the response rates of achievement tests.

Table 3.5 Response Rates for Science Achievement Test

Item #	Response Rate	Item #	Response Rate
1	99.0	11	97.9
2	98.7	12	97.0
3	99.6	13	98.9
4	99.5	14	98.5
5	99.6	15	99.2
6	98.1	16	99.1
7	98.7	17	99.1
8	99.6	18	97.6
9	99.0	19	94.4
10	99.6	20	97.5

In the achievement tests, no wrong items canceled out true items, so response rate of the achievement tests are so high. Table 3.6 shows number of students in terms of grade levels.

Table 3.6 Number of Students for Booklets in Grade Levels

Grade Level	Booklet A	Booklet B
6	10519	10307
7	10355	9985
8	9876	9660
Total	30750	29952

This study is based on booklet B. In these two booklets, subject matters and ability levels of anchor items were set to be same. Also there are some anchor items in the forms in order to secure test equity and to monitor progress among grade levels. Table 3.7 shows the number of items in booklets. 6^{th}, 7^{th}, and 8^{th} grade science achievement tests have 15 items as well as 5 anchor items in each test. Items in science achievement test are 4-point multiple choice items.

Table 3.7 Number of Items in Booklets

Grade Level	Science	Mathematics	Social Sciences	Turkish
4	10+5*	10+5*	13+2*	11+4*
5	10+5*	10+5*	13+2*	11+4*
6	15+5*	15+5*	18+2*	16+4*
7	15+5*	15+5*	18+2*	16+4*
8	15+5*	20+5*	18+2*	21+4*

* indicated anchor items

3.2.2 Student Questionnaire

In OBBS-2002, students received a student questionnaire in order to obtain information about socioeconomic status, classroom activities, perception of success and interest, etc. There was a total of 58 items in the questionnaire and items were the same for all grade levels. In the factor analysis which was carried out for determining the latent structure of the model, all the items in the questionnaire were included.

First 4 items (1-4) in the questionnaire are related to parental education, number of siblings in the family and number of book at home. All these 4 items are 5-point multiple choice items.

Next 8 items (5-12) are related to home possessing such as computer, TV, washing machine, own study room, own study desk, etc. These are 2-point yes and no items.

Next 16 items (13-28) seek to obtain information on students' out-of-school activities such as watching TV, reading newspapers/magazines, playing with friends, private tutoring, using computers, etc. These are 5-point Likert types items (never, less than 1 hour, between 1-2 hours, between3-5 hours, and more than 5 hours).

4 items following (29-32) are about time spent for homework of Turkish, social sciences, mathematics and science. These items are also 5-point Likert types items (never, less than 1 hour, between 1-2 hours, between3-5 hours, and more than 5 hours).

Items 33-36 were asked to obtain information students' interests towards Turkish, social sciences, mathematics and science. None, I do not like, I like, and I like very much are choices of these 4-point items.

Items 37-40 measure the perception of success in Turkish, social sciences, mathematics and science. Again these are 4-point items and their choices are very unsuccessful, unsuccessful, successful, and very successful.

Next 12 items (41-52) are for frequencies of in-class activities for Turkish, social sciences, mathematics and science. Lectures are given by students/teacher,experiments are carried out by students/teacher, group work and exercise are made in the class, etc. are some items in these group. 4-point items have choices never, seldom, frequently, and very frequently.

Last 6 items (53-58) are related to attitudes toward examinations. These are 5-point items and have alternatives strongly disagree, disagree, neutral, agree, and strongly agree.

Like science achievement test, response rates for student questionnaire are very high. Table 3.8 shows response rates for student questionnaire.

Table 3.8 Response Rates for Student Questionnaire

Item #	Response Rate	Item #	Response Rate
1	99.5	30	99.5
2	99.2	31	99.3
3	99.1	32	99.3
4	99.2	33	99.4
5	99.0	34	99.3
6	99.3	35	99.4
7	99.3	36	99.4
8	99.1	37	99.4
9	99.2	38	99.3
10	99.2	39	99.3
11	99.0	40	99.4
12	98.8	41	99.3
13	99.3	42	99.3
14	99.3	43	99.4

Table 3.8 (cont.)

15	99.3	44	99.2
16	99.1	45	99.2
17	99.1	46	99.1
18	99.3	47	99.1
19	99.2	48	98.9
20	99.2	49	99.2
21	99.4	50	99.0
22	99.3	51	99.1
23	99.3	52	99.1
24	99.1	53	99.1
25	99.0	54	98.9
26	99.2	55	98.9
27	99.0	56	98.6
28	98.9	57	98.7
29	99.0	58	98.8

3.3 Validity and Reliability

In the construction phase of OBBS-2002 achievement tests and student questionnaire, items with pilot-study and technically examined were used. And following points were taken into account.

1. Appropriateness of item to the construction to be measured,
2. Appropriateness of item to the item-writing rules,
3. Appropriateness of items to level of students in terms of curricula,
4. Discrimination indexes,
5. Internal-consistency coefficients,
6. Constructs of factors for tests and subtest.

Also academicians, experts and teachers were participated to this phase. At the end of the construction phase of OBBS-2002, all items were found to have validity and high reliability coefficients.

Factor analysis is a good way to obtain an evidence for construct-related validity. In this manner, factor analysis that was carried out to obtain constructs of science achievement test and student questionnaire provided information about construct-related validity. Based on the factor analysis, latent variables were formed from items with higher factor loadings. Factor structure of the data set used in the study showed an

expected and literature-supported pattern. Therefore it can be said that evidence for construct-related validity for data set of this study exists.

Moreover, it is stated in EARGED's report for OBBS-2002 that groups obtained as a result of factor analysis were found to be coherent with the groups stated at the construction of OBBS-2002 tests. This also provides an evidence for construct-related validity of OBBS-2002.

Results of the factor analysis will be presented in the next chapter. Factor obtained from principle components analysis were named according to their contents and literature review.

After composing latent variables, reliability coefficients were calculated to see internal-consistency of the latent variables. Reliability coefficient of student questionnaire (Kronbach's alpha) with 58 items for 6^{th}, 7^{th}, and 8^{th} grade students is 0.818.

3.4 Data Collection

OBBS-2002 was conducted by the collaboration of Directorate of Educational Research and Development (EARGED), General Directorate of Educational Technologies (EGITEK) and General Directorate of Elementary Education in April 12, 2002.

Construction and implementation of standardized tests, analyses and assessment/evaluation of results were in responsibility of ERDD. OBBS-2002 was conducted by 48 experts from ERDD, 47 deputy directors, 315 county department chiefs, 573 primary education inspectors, 573 school principals and nearly 6900 teachers.

When OBBS-2002 was conducted, all measures required for standardized conditions were taken and personal were given an instruction sheet about the rules. Also seminars were organized to give information about OBBS-2002 sessions for people who participated to the study.

Data files used in this study were obtained from MoNE/ERDD. Also some supplementary reports and manuals were used for necessary information. All data files was in SPSS data file (*.sav) format.

3.5 Procedures

In the first phase of this study, a comprehensive information gathering on OBBS such as publications, technical reports, participants, population & sample was made. Data files of the OBBS-2002 were obtained and introductory analyses were carried out.

Afterward, again a comprehensive study on structural equation modeling (SEM) and large-scale assessment programs from many parallel channels. Libraries were searched for the books, several databases (ERIC, ASP, ERA, etc.) were scanned, international on line forums were subscribed and web sites were examined to gather information about how to use SEM, background theory, model fit, modification of the models, limitations, etc.

Later in order to obtain dimensions of science achievement test and student questionnaire and to find out latent structure of the model proposed in this study, many factor analyses were made. Based on related literature, interest of researcher and results on the analyses, factors to be included in the proposed model were determined. Then modeling was first conducted on all 6^{th} grade students for obtaining a reference model. Later on, other grade levels and different school types were examined through this reference model to be used for other grade levels and school types. Making necessary modifications and/or proposing new models, final model were obtained. At the end of the study, results and findings of the analyses were examined. And explanations and recommendations were presented.

3.6 Data Analysis

The data obtained were merged in a single data file, which was obtained in a good condition. Data in the file were both in nominal and scale measure. Name of variables and labels in the data file were well-defined. Since data file was very huge, variables which were not in the scope of this study were excluded from the data file.

3.6.1 Missing Data Analyses

In order to obtain items to be included to the analyses, missing value analyses were carried out based on the grade level criteria. Number of missing values in the data file was very low. In the 6^{th} grade level, 1.4%; in the 7^{th} grade level, 1.3% and in the 8^{th} grade level, 1.1% were the highest missing value ratios. According to the results of missing value analysis, no item in the student questionnaire is required to exclude from the analysis.

Missing value analysis was also applied to student science achievement test. According to the results, ratio of missing values according to the grade level were as follows: 6^{th} grade level, 5.6%, in the 7^{th} grade, 3.8%, and in the 8^{th} grade level, 5.2%. Scale for science achievement test was converted to dichotomous scale, and then missing values were coded as wrong answers, which were indicated by 0. As can be seen, no item has a high missing value ratio to be excluded from science achievement test. Since data files for grade levels include school types, a separate missing value analysis were not conducted for school types.

Generally, it can be said that there is no potential problem that can arise due to high missing value ratios. All the missing values are below 10%, which is a general criterion. In this study the highest missing value ration was 5.6%.

For factor analysis, listwise deletion method was preferred in order to avoid contradictory results.

3.6.2 Effect Size

Effect size is a measure of association among variables. Squared multiple correlation coefficients can be approximately used for indicating effect sizes. To this end, Cohen (1988) proposed a classification for effect sizes which were measured in terms of R. According to this classification, $R^2 = 0.01$ is small, $R^2 = 0.09$ is medium, and $R^2 = 0.25$ is large effect size. But these values should not be considered as rigid; in many cases it is in researcher's responsibility to interpret the magnitude of the effect

size. In this study, squared multiple correlation coefficients were used for indicating effect size.

Also he stated a classification for standardized path coefficients for interpreting the effect sizes of the relationships. Absolute values less 0.10 considered as small, absolute values around 0.30 as medium, and absolute values greater than 0.50 as large effect sizes. Again it is important that these criteria may be required to adjust up and down (Cohen, 1998; as cited by Kline 1998).

3.6.3 Analysis

In the first step of the study, principle components analyses (PCA) with varimax rotation were carried out using SPSS 11.5 for Windows to obtain factor structure of the student questionnaire test and science achievement tests. In PCA, all grade levels and different school types were analyzed to find out the common factors. Then latent variables were formed based on the factor loading of the items. Reference model which provided general model for the study was modeled using 6^{th} grade level including all school types. This model was used to compare grade levels and school types. Later on, separate data files for grade levels were prepared.

After obtaining latent structure of the student questionnaire and achievement tests, the data file was imported to PRELIS 2.30, a program come with LISREL 8.30. Preliminary analyses such as normality check, distribution of variables, etc. were made by PRELIS 2.30. Covariance matrix used by LISREL 8.30 was also generated by PRELIS 2.30. At the end, data file was imported to LISREL 8.30 for Windows for making modeling. Using SIMPLIS command language rather than LISREL's complex language, appropriate syntax was typed for obtaining the proposed model.

In this study, even tough items were not continuous in scales, they were treated as continuous for statistical purposes. An assumption that Likert scales have an internal increase in scale was made in this study. Accordingly, Maximum Likelihood Estimation (MLE) method was used for estimating parameters. This method is very robust against rejected assumptions and works well with data which do not met normality and/or interval scale assumption.

3.7 Structural Equation Modeling (SEM)

Structural equation modeling, also called casual modeling, or covariance structure analysis, covariance structure modeling, analysis of covariance structures refers to a family of statistical techniques rather than a single method.

Structural equation modeling (SEM) grows out and serves purposes similar to multiple regression, but in a more powerful way which takes into account the modeling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also each with multiple indicators. (Kline, 1998)

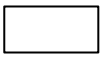
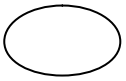
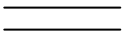
In 1968, Karl Jöreskog presented a paper at the Psychometric Society suggesting that the data could be fitted to complex, casual models in a single stage of analysis using appropriate statistical techniques. As a result, LISREL (LInear Structural RELations) was emerged and gained popularity in a short time. Using LISREL, one can specify the variables and relationships among them so easily and LISREL calculates best fit of the model at hand and also $?^2$ is calculated for expressing the degree to which the proposed model fits the data. (Biddle and Martin, 1987)

3.7.1 Definitions of Terms Related to Structural Equation Modeling

1. Path Diagram

Even tough they are not strictly necessary in structural equation modeling, path diagrams provides investigator with a visual way to examine the outputs. Symbols appeared in those diagrams are given in the following table, Table 3.9 (adapted from Kline, 1998):

Table 3.9 Symbols used in SEM

Category	Symbol	Standard	Definition
Observed		*Yes*	These are variables which they can be manipulated by researchers and their effects can be observed.
Latent		*Yes*	These variables can only be measured indirectly.
Direct effect		*Yes*	Causal effects that are presumed to flow from one latent variable to another.
Reciprocal effect		*Yes*	Bidirectional effect between two latent variables.
Correlation or covariance		*Yes*	Covarying variables in the model.

2. Measurement models

Models that represent a priori hypothesis about relations between observed variables and latent variables. Confirmatory factor analysis can be used for measurement models. Purposes of them are to describe how well the observed variables serve as a measurement instrument for latent variables. Measurement models are useful in social sciences when researchers want to measure abstractions such as attitudes, behaviors, etc. and are available both for independent and dependent variables.

3. Structural models

They include the relationships among the latent constructs. These relationships are chiefly linear, although flexible extensions to the basic SEM system allow for the inclusion of nonlinear relations, as well. In the diagram, one-headed arrows represent

regression relationships, while two-headed arrows represent correlational relations – that is, shared variation that is not explained within the model.

4. *Observed Variables*

Also called indicator or manifest variable. These are variables that can be manipulated by researchers and their effects can be observed. Observed variables of independent and dependent latent variables are designated by X and Y, respectively.

5. *Latent Variables*

These variables can only be measured indirectly. They are unobservable, hypothetical constructs. Their effects can not be observed directly. Rather, effects of observed variables are used to represent the latent variables' effects.

6. *Latent endogenous variables*

Also called latent dependent variables and comes from Greek meaning 'of internal origin'. These are represented as the effects of other latent variables. Measurements of these variables are made on observed dependent variables. They are designated by ? (lowercase eta).

7. *Latent exogenous variables*

Also called latent independent variables and meaning 'of external origin'. These variables affect other variables in the model. Their causes are not presented in the model. Measurements of these variables are made on observed independent variables. They are designated by *?* (lowercase ksi).

8. *Direct effect*

In a model, it depicts causal effects that are presumed to flow from one latent variable to another. Statistical estimates of direct effects are called path coefficients.

9. *Indirect effect*

Also called mediator effect. This is the effect involving one or more intervening variables that transmit some of the casual effects of prior variables onto subsequent variables.

10. *The ß coefficient (lowercase beta)*

A coefficient that shows the strength of a relationship between two latent dependent variables.

11. *The $?_x$ and $?_y$ (lowercase lambda x and y)*

These coefficients are used to indicate the how well an observed variable measures a latent variable. These serve as validity coefficients.

12. The ? (lowercase gamma)

This is a coefficient that refers to strength of the relationship between latent dependent variables and latent independent variables.

13. The d (lowercase delta) and e (lowercase epsilon)

These are the measurement errors on the observed variables and they serve as a reliability coefficient.

14. Principle Components Analysis (PCA)

This statistical technique is used for determining the subsets (factors) which are relatively independent from each other. Varimax rotation rotates axes, while keeping them orthogonal, for maximize the variance of loading.

3.7.2 Steps of Structural Equation Modeling

Although SEM is a family of statistical methods, all members of this family follow the same sequence. The steps of this sequence are given below:

1. Specify the model

At this step, hypotheses are expressed in the form of structural equation models. Latent variables and their observed variables, direct and reciprocal relationships, error covariances are stated in this step. In LISREL, models can be stated by using symbols on the canvas or they can be stated as equations in SIMPLIS/LISREL command language.

2. Determine whether the model is identified

Determination of the identification of the model is made in this step. A model is said to be *identified* if it is *theoretically* possible to calculate a unique estimate for every one of its parameters. Otherwise, this model is not identified. A basic requirement exists for identification; there must be at least many observations as model parameters. If the model violates this requirement, this model is said to be *underidentified*. If there are observations more than model parameters, this model is called *overidentified*.

3. Analyze the model

This step provides estimation of the model parameters using a model-fitting program such as LISREL, AMOS or EQS. There are many estimation techniques available such as maximum likelihood, ordinary least squares, generalized least squares, two stage least squares, unweighted least squares, etc. Choice of estimation method depends on the several factors such as normality assumption and scale of variables. In this study, maximum likelihood estimation method was preferred since it provides a consistent approach, has desired mathematical and optimality properties such as robustness for the violation of assumptions and scale properties.

4. Evaluate the model fit

At this step, degree of fit of the data is investigated. Probably first proposed model does not give a good fit. There are lots of fit indices available for using goodness of fit criteria. In this study which used LISREL 8.30, Chi-Square, Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (S-RMR) were used as goodness of fit criteria.

Chi-Square (?^{2})

This statistics is based on generalized likelihood ratio (G^2). In larger samples it is interpreted as a Pearson chi-square statistics wit the degrees of freedom that are equal to the difference between the number of observations and number of parameters. Low and non-significant chi-square values are desired. It has two drawbacks. First, since its lower bound is zero, there is no upper level, therefore there is no standardized way to interpret it. Second it is very sensitive to sample size. With larger samples, it tends to give significant values.

Goodness of Fit Index (GFI)

One of the indices which are less sensitive to sample sizes and which are more standardized is Goodness of Fit Index (GFI). Its values theoretically range between 0 (poor fit) and 1 (perfect fit). GFI, which was developed by Jöreskog-Sörbom, is similar to a squared multiple correlation in that it indicates the proportion of the observed covariances explained by the model-implied covariances. Values greater than 0.9 are acceptable for GFI.

Adjusted Goodness of Fit Index (AGFI)

This index is used in more complex models, and those with more values, which tend to fit the same data better than the simpler ones do. AGFI corrects downward the value of GFI as the number of parameters increases. Like GFI, its range is between 0 and 1 and values greater than 0.9 are acceptable for GFI.

Root Mean Square Error of Approximation (RMSEA)

This is an index which was developed by Steiger and it provides a measure for discrepancy per degree of freedom based on the analysis of residuals. Values lower than 0.10, 0.05, and 0.01 indicate a good fit, a very good fit and perfect fit, respectively.

Standardized Root Mean Square Residual (S-RMR)

Root mean square is the squared root of the mean of differences between the implied and observed covariance matrices. LISREL provides a standardized value for RMR, called S-RMR. This is a standardized summary of the average covariance residuals. S-RMR was developed by Jöreskog-Sörbom. It ranges between 0 and 1. Values lower than 0.05 are said to be acceptable.

In following table, Table 3.10, a summary on the criterion values for these indices are given.

Table 3.10 Fit Indices Used in This Study

Fit Index	**Criteria**
Chi-Square	Non-significant value
Goodness of Fit Index (GFI)	> 0.9
Adjusted Goodness of Fit Index (AGFI)	> 0.9
Root Mean Square Error of Approximation (RMSEA)	< 0.05
Standardized Root Mean Square Residual (S-RMR)	< 0.05

5. Respecify the model

Required modifications are made in this step in order to improve fit of the model to the data set. While modifying the model, variables can be included and/or excluded; relationships/error covariances can be deleted and/or added. Modifications can be done based on the researcher's hypothesis. Also LISREL suggests researcher some modification indices. These modification indices are two kinds for LISREL: one for adding and/or deleting paths; second for adding/deleting error covariances between variables.

CHAPTER 4

RESULTS

In this chapter, results obtained from both descriptive and inferential analyses will be given. In descriptive statistics section, mainly results of factor analyses will be presented.

At the second section of this chapter, structural equation modeling and results of these different models were presented and goodness of fit for each model was examined.

4.1 Descriptive Statistics

Before conducting analyses, descriptive statistics of the data set were investigated in skewness and kurtosis values. Some of skewness and kurtosis values for the items in the student questionnaire were not in -2 and +2 range, so normality of the data distribution was not met. These observed variables were not included in the analysis as much as possible. Descriptive statistics for items in the student achievement test were in the appendices.

In order to find out factor structure of the data set, principal components analysis (PCA) were carried out by using SPSS 11.5 for student questionnaire and science achievement test. Principle components analyses for student questionnaire analyses were conducted on the merged file including all grade levels and school types. Common factors for each grade level were selected for modeling phase. PCAs on student achievement tests were conducted according to the grade levels on separate data set

files. This way provided the best representation of student achievement for each grade levels.

Factor analysis was carried out on the merged student questionnaire file, which included all grade levels and school types. After the factor analysis, observed variables were selected and latent variables were formed. Later on, a model was proposed and tested on 6^{th} grade level, including all school types. This model was regarded as a reference model for comparison with other grade levels and school types. After this, this reference model tested in three different grade levels (6^{th}, 7^{th}, 8^{th}) and three different school types (state primary schools, private primary schools and primary regional boarding schools-YIBOs). For each model, appropriate science achievement tests were used. Observed variables which constituted latent variables were selected for each model separately to represent students' achievement better.

4.1.1 Results of the PCA for Student Questionnaire

Student questionnaire which was given to all grade levels in the scope of this study had 58 items. But as a result of preliminary analysis, it has been found that some items required to be excluded from analysis since these items did not give definitive loadings on a factor. To find out factor structure, principle components analysis was conducted on this data set. Before defining observed and latent variables to be used in the study, KMO and Bartlett's Test were examined to decide on whether PCA can be applied to the data set. These two test resulted good results. Table 4.1 presents the results of KMO and Bartlett's test.

Table 4.1 KMO and Bartlett's Test for Student Questionnaire

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.859
Bartlett's Test of Sphericity	Approx. Chi-Square	395691.938
	df	1431
	Sig.	0.000

The value of 0.859 for KMO was defined by Kaiser himself as meritorious for the values between 0.8 and 0.9. The value of Barttlet's Test of sphericity is 0.000, a significant value, indicated that these data set would not produce an identity matrix, which is a problem in structural equation in modeling.

Since data set are adequate in quality for principle components analysis, results of varimax factor rotation were used in order to define the observed and latent variables to be used in the structural equation modeling stage. While conducting principle components analysis, some items which yielded the inconsistent factor loadings were excluded from the analysis. These factors were "Dish machine at home", "Out-of-school time / work for money", "Out-of-school time / attend social activities clubs, associations, etc.", and "Out-of-school time / go café, cinema, etc. with friends". First principle components analysis on student questionnaire, which includes 54 items, was conducted. Scree plot indicated that there were 10 factors, while number of factors which have values greater than 1 was 15. Later on, one more principle components analysis was conducted forcing number of factor to 10. This yielded a better factor structure. "Out-of-school time / go café, cinema, etc. with friends". After these items were excluded, principle components analysis resulted in 10 factors with 54 items. These 10 factors explained 46.450% of total variance. While conducting PCA, varimax rotation applied to the data set in order to make grouping of factors better. In addition, listwise deletion method was used to handle the missing values. Since missing values are low, listwise deletion method was preferred to obtain consistent results. Table 4.2 presents rotated components matrix for student questionnaire.

Table 4.2 Rotated Component Matrix

Rotated Component Matrix										
	Component									
	1	2	3	4	5	6	7	8	9	10
Time spent for Turkish	**.762**									
Time spent for mathematics	**.748**					.274				
Time spent for science	**.734**					.208				
Time spent for social sciences	**.725**							.167		

Table 4.2 (cont.)

Out-of-school time / homework	**.627**	.112					.112		.163
Out-of-school time / study	**.615**	.132	.164			.160	.111	.117	
Out-of-school time / read newspapers, magazine and book	**.522**	.138						.144	.156
Out-of-school time / research and study in library	**.368**				.295			.104	.160
Mother's education level		**.642**	.106	.353			.144		
Washing machine at home		**.630**							
Father's education level		**.629**	.111	.305		.113	.121		
Study desk at home	.108	**.612**		.164	.124				
Number of siblings		**-.588**		-.120			-.128		
Number of books except course books at home	.165	**.581**	.143	.316					
Study room at home		**.576**		.144	.144				
Telephone at home		**.440**		-.161					.134
Television at home		**.351**		-.241					.198
Out-of-school time / private tutoring for Turkish			**.899**						
Out-of-school time / private tutoring for social science			**.890**						
Out-of-school time / private tutoring for science		.148	**.881**	.118					
Out-of-school time / private tutoring for mathematics		.163	**.856**	.116					
Computer at home		.255		**.771**					
Internet connection at home		.177		**.725**					
Out-of-school time / make homework using computers			.135	**.709**	.128				.161
Out-of-school time / play games on computer				**.630**	.114				.369
In-class activities / group work					**.591**				
In-class activities / student discussions					**.574**		.109		
In-class activities / experiments by students					**.541**				
In-class activities / lessons given by students					**.495**		-.197		
In-class activities / study sheets				.157	**.463**		.244		
In-class activities / discussion between teacher and students					**.446**		.334	.110	
In-class activities / technological material used in class		.153			**.401**		.331		
Perception of success for mathematics	.114					**.771**			.105

Table 4.2 (cont.)

Perception of interest for mathematics	.199				**.717**				
Perception of success for science					**.622**		.289		
Perception of interest for mathematics	.160			.110	**.546**		.233		
In-class activities / lessons given by teacher				-.122		**.614**			
In-class activities / teacher solve examples				.149		**.557**			
In-class activities / appropriate materials in class	.111	.163		.328		**.531**			
In-class activities / experiments by teacher				.117		**.529**			
In-class activities / daily examples by teacher				.345		**.401**	.136		
Perception of success for social sciences					.208		**.700**		.114
Perception of interest for social sciences	.149						**.696**		
Perception of success for Turkish	.149	.132			.276	.120	**.544**		
Perception of success for Turkish	.215					.109	**.529**		-.171
Exams / exam anxiety affects my success								**.651**	
Exams / I afraid		-.144						**.615**	
Exams / not reflect my true success								**.606**	
Exams / I'd more successful if exams do not exist			.134		-.172		-.141	**.504**	
Exams / Exams results provide me a chance for improving myself					.148			**.498**	
Exams / they should not be used for only grading		.121				.146	.125	**.456**	
Out-of-school time / play with friends									**.743**
Out-of-school time / do sport	.133	.149	.133	.108					**.672**
Out-of-school time / watch TV, video	.135	.298		-.173		.129			**.473**

Using rotated component matrix, six factors were selected as latent variables based on the literature and researcher's interest. These factors were named as follows; socioeconomic status, student-centered activities, teacher-centered activities, private tutoring, perception of interest and success for science and mathematics, and experiments and material usage. Last factor, experiments and material usage, have items

from different factors. These items were merged into a single factor for researcher's interest. Table 4.3 shows eigenvalues, variance and cumulative variance percentages for these factors. As can be seen from the table, total variance explained by these five factors is 25.159. Since the latent variable experiments and technological material usage has items from two different factors, its explained variance could not be determined.

Table 4.3 Rotation Sums of Squared Loadings for Selected Factors

	Factor	Eigenvalue	% of Variance	Cumulative % Variance
Mather's education level	SOCIOECONOMIC STATUS	3.756	6.955	6.955
Father's education levels				
Number of siblings				
Number of book except course books at home				
In-class activities / lessons given by students	STUDENT-CENTERED ACTIVITIES	2.331	4.316	11.311
In-class activities / student discussions				
In-class activities / discussion between teacher and students				
In-class activities / lessons given by teacher	TEACHER-CENTERED ACTIVITIES	1.974	3.656	14.967
In-class activities / teacher solve examples				
Out-of-school time / private tutoring for science	PRIVATE TUTORING	3.287	6.087	21.054
Out-of-school time / private tutoring for mathematics				
Out-of-school time / private tutoring for Turkish				
Perception of interest for science	PERCEPTION OF INTEREST AND SUCCESS FOR	2.217	4.105	25.159
Perception of interest for				

mathematics Perception of success for science Perception of success for mathematics	SCIENCE AND MATHEMATICS			
In-class activities / technological material used in class In-class activities / experiments by teacher In-class activities / experiments by students	EXPERIMENTS AND TECHNOLOGICAL MATERIAL USAGE	-	-	-

4.1.2 Results of the PCA for Science Achievement Tests

Principal components analyses were conducted for each grade level separately in order to represent student achievement better. Science achievement tests have 20 items for each grade level. Like student questionnaire, before examining the rotated components, data were investigated as to appropriateness for PCA via KMO and Bartlett's tests. The values of these two tests were so good that they indicated that data was appropriate for principal components analysis. Table 4.4 shows results of KMO and Bartlett's tests for each grade level.

Table 4.4 Results of KMO and Bartlett's Test for Student Questionnaire for Grade Levels

Test		**Grade Levels**		
		6th grade	7th grade	8th grade
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.858	0.852	0.889
Bartlett's Test of Sphericity	Approx. Chi-Square	11162.959	11019.561	13777.141
	df	190	190	190
	Sig.	0.000	0.000	0.000

As can be seen from the table above, KMO values for 6th, 7th, and 8th grade levels are 0.844, 0.852, and 0.889, respectively, which named by Keiser himself meritorious. Furthermore, all Bartlett's Test of Sphericity yielded significant results, which indicated that data set for each grade levels would not produce identity matrices.

Also science achievement tests were applied principal components analysis according to the school types under investigation. Table 4.5 shows results of KMO and Bartlett's tests for each school type.

Table 4.5 Results of KMO and Bartlett's Test for Student Questionnaire for School Types

Test		School Type		
		State	Boarding	Private
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.818	0.757	0.848
Bartlett's Test of Sphericity	Approx. Chi-Square	28790.237	2426.093	3675.435
	df	190	190	190
	Sig.	0.000	0.000	0.000

Results of KMO and Bartlett's tests yielded good results. High values (0.818, 0757, .848, which are meritorious, middling, and meritorious as defined by Keiser), and significant values (0.000 for all three school types) for Bartlett's tests indicated that data set were appropriate principal components analysis.

After those tests, rotated component matrices were examined in order to define variables to be used in the structural equation modeling stage. In principal components analyses, there was no item to be excluded from the analyses. In order to provide better grouping of items in the factors, axes were rotated using Varimax rotation. Also to handle the missing values in the data sets, listwise deletion method was used. A total of six PCA were applied for science achievement tests (three for grade levels and three for school types). Rotated Component Matrices of PCA applied to science achievement tests for these six analyses will not be given here, but in appendices for simplicity. From

the analyses of rotated component matrices no factor could be identified to constitute factor that represents different dimensions of science achievement. There is only one latent variable named Sci_Achv (science achievement) formed and used to represent students' science achievements. While selecting observed variables for latent variable Sci_Achv, factor loadings and some other observed variable features such as sub-topic relationship, graphical/non-graphical, etc. were considered.

Total variances explained by science achievement tests are 30.643%, 31.015% and 22.427% and factors yielded as a result of PCAs are four, four and two factors for grade levels 6^{th}, 7^{th}, and 8^{th}, respectively. When examining for school types total variances explained are 27.173%, 41.962% and 31.412% with three, six, and three for state schools, boarding schools and private schools. Three factors for state schools, six for boarding schools and three for private schools were identified. Table 4.6 shows a summary of results of PCAs.

Table 4.6 A Summary for Principal Components Analyses

		Eigenvalue	**% of Variance**	**Cumulative % Variance**
Grade Level				
6^{th}		1.926	9.628	9.628
		1.848	9.240	18.868
		1.266	1.266	25.200
		1.089	1.089	30.643
7^{th}		2.200	11.002	11.002
		1.832	9.158	20.159
		1.107	5.535	25.695
		1.064	5.321	31.015
8^{th}		2.273	11.367	11.367
		2.212	11.060	22.427
School Type				
State		1.986	9.929	9.929
		1.802	9.008	18.936

Table 4.6 (cont.)

	1.647	8.237	27.173
Boarding	1.726	8.628	8.628
	1.640	8.201	16.829
	1.413	7.066	23.895
	1.259	6.296	30.191
	1.245	6.226	36.418
	1.109	5.544	41.962
Private	2.737	13.683	13.683
	1.936	9.678	23.361
	1.610	8.051	31.412

4.1.3 A Summative Result of Factor Analyses

The principal components analyses were conducted to find out factor structure of the student questionnaires. In this study, the same factor structure was used for modeling each sub-group. To this end, principal components analysis was conducted on the largest data set, which includes all grade levels (6^{th}, 7^{th}, and 8^{th} grade levels) and school types (state schools, private schools and boarding schools). By doing this, the best factor structure representing the whole groups was expected to be obtained. Later on, using this factor structure, latent variables that were used in modeling were selected. When selecting items for latent variables, items with highest factor loadings were selected. All items except one were selected from only one factor for latent variables and had at least three items with highest factor loadings. But latent variable teacher-centered activities (TEAC_CEN) had two items. Latent variables were selected based on literature and researcher's purposes.

Since to make a scientific contribution to the debate on whether student- and/or teacher-centered activities are more effective in science education, latent variables student-centered and teacher-centered activities were especially included in the analysis to find out their effects on students' science achievement and to make contributions to this debate.

Socioeconomic status, which has a serious effect on achievement, and experiments and material usage were also examined in the study. Furthermore, tutoring, also called shadow education, were also included in the analysis to find out its effect on science achievement. Perception of interest and science toward science and mathematics were included to see whether it has direct effect on science achievement and whether it constitutes an intervening variable to transmit the effects of latent variables to the science achievement latent variable. At last, experiments and technological material usage were included in the study.

Latent variables that were selected and used in this study are: socioeconomic status, student-centered and teacher-centered activities, tutoring, experiments and material usage, perception of interest and success. Table 4.7 shows the observed variables and latent variables formed using them.

Table 4.7 Names Given to Latent and Observed Variables

Latent Variable	**Name Given**	**Observed Variable**	**Name Given**
SOCIOECONOMIC STATUS	SES	Mother's education level	Mother_e
		Father's education level	Father_e
		Number of siblings	Siblings
		Number of book except course books at home	Books
STUDENT-CENTERED ACTIVITIES	STUD_CEN	In-class activities / lessons given by students	Stu_less
		In-class activities / student discussions	Stu_disc
		In-class activities / discussion between teacher and students	Tea_disc
TEACHER-CENTERED ACTIVITIES	TEAC_CEN	In-class activities / lessons given by teacher	Tea_less
		In-class activities / teacher solve examples	Examples
PRIVATE TUTORING	TUTOR	Out-of-school time / private tutoring for science	Tut_scie
		Out-of-school time / private tutoring for mathematics	Tut_math

Table 4.7 (cont.)

		Out-of-school time / private tutoring for Turkish	Tut_turk
PERCEPTION OF SCIENCE AND MATHEMATICS INTEREST AND SUCCESS	INT&SUCC	Perception of interest for science	Int_scie
		Perception of interest for mathematics	Int_math
		Perception of success for science	Suc_scie
		Perception of success for mathematics	Suc_math
EXPERIMENTS AND TECHNOLOGICAL MATERIAL USAGE	EXPRMT	In-class activities / technological material used in class	Techno
		In-class activities / experiments by teacher	Tea_expe
		In-class activities / experiments by students	Stu_expe

4.2 Structural Equation Modeling

In this section, results of testing the proposed model in the Chapter 1 will be given for different sub-groups. In this section six different models will be presented, three for 6^{th}, 7^{th} and 8^{th} grade levels and three for state school, private schools and boarding schools. In this stage of the study, LISREL was used to test the model. SIMPLIS provided researcher with an easy –to-use command language to modeling. Deletion method was listwise deletion and method of estimation was Maximum Likelihood for the modeling. Significance levels for all the analyses were stated as 0.05. For modeling, covariance matrices were used and these matrices were obtained by Prelis, which is a sub-program in LISREL package.

4.2.1 Science Achievement Model for 6^{th} Grade Level

Proposed model in the Chapter 1 was tested firstly in grade level 6 without school type discrimination. PRELIS command language syntax was given in appendices section of the study. In order to improve model, five covariance terms were added to the model based on the modification indices suggested by LISREL. Path diagrams obtained in terms of standardized coefficients and t-values were given as structural models in

Figure 4.1 & Figure 4.2, respectively. Basic model for grade level 6 can be found in the appendices.

This model examines the effects of five independent latent variables (SES, STUD_CEN, EXPRMT, TUTOR, and TEAC_CEN) and one intervening latent variable (INT&SUCC) on the one latent dependent variable (SCI_ACHV).

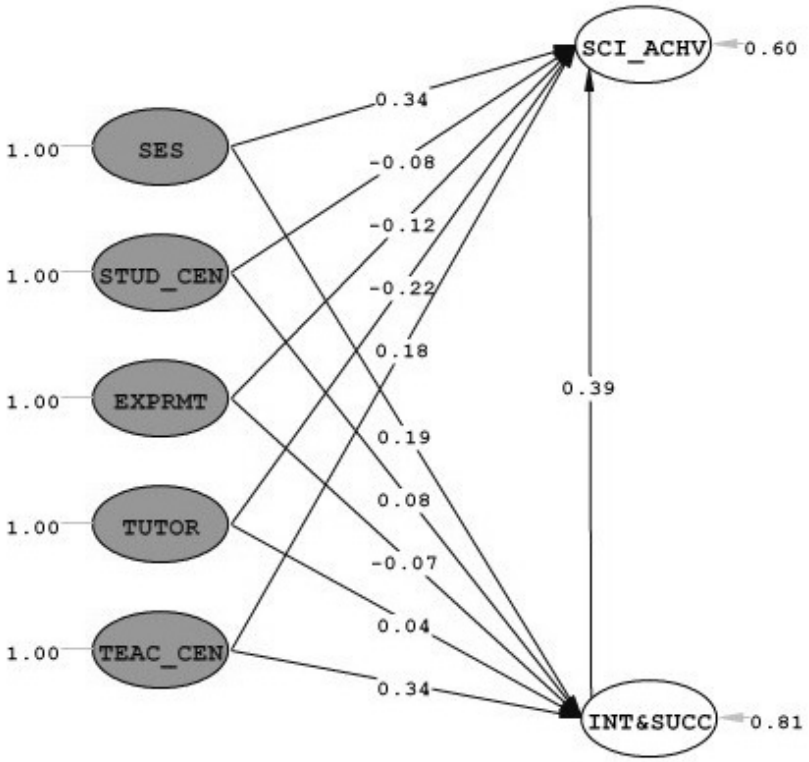


Figure 4.1 Structural Model for Science Achievement for Grade Level 6 (Standardized Coefficients)

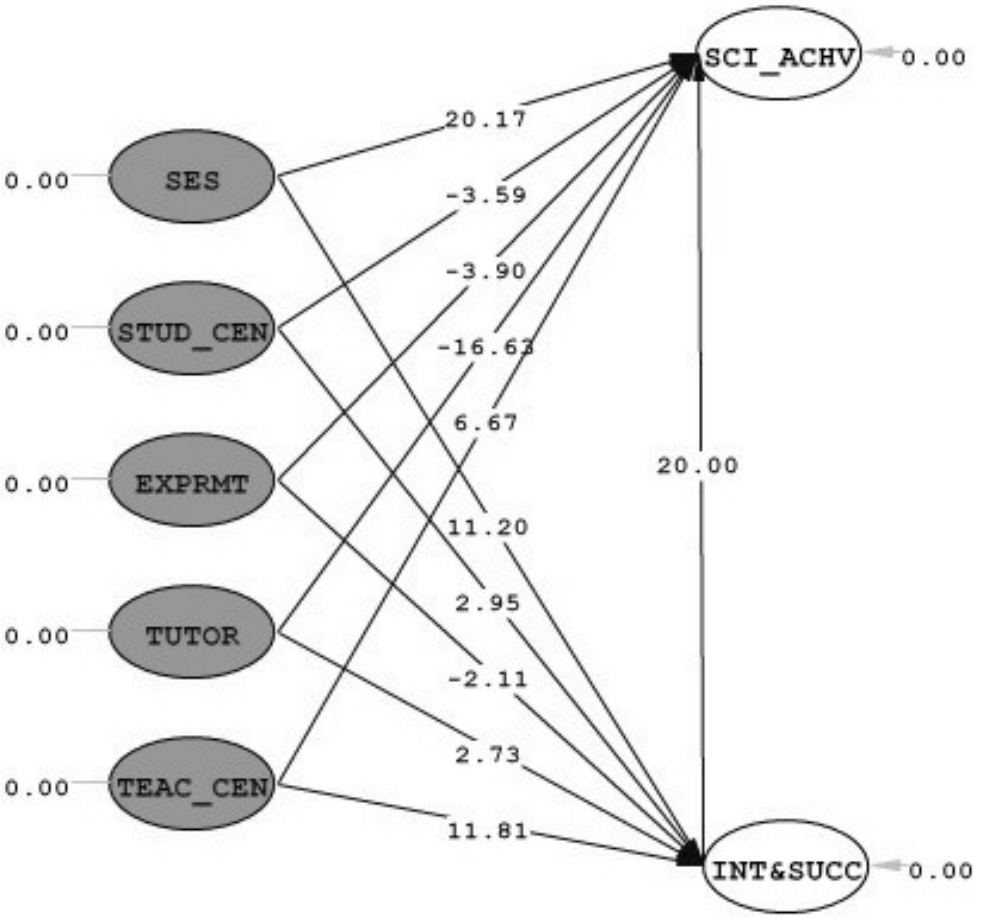


Figure 4.2 Structural Model for Science Achievement for Grade Level 6 (t values)

The fit indices for the model are given in Table 4.8.

Table 4.8 Fit Indices for the Model Tested in Grade Level 6

Fit Index	Criteria	Value
Chi-Square	Non-significant	4627.82 (p = 0.00)
Goodness of Fit Index (GFI)	> 0.9	0.96
Adjusted Goodness of Fit Index (AGFI)	> 0.9	0.95
Root Mean Square Error of Approximation (RMSEA)	<0.05	0.045
Standardized Root Mean Square Residual (S-RMR)	<0.05	0.039

All the fit indices generated by LISREL indicated the model proposed fitted very well to the data set. Chi-square index indicated a significant value, which was expected because of the large sample size. Therefore, it was not taken into account for a fit index.

In the model tested there is no non-significant t-value, that all the path coefficients in the model were significant at 0.05 significance level, as can be seen in Figure 4.2. Table 4.9 shows the standardized $?_x$ and $?_y$ coefficients for observed variables.

Table 4.9 $?_x$ and $?_y$ Path Coefficients

Latent Variable	Observed Variable	? parameter
SES	Mother_e	0.81 ($?_x$)
	Father_e	0.81 ($?_x$)
	Siblings	-0.50 ($?_x$)
	Books	0.67 ($?_x$)
STUD_CENT	Stu_less	0.29 ($?_x$)
	Stu_disc	0.62 ($?_x$)
	Tea_disc	0.65 ($?_x$)

Table 4.9 (cont.)

TEAC_CENT	Tea_less	0.44 ($?_x$)
	Examples	0.67 ($?_x$)
TUTOR	Tut_scie	0.91 ($?_x$)
	Tut_math	0.89 ($?_x$)
	Tut_turk	0.87 ($?_x$)
INT&SUCC	Int_math	0.54 ($?_y$)
	Int_scie	0.54 ($?_y$)
	Suc_math	0.58 ($?_y$)
	Suc_scie	0.61 ($?_y$)
EXPRMT	Techno	0.58 ($?_x$)
	Tea_expe	0.34 ($?_x$)
	Stu_expe	0.43 ($?_x$)
SCI_ACHV	NF5	0.46 ($?_y$)
	NF10	0.69 ($?_y$)
	NF12	0.34 ($?_y$)
	NF15	0.55 ($?_y$)
	NF17	0.43 ($?_y$)

The following two tables, 4.10 and 4.11, show the standardized ? and ß coefficients (direct effects) estimates generated by LISREL software for exogenous and endogenous variables for the model at hand. While ? coefficients give the strength and direction of the relationship between exogenous and endogenous latent variables, ß coefficients indicate how strong and in what direction the relationships between endogenous latent variables.

Table 4.10 ? Path Coefficients

Exogenous Latent Variable	**? Parameter**	**Endogenous Latent Variable**
SES	0.34	SCI_ACHV

Table 4.10 (Cont.)

STUD_CENT	-0.08	
TEAC_CENT	0.18	
TUTOR	-0.22	
EXPRMT	-0.12	
SES	0.19	INT&SUCC
STUD_CENT	0.08	
TEAC_CENT	0.34	
TUTOR	0.04	
EXPRMT	-0.07	

Table 4.11 ß Path Coefficients

Endogenous Latent Variable	**ß Parameter**	**Endogenous Latent Variable**
SCI_ACHV	0.39	INT&SUCC

Table 4.12 shows estimates for R^2, squared multiple correlation coefficients, which was calculated for each variable in the model and can be used as a measure of effect size. The value R^2 indicates the proportion of explained variance of the variable (unique variance) and can be used find out how good the observed variables are indicators of latent variables.

Table 4.12 R^2 Values for Observed Variables

Observed Variable	**R^2**	**Observed Variable**	**R^2**
Mother_e	0.66	Int_math	0.30
Father_e	0.65	Int_scie	0.29
Siblings	0.25	Suc_math	0.33

Table 4.12 (cont.)

Books	0.44	Suc_scie	0.37
Stu_less	0.08	Techno	0.34
Stu_disc	0.39	Tea_expe	0.11
Tea_disc	0.42	Stu_expe	0.19
Tea_less	0.20	NF5	0.21
Examples	0.45	NF10	0.48
Tut_scie	0.84	NF12	0.11
Tut_math	0.79	NF15	0.31
Tut_turk	0.76	NF17	0.18

R^2 for the latent variables SCI_ACHV and INT&SUCC was given below, Table 4.13. These values are approximately effect size measures, so they can be used to this end. As Cohen stated (1988), effect sizes measured in terms of R^2 can be classified as follows: up to 0.01 is small, around 0.09 is medium, and 0.25 or up is large effect size. Small to medium effect sized can be acceptable in social sciences.

Table 4.13 R^2 Values for Latent Variables

Latent Variables	**R^2**
SCI_ACHV	0.40
INT&SUCC	0.19

LISREL can also generate indirect and total effects as well as direct effects, if demanded. LISREL path diagram gives path coefficients in terms of direct effects (= total effects – indirect effects) and these coefficients were given in Table 4.10. On Table 4.14 and 4.15 below, indirect and total effects for endogenous and exogenous latent variables were shown. Since there was no path proposed from SCI_ACHV to INT&SUCC, no indirect effect was estimated for the endogenous latent variable INT&SUCC. Also because there two latent dependent variables in the model, there are

no indirect effect between them, and direct effect is also equal to total effect. Therefore only total effect was estimated, which is 0.39, as indicated before.

As can be seen from the tables, only the observed latent variable EXPRMT has a negative indirect effect of -0.03. The other observed latent variables have all positive indirect effects on each other. Therefore total effects are higher than direct effects, except for EXPRMT

Table 4.14 Indirect Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	-	-	-	-
SCI_ACHV	0.08	0.03	-0.03	0.02	0.13

Table 4.15 Total Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	0.19	0.08	-0.07	0.04	0.34
SCI_ACHV	0.42	-0.05	-0.14	-0.21	0.31

As a summary for the findings stated up to this point, fit indices for the model indicated that the model proposed for the grade level 6 fitted the data set well. There is no non-significant parameter estimated at the significance level 0.05 for the loadings. Observed variable Siblings has a negative loading with SES ($?_x$ = -0.50). Other three observed variables, Mother_e, Father_e and Books have positive loadings ($?_x$ = 0.81, 0.81 and 0.67). Latent variable STUD_CENT have three significant and positive loadings ($?_x$ = 0.29, 0.62 and 0.65). Two observed variables, Tea_less and Examples, of TEAC_CEN have significant loadings ($?_x$ = 0.44 and 0.67). Tutor has three observed variable, Tut_scie, Tut_math and Tut_turk and their loading are high ($?_x$ = 0.91, 0.89 and 0.87). Techno, Teac_expe and Stu_expe constituted the latent variable EXPRM with the four loadings ($?_x$ = 0.58, 0.34 and 0.43). INT&SUCC have four positive and significant

loadings for Int_math, Int_scie, Suc_math and Suc_scie ($?_y$ = 0.54, 0.54, 0.58 and 0.61). At last, items for SCI_ACHV (NF5, NF10, NF12, NF15 and NF17) have significant loadings ($?_y$ = 0.46, 0.69, 0.34 0.55 and 0.43).

Exogenous latent variable SES has a positive direct effect for (? = 0.34) for SCI_ACHV, and its total effect is 0.42 with an indirect effect of 0.08. SES also has a positive direct effect (? = 0.19) for INT&SUCC which is the both direct and total effect. Direct effect of the latent variable STUD_CEN on SCI_ACHV is negative (? = -0.08), and with an indirect effect of 0.03, its total effect is -0.05. Total effect of STUD_CEN on INT&SUCC is 0.08 with no indirect effect. Exogenous latent variable TEAC_CENT has a positive direct effect (? = 0.18) on SCI_ACHV, its indirect effect is 0.13, so total effect of TEAC_CEN on SCI_ACHV is 0.31. TEAC_CEN has also a positive direct, also total, effect on INT&SUCC (? = 0.34). Direct effect of TUTOR on SCI_ACHV is negative (? = -0.22), its indirect effect is 0.02. Therefore its total effect on SCI_ACHV is -0.21. TUTOR has a positive direct on INT&SUCC (? = 0.04). Exogenous latent variable EXPRMT have a negative direct effect on SCI_ACHV (? = -0.12), and its total effect is -0.14 with an indirect effect of -0.03. Total effect of EXPRMT on INT&SUCC is also negative with a value of -0.07. Endogenous variable INT&SUCC have a positive direct effect on SCI_ACHV (ß = 0.39), this is also its total effect since there is no indirect effect of it.

Important points to be noticed for this model are that exogenous latent variables SES and TEAC_CEN have medium effects on SCI_ACHV. And their effects on INT&SUCC can be said to be medium. It is also important to notice that effect of STUD_CEN on SCI_ACHV is small and negative. INT&SUCC has a large effect on SCI_ACHV. Another interesting point is that TEAC_CEN has also a medium effect on INT_SUCC.

Finally, regression equations for grade level 6, Y_{SCI_ACHV} and $Y_{INT\&SUCC}$, which consist of standardized total effects as coefficients are given below, respectively.

$$Y_{INT\&SUCC} = 0.19X_{SES} + 0.08X_{STUD\_CEN} - 0.07X_{EXPRMT} + 0.04X_{TUTOR} + 0.34X_{TEAC\_CEN}$$
$$(R^2 = 0.19)$$

$$Y_{SCI\_ACHV} = 0.42X_{SES} - 0.05X_{STUD\_CEN} - 0.14X_{EXPRMT} - 0.21X_{TUTOR} + 0.31X_{TEAC\_CEN}$$
$$(R^2 = 0.40)$$

R^2 values for the SCI_ACHV (0.40) and INT&SUCC (0.19) indicate large and medium effect sizes, respectively.

4.2.2 Science Achievement Model for 7th Grade Level

This time, the same proposed model in the Chapter 1 was tested in grade level 7 without school type discrimination. PRELIS command language syntax was given in appendices section of the study. Seven covariance terms were added to the model based on the modification indices suggested by LISREL. Path diagrams obtained in terms of standardized coefficients and t-values were given as structural models in Figure 4.3 & Figure 4.4, respectively. Basic model for grade level 7 was given in the appendices.

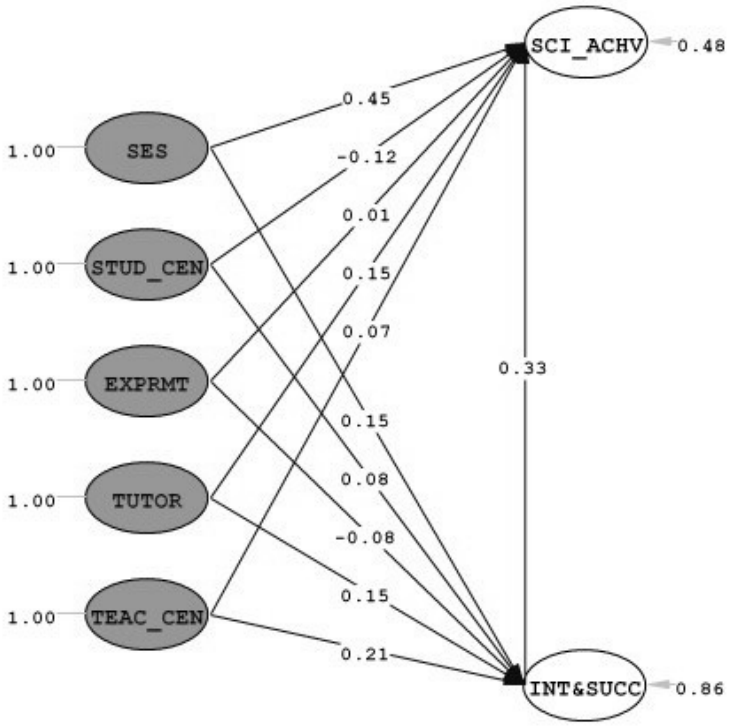


Figure 4.3 Structural Model for Science Achievement for Grade Level 7 (Standardized Coefficients)

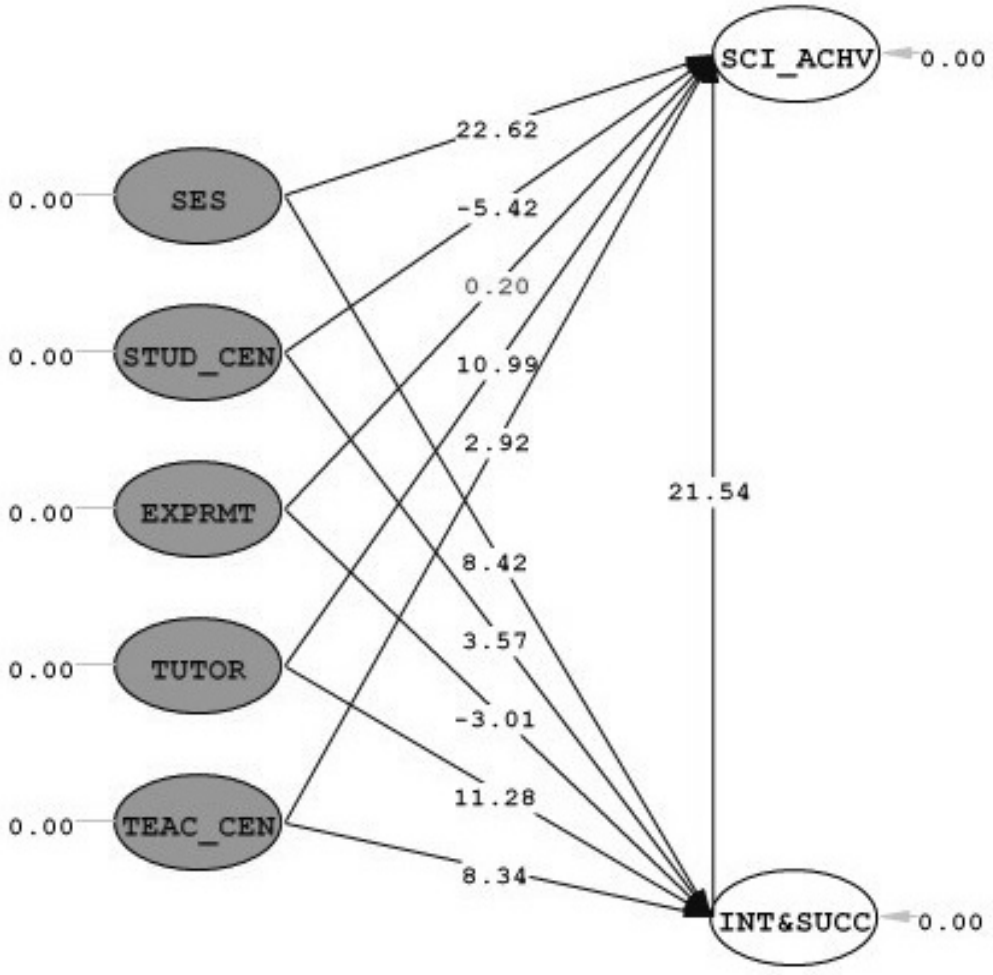


Figure 4.4 Structural Model for Science Achievement for Grade Level 7 (t values)

As can be seen from table which shows t-values, there is only one non-significant t-value for the path from EXPRMT to SCI_ACHV (t = 0.20). The all other values are significant at the 0.05 significance level.

Fit indices for the model generated by LISREL are given in Table 4.16. All the fit indices indicate the proposed model fit to data set very well. Again, due to large sample size, chi-square is significant, so it was not considered a fit index for the model.

Table 4.16 Fit Indices for the Model Tested in Grade Level 7

Fit Index	**Criteria**	**Value**
Chi-Square	Non-significant	3864.91 (p = 0.00)
Goodness of Fit Index (GFI)	> 0.9	0.97
Adjusted Goodness of Fit Index (AGFI)	> 0.9	0.96
Root Mean Square Error of Approximation (RMSEA)	<0.05	0.038
Standardized Root Mean Square Residual (S-RMR)	<0.05	0.030

The fit indices are following Table 4.17, which shows the standardized $?_x$ and $?_y$ coefficients for observed variables. There is no non-significant value for $?_x$ and $?_y$ coefficients.

Table 4.17 $?_x$ and $?_y$ Path Coefficients

Latent Variable	**Observed Variable**	**? parameter**
SES	Mother_e	0.72 ($?_x$)
	Father_e	0.75 ($?_x$)
	Siblings	-0.49 ($?_x$)
	Books	0.75 ($?_x$)

Table 4.17 (cont.)

STUD_CENT	Stud_les	0.29 ($?_x$)
	Stud_dis	0.61 ($?_x$)
	Tea_dis	0.71 ($?_x$)
TEAC_CENT	Tea_less	0.41 ($?_x$)
	Examples	0.66 ($?_x$)
TUTOR	Tut_scie	0.95 ($?_x$)
	Tut_math	0.93 ($?_x$)
	Tut_turk	0.90 ($?_x$)
INT&SUCC	Int_math	0.77 ($?_y$)
	Int_scie	0.51 ($?_y$)
	Suc_math	0.81 ($?_y$)
	Suc_scie	0.60 ($?_y$)
EXPRMT	Techno	0.56 ($?_x$)
	Teac_expe	0.35 ($?_x$)
	Stu_expe	0.45 ($?_x$)
SCI_ACHV	NF1	0.61 ($?_y$)
	NF6	0.42 ($?_y$)
	NF7	0.46 ($?_y$)
	NF8	0.35 ($?_y$)
	NF14	0.59 ($?_y$)
	NF14	0.37 ($?_y$)

Table 4.18 and 4.19 show the ? and ß coefficients estimates generated by LISREL software for exogenous and endogenous variables for the model at hand. These coefficients can be used to indicate the strength and direction of the effect between exogenous and endogenous latent variables (?) and between endogenous latent variables (ß). The coefficients in table below are in standardized values and indicate direct relationship. As stated before, there is only one no non-significant value for ? coefficients for the model (the path from EXPRMT to SCI_ACHV). Non-significant values are remarked by a star (*) in the following table.

Table 4.18 ? Path Coefficients

Exogenous Latent Variable	? Parameter	Endogenous Latent Variable
SES	0.45	SCI_ACHV
STUD_CENT	-0.12	
TEAC_CENT	0.07	
TUTOR	0.15	
EXPRMT	0.01*	
SES	0.15	INT&SUCC
STUD_CENT	0.08	
TEAC_CENT	0.21	
TUTOR	0.15	
EXPRMT	-0.08	

Table 4.19 ß Path Coefficients

Endogenous Latent Variable	ß Parameter	Endogenous Latent Variable
SCI_ACHV	0.33	INT&SUCC

Estimates for R^2, squared multiple correlation coefficients, which was calculated for each variable in the model were given in Table 4.20. These estimates are approximately equa l to the measures of effect sizes. The value R^2 indicates the proportion of explained variance of the variable (unique variance) and can be used find out how good the observed variables are indicators of latent variables.

Table 4.20 R^2 Values for Observed Variables

Observed Variable	R^2	Observed Variable	R^2
Mother_e	0.52	Int_math	0.59
Father_e	0.56	Int_scie	0.26
Siblings	0.24	Suc_math	0.39
Books	0.56	Suc_scie	0.36
Stud_les	0.09	Techno	0.31
Stud_dis	0.37	Teac_expe	0.12
Tea_dis	0.51	Stu_expe	0.20
Tea_less	0.17	NF1	0.37
Examples	0.44	NF6	0.18
Tut_scie	0.97	NF7	0.21
Tut_math	0.87	NF8	0.12
Tut_turk	0.81	NF14	0.35
		NF16	0.13

R^2 for the latent variables SCI_ACHV and INT&SUCC was given below, Table 4.21. As stated before, these values can be used for effect size measures. As Cohen stated (1988), effect sizes measured in terms of R^2 can be classified as follows: up to 0.01 is small, around 0.09 is medium, and 0.25 or up is large effect size. R^2 values for SCI_ACHV and INT&SUCC are 0.52 (large) and 0.14 (medium), respectively.

Table 4.21 R^2 Values for Latent Variables

Latent Variables	R^2
SCI_ACHV	0.52
INT&SUCC	0.14

Indirect and total effects were also demanded as well as direct effects fom LISREL. Table 4.22 and 4.23 shows indirect and total effects of the exogenous latent

variables (SES, STUD_CEN, EXPRMT, TUTOR and TEAC_CEN) on the endogenous latent variables (SCI_ACHV and INT&SUCC). Again there is no indirect effect for INT&SUCC since this relationship was not established. And also there is no effect between SCI_ACHV and INT&SUCC since there are just two endogenous latent variables, which total effect of INT&SUCC on SCI_ACHV is 0.33.

Like the model for the grade level 6, only the observed latent variable, which has a negative indirect effect (-0.03) on SCI_ACHV is EXPRMT. The other observed latent variables have all positive indirect effects on each other. Therefore, total effects are higher than direct effects, except for EXPRM, which has a non-significant effect. Non-significant effects are remarked by a star (*).

Table 4.22 Indirect Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	-	-	-	-
SCI_ACHV	0.05	0.03	-0.03	0.05	0.07

Table 4.23 Total Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	0.15	0.08	-0.08	0.15	0.21
SCI_ACHV	0.49	-0.09	-0.02*	0.19	0.14

To sum up of, fit indices for the model indicate that the model proposed for the grade level 7 fits the data set well. There is no non-significant parameter estimated at the significance level 0.05 in the loadings. Like model for grade level 6, observed variable Siblings has a negative loading with SES ($?_x$ = -0.49). Other three observed variables, Mother_e, Father_e and Books have positive loadings ($?_x$ = 0.72, 0.75 and 0.75). Latent variable STUD_CEN has three significant and positive loadings ($?_x$ = 0.29, 0.61 and

0.71). Two observed variables of TEAC_CEN, Tea_less and Examples, have significant loadings ($?_x$ = 0.41 and 0.66). TUTOR has three observed variable, Tut_scie, Tut_math and Tut_turk with high loadings ($?_x$ = 0.95, 0.93 and 0.90). Observed variables Techno, Teac_expe and Stu_expe of the latent variable EXPRMT has the three loadings ($?_x$ = 0.55, 0.35 and 0.45). INT&SUCC have four positive significant loadings for Int_math, Int_scie, Suc_math and Suc_scie ($?_y$ = 0.77, 0.51, 0.81 and 0.60). In addition, items for SCI_ACHV (NF1, NF6, NF7, NF8, NF14 and NF16) have the six positive loadings ($?_y$ = 0.61, 0.42, 0.46 0.35, 0.59, and 0.37).

SES has a positive direct effect for (? = 0.45) for SCI_ACHV, and its total effect is 0.49 with an indirect effect of 0.05. Direct effect, also total, of SES on INT&SUCC is positive and significant (? = 0.15). Direct effect of the latent variable STUD_CEN on SCI_ACHV is negative (? = -0.12), and as a result of an indirect effect of 0.03, its total effect is -0.09. STUD_CEN has direct and total effect on INT&SUCC, which is 0.08. TEAC_CEN has a positive direct effect (? = 0.07) on SCI_ACHV, its indirect effect is 0.07, and therefore total effect of TEAC_CEN on SCI_ACHV is 0.14. TEAC_CEN has also a positive direct, also total, effect on INT&SUCC (? = 0.21). Direct effect of TUTOR on SCI_ACHV is positive (? = 0.15), its indirect effect is 0.05. Therefore, its total effect on SCI_ACHV is 0.19. TUTOR has also a positive direct effect on INT&SUCC (? = 0.15). Exogenous latent variable EXPRMT have a non-significant direct effect on SCI_ACHV (? = 0.01), and its total effect is also non-significant with a value of -0.02 with an indirect effect of -0.03 which is significant. Total effect of EXPRMT on INT&SUCC is negative (? = -0.08). Endogenous variable INT&SUCC have a positive direct effect on SCI_ACHV (ß = 0.33), this is also its total effect since there is no indirect effect of it.

Interesting findings for this model are that large and medium effects of SES and TEAC_CEN on SCI_ACHV, respectively. Also TUTOR has a high effect both on SCI_ACHV and INT&SUCC in this model. STUD_CEN has a negative and a small effect on SCI_ACHV, like the previous model. It is of importance that direct and indirect effects of TEAC_CEN are approximately the same, which are small effects. INT&SUCC has a medium effect on SCI_ACHV. As a last notice, SES and

TEAC_CEN have also small and medium effects on INT_SUCC for the model grade level 7, respectively.

At the end of this section are regression equations for the model proposed of the grade level 7, Y_{SCI_ACHV} and $Y_{INT\&SUCC}$, with standardized total effects as coefficients.

$$Y_{INT\&SUCC} = 0.15X_{SES} + 0.08X_{STUD\_CEN} - 0.08X_{EXPRMT} + 0.15X_{TUTOR} + 0.21X_{TEAC\_CEN}$$
$$(R^2 = 0.14)$$
$$Y_{SCI\_ACHV} = 0.49X_{SES} - 0.09X_{STUD\_CEN} - 0.02X_{EXPRMT} + 0.19X_{TUTOR} + 0.14X_{TEAC\_CEN}$$
$$(R^2 = 0.52)$$

R^2 values for the SCI_ACHV (0.52) and INT&SUCC (0.14) indicate large and medium effect sizes, respectively.

4.2.3 Science Achievement Model for 8th Grade Level

In this section model proposed for the data set of the grade level 8 was tested without school type discrimination. PRELIS command language syntax was given in appendices section of the study. Six covariance terms were added to the model based on the modification indices suggested by LISREL. Path diagrams obtained in terms of standardized coefficients and t-values were given as structural models in Figure 4.5 & Figure 4.6, respectively. Basic model for grade level 8 can be found in the appendices.

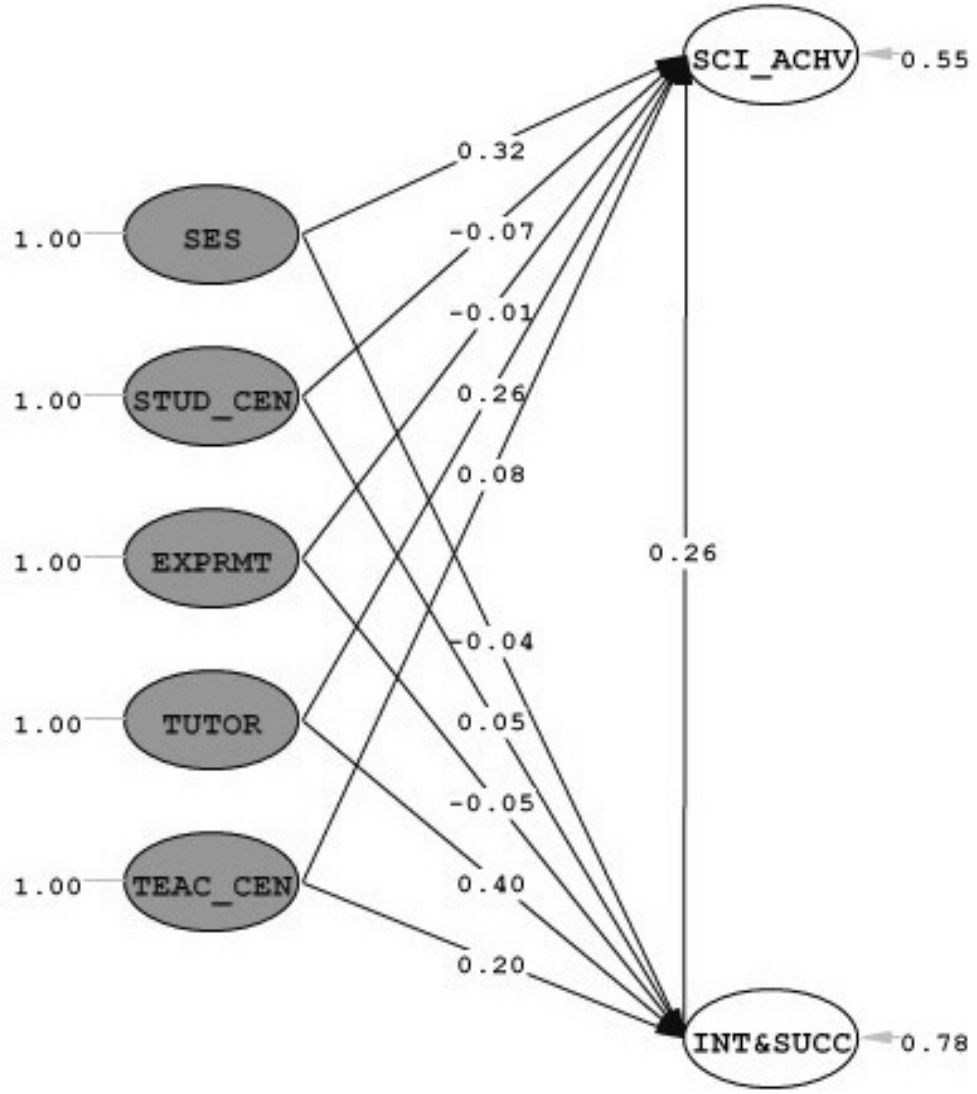


Figure 4.5 Structural Model for Science Achievement for Grade Level 8 (Standardized Coefficients)

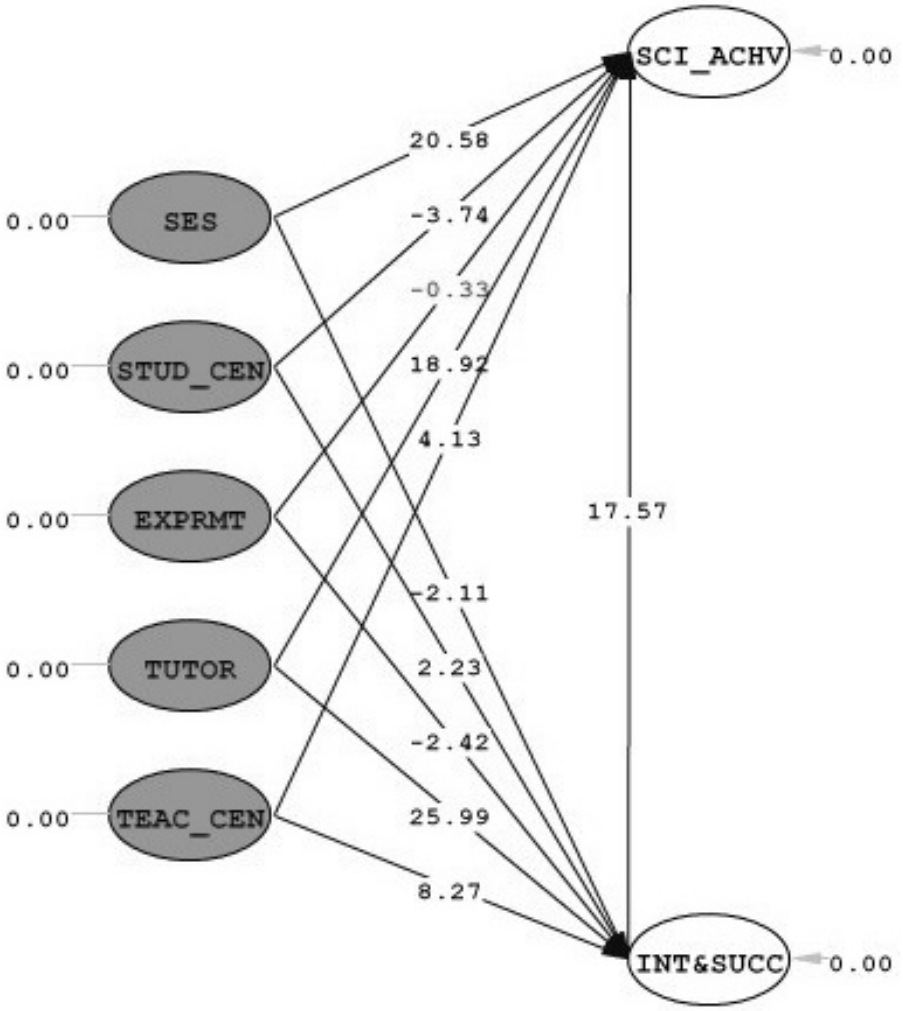


Figure 4.6 Structural Model for Science Achievement for Grade Level 8 (t values)

Like the model for grade level 7, there is only one non-significant relationship, the path from EXPRM T to SCI_ACHV (t = -0.33). The all other values are significant at the 0.05 significance level.

Table 4.24 shows the fit indices for the model generated by LISREL. All the fit indices indicate the proposed model fit to data set very well. Again due to large sample size, chi-square is significant, and it was not considered a fit index for the model.

Table 4.24 Fit Indices for the Model Tested in Grade Level 8

Fit Index	**Criteria**	**Value**
Chi-Square	Non-significant	4816.30 (p = 0.00)
Goodness of Fit Index (GFI)	> 0.9	0.97
Adjusted Goodness of Fit Index (AGFI)	> 0.9	0.96
Root Mean Square Error of Approximation (RMSEA)	<0.05	0.035
Standardized Root Mean Square Residual (S-RMR)	<0.05	0.031

The standardized $?_x$ and $?_y$ coefficients for observed variables are given Table 4.25. As stated before, there is no non-significant value for $?_x$ and $?_y$ for the model.

Table 4.25 $?_x$ and $?_y$ Path Coefficients

Latent Variable	**Observed Variable**	**? parameter**
SES	Mother_e	0.80 ($?_x$)
	Father_e	0.81 ($?_x$)
	Siblings	-0.53 ($?_x$)
	Books	0.69 ($?_x$)
STUD_CENT	Stud_les	0.22 ($?_x$)
	Stud_dis	0.59 ($?_x$)
	Tea_dis	0.73 ($?_x$)

Table 4.25 (cont.)

TEAC_CENT	Tea_less	0.39 ($?_x$)
	Examples	0.68 ($?_x$)
TUTOR	Tut_scie	0.98 ($?_x$)
	Tut_math	0.97 ($?_x$)
	Tut_turk	0.94 ($?_x$)
INT&SUCC	Int_math	0.73 ($?_y$)
	Int_scie	0.47 ($?_y$)
	Suc_math	0.76 ($?_y$)
	Suc_scie	0.55 ($?_y$)
EXPRMT	Techno	0.61 ($?_x$)
	Teac_expe	0.46 ($?_x$)
	Stu_expe	0.50 ($?_x$)
SCI_ACHV	NF1	0.44 ($?_y$)
	NF3	0.40 ($?_y$)
	NF5	0.36 ($?_y$)
	NF6	0.39 ($?_y$)
	NF10	0.51 ($?_y$)
	NF12	0.51 ($?_y$)
	NF14	0.41 ($?_y$)
	NF15	0.54 ($?_y$)
	NF16	0.57 ($?_y$)
	NF17	0.47 ($?_y$)
	NF18	0.45 ($?_y$)

Standardized ? and ß coefficients estimates that give direct effects generated by LISREL software for exogenous and endogenous variables can be found on the Table 4.26 and 4.27, respectively. These coefficients can be used to indicate the strength and direction of the effect between exogenous and endogenous latent variables (?) and between endogenous latent variables (ß). There is no non-significant value for the model, except the path from EXPRMT to SCI_ACHV. Non-significant values are remarked by a star (*) in the following table.

Table 4.26 ? Path Coefficients

Exogenous Latent Variable	? Parameter	Endogenous Latent Variable
SES	0.32	SCI_ACHV
STUD_CENT	-0.07	
TEAC_CENT	0.08	
TUTOR	0.26	
EXPRMT	-0.01*	
SES	-0.04	INT&SUCC
STUD_CENT	0.05	
TEAC_CENT	0.20	
TUTOR	0.40	
EXPRMT	-0.05	

Table 4.27 ß Path Coefficients

Endogenous Latent Variable	ß Parameter	Endogenous Latent Variable
SCI_ACHV	0.26	INT&SUCC

Estimates for R^2, squared multiple correlation coefficients which was calculated for each variable in the model were given in Table 4.28. These estimates are approximately equal to the measures of effect sizes. The value R^2 indicates the proportion of explained variance of the variable (unique variance) and can be used find out how good the observed variables are representatives of the latent variables.

Table 4.28 R^2 Values for Observed Variables

Observed Variable	R^2	Observed Variable	R^2
Mother_e	0.64	Suc_scie	0.30
Father_e	0.66	Techno	0.38
Siblings	0.28	Teac_expe	0.21
Books	0.48	Stu_expe	0.25
Stud_les	0.05	NF1	0.19
Stud_dis	0.35	NF3	0.16
Tea_dis	0.53	NF5	0.13
Tea_less	0.15	NF6	0.14
Examples	0.46	NF10	0.26
Tut_scie	0.95	NF12	0.26
Tut_math	0.95	NF14	0.17
Tut_turk	0.89	NF15	0.30
Int_math	0.53	NF16	0.32
Int_scie	0.22	NF17	0.22
Suc_math	0.58	NF18	0.21

Table 4.29 shows R^2 values for endogenous latent variables were SCI_ACHV and INT&SUCC. As stated before, these values can be used for effect size measures. As Cohen stated (1988), effect sizes measured in terms of R^2 can be classified as follows: up to 0.01 is small, around 0.09 is medium, and 0.25 or up is large effect size. R^2 values for SCI_ACHV and INT&SUCC are 0.45 (large) and 0.22 (large), respectively.

Table 4.29 R^2 Values for Latent Variables

Latent Variables	R^2
SCI_ACHV	0.45
INT&SUCC	0.22

Indirect and total effects for the latent variables were also demanded as well as direct effects from LISREL. Table 4.30 and 4.31 show indirect and total effects of the exogenous latent variables (SES, STUD_CEN, EXPRMT, TUTOR and of TEAC_CEN) on the endogenous latent variables (SCI_ACHV and INT&SUCC). Like the previous two model, there is no indirect effect for INT&SUCC since this relationship was not established. In addition, there is no indirect effect between SCI_ACHV and INT&SUCC since there are just two endogenous latent variables, which total effect of INT&SUCC on SCI_ACHV is 0.26.

In this model, exogenous latent variables SES and EXPRMT have negative indirect effects (-0.01 and -0.01 for both) on SCI_ACHV is EXPRMT. The other observed latent variables have all positive indirect effects on each other. Like before, non-significant values are remarked by a star (*).

Table 4.30 Indirect Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	-	-	-	-
SCI_ACHV	-0.01	0.01	-0.01	0.10	0.05

Table 4.31 Total Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-0.04	0.05	-0.05	0.40	0.20
SCI_ACHV	0.31	-0.05	-0.02*	0.36	0.13

Finally, fit of the model to the data set for the grade level 8 was proved by the fit indices generated by LISREL. Loadings have no non-significant relationship estimated at the significance level 0.05. Like the previous the model, observed variable Siblings has a negative loading with SES ($?_x$ = -0.53). Other three observed variables, Mother_e,

Father_e and Books have positive loadings ($?_x$ = 0.80, 0.81 and 0.69). Latent variable STUD_CEN has three significant and positive loadings ($?_x$ = 0.22, 0.59 and 0.73). Two observed variables of TEAC_CEN, Tea_less and Examples, have significant loadings ($?_x$ = 0.39 and 0.68). TUTOR has three observed variables, Tut_scie, Tut_math and Tut_turk with high loadings ($?_x$ = 0.98, 0.97 and 0.94). EXPRMT has three significant and positive loadings ($?_x$ = 0.61, 0.46 and 0.50) for the observed variables Techno, Teac_expe and Stu_expe, respectively. INT&SUCC have four positive significant loadings for Int_math, Int_scie, Suc_math and Suc_scie ($?_x$ = 0.73, 0.47, 0.76 and 0.55). At last, items for SCI_ACHV that is, NF1, NF3, NF5, NF6, NF10, NF12, NF14, NF15, NF16, NF17 and NF18 have all positive loadings ($?_y$ = 0.44, 0.40, 0.36 0.39, 0.51, 0.51, 0.41, 0.54, 0.57, 0.47 and 0.45).

SES has a positive direct effect for (? = 0.32) for SCI_ACHV, and its total effect is 0.31 with an indirect effect of -0.01. Direct effect, also total, of SES on INT&SUCC is negative and significant (? = -0.04). Direct effect of the latent variable STUD_CEN on SCI_ACHV is negative (? = -0.07), and as a result of an indirect effect of 0.01, its total effect is -0.05. STUD_CEN has only direct and total effect on INT&SUCC, which is 0.05. TEAC_CEN has a positive direct effect (? = 0.08) on SCI_ACHV, its indirect effect is 0.05, and therefore total effect of TEAC_CEN on SCI_ACHV is 0.13. TEAC_CEN has also a positive direct, also total, effect on INT&SUCC (? = 0.20). Direct effect of TUTOR on SCI_ACHV is positive (? = 0.26), its indirect effect is 0.10. Therefore its total effect on SCI_ACHV is 0.36. TUTOR has also a positive direct effect on INT&SUCC (? = 0.40). Exogenous latent variable EXPRMT have a non-significant direct effect on SCI_ACHV (? = -0.01), and its total effect is a non-significant value of -0.02 with an indirect effect of -0.01. Total effect of EXPRMT on INT&SUCC is also negative (? = -0.05). Endogenous variable INT&SUCC has a positive direct effect on SCI_ACHV (ß = 0.26), this is also its total effect since there is no indirect effect of it.

The most important remark on the findings about this model is that there is a relatively higher effect of TUTOR both on SCI_ACHV and INT&SUCC besides SES and TEAC_CENT. TUTOR gains importance as grade level increases (? = -0.11, 0.15 and 0.26 on SCI_ACHV for the grade level 6, 7, and 8, respectively). Like the previous models, while STUD_CENT has a negative effect on SCI_ACHV, TEAC_CENT has a

positive effect. TEAC_CENT has also higher effect on INT&SUCC. INT&SUCC has a medium effect on SCI_ACHV. Effect of INT&SUC lowers with the grade level (? = 0.39, 0.33 and 0.26 on SCI_ACHV for the grade level 6, 7, and 8, respectively). .

At the end of this section are regression equations for the model proposed of the grade level 8, Y_{SCI_ACHV} and $Y_{INT\&SUCC}$, with standardized total effects as coefficients.

$$Y_{INT\&SUCC} = -0.04X_{SES} + 0.05X_{STUD\_CEN} - 0.05X_{EXPRMT} + 0.40X_{TUTOR} + 0.20X_{TEAC\_CEN}$$
$$(R^2 = 0.22)$$
$$Y_{SCI\_ACHV} = 0.31X_{SES} - 0.05X_{STUD\_CEN} - 0.02X_{EXPRMT} + 0.36X_{TUTOR} + 0.13X_{TEAC\_CEN}$$
$$(R^2 = 0.45)$$

R^2 values for the SCI_ACHV (0.45) and INT&SUCC (0.22) indicate large effect sizes, respectively.

4.2.4 Science Achievement Model for State School Type

In this and next two sections, results of science achievement model proposed in Chapter 1 will be given according to the school types, state, boarding and private. In these three models, grade level discrimination was lost. While testing the proposed model according to the school types, many non-significant relationships were found. Effect of socioeconomic status on other variables was considered as the reason of these non-significant values. In order to solve this problem, effect of the exogenous latent variable SES was forced to be zero by adding 0* in front of the lines that define the relationships among the latent variables. This means that researcher tested the hypothesis that exogenous latent variable SES had no effect on SCI_ACHV. Obtaining a good fit for the model indicates that the hypothesis was rejected. As a result, better models were obtained when effect of SES was defined to be zero.

This section covers the model for state school type. Like previous models, PRELIS command language syntax was used and syntax was given in appendices section of the study. Five covariance terms were added to the model based on the modification indices suggested by LISREL. Path diagrams obtained in terms of

standardized coefficients and t-values were given as structural models in Figure 4.7 & Figure 4.8, respectively. Basic model for state school type can be found in the appendices.

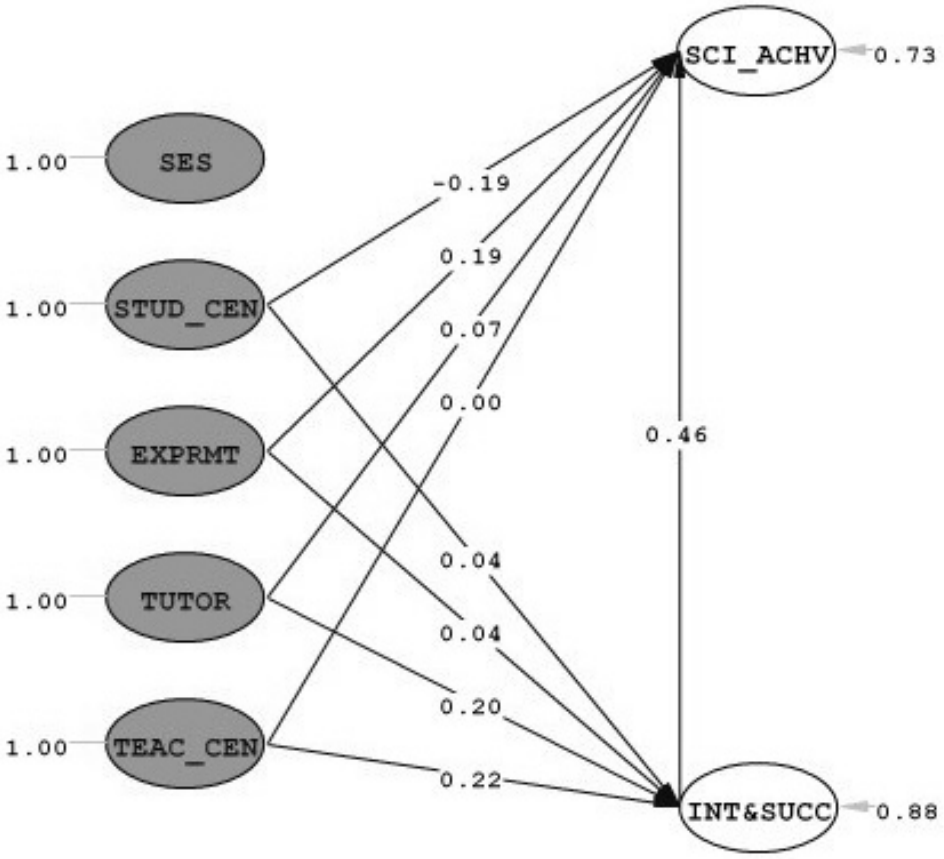


Figure 4.7 Structural Model for Science Achievement for State School Type (Standardized Coefficients)

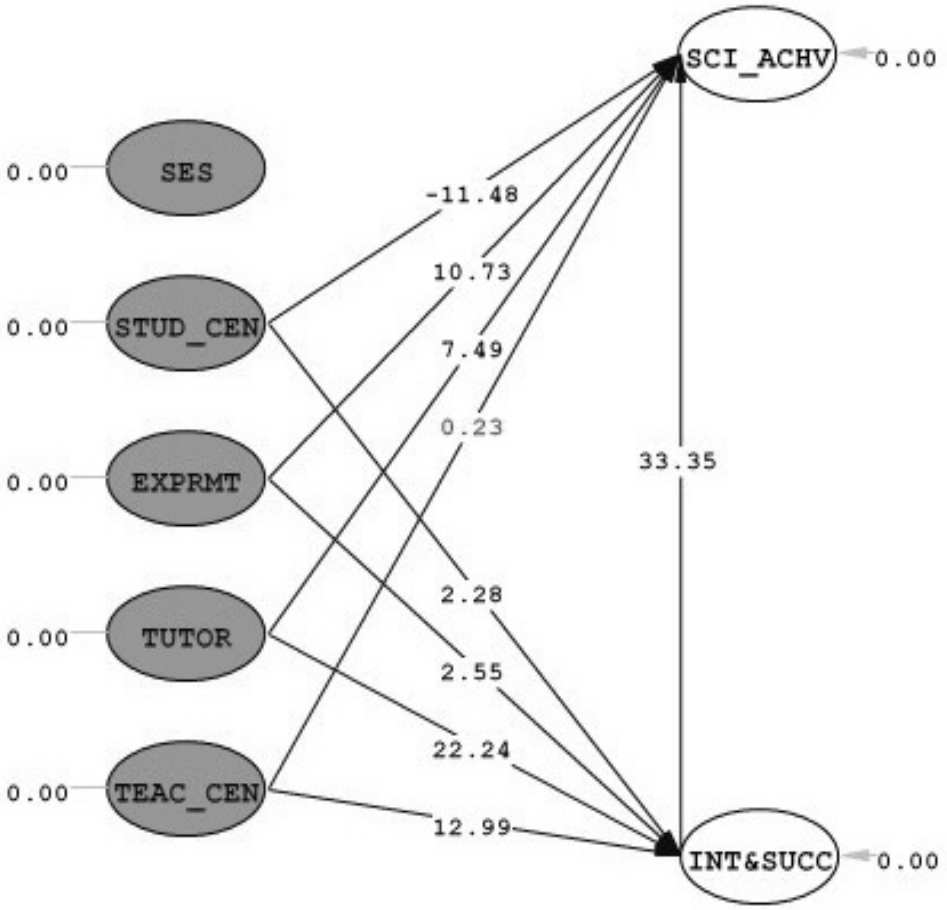


Figure 4.8 Structural Model for Science Achievement for State School Type (t values)

Fit indices for the model proposed indicate a good fit of the model to the data set. Table 4.32 shows the fit indices for the model generated by LISREL. All the fit indices indicate the proposed model fit to data set very well. Since chi-square is very sensitive to the sample size, the fact that chi-square is significant for the model was not considered a fit index for the model.

Table 4.32 Fit Indices for the Model Tested in State School Type

Fit Index	Criteria	Value
Chi-Square	Non-significant	7856.93 (p = 0.00)
Goodness of Fit Index (GFI)	> 0.9	0.97
Adjusted Goodness of Fit Index (AGFI)	> 0.9	0.96
Root Mean Square Error of Approximation (RMSEA)	<0.05	0.041
Standardized Root Mean Square Residual (S-RMR)	<0.05	0.037

The standardized $?_x$ and $?_y$ coefficients for observed variables are given Table 4.33 in standardized coefficients. As stated before, there is no non-significant value for $?_x$ and $?_y$ for the model.

Table 4.33 $?_x$ and $?_y$ Path Coefficients

Latent Variable	Observed Variable	? parameter
SES	Mother_e	0.82 ($?_x$)
	Father_e	0.74 ($?_x$)
	Siblings	-0.57 ($?_x$)
	Books	0.60 ($?_x$)
STUD_CENT	Stud_les	0.27 ($?_x$)
	Stud_dis	0.61 ($?_x$)
	Tea_dis	0.69 ($?_x$)
TEAC_CENT	Tea_less	0.38 ($?_x$)
	Examples	0.69 ($?_x$)
TUTOR	Tut_scie	0.96 ($?_x$)

Table 4.33 (cont.)

	Tut_math	0.94 ($?_x$)
	Tut_turk	0.92 ($?_x$)
INT&SUCC	Int_math	0.64 ($?_y$)
	Int_scie	0.53 ($?_y$)
	Suc_math	0.66 ($?_y$)
	Suc_scie	0.61 ($?_y$)
EXPRMT	Techno	0.56 ($?_x$)
	Teac_expe	0.38 ($?_x$)
	Stu_expe	0.44 ($?_x$)
SCI_ACHV	NF4	0.46 ($?_y$)
	NF10	0.60 ($?_y$)
	NF14	0.44 ($?_y$)
	NF16	0.41 ($?_y$)
	NF17	0.48 ($?_y$)

Table 4.34 and 4.35 present standardized ? and ß coefficients, respectively, estimates (direct effects) generated by LISREL software for exogenous and endogenous variables. These coefficients can be used to indicate the strength and direction of the effect between exogenous and endogenous latent variables (?) and between endogenous latent variables (ß). There is one ? values which has non-significant value, path from TEAC_CEN to SCI_ACHV. But as will be explained later, the non-significant value is the direct of TEAC_CENT on SCI_ACHV. When indirect effect of TEAC_CENT was added, total effect of it was obtained to be significant. Non-significant values are remarked by a star (*) in the following table.

Table 4.34 ? Path Coefficients

Exogenous Latent Variable	**? Parameter**	**Endogenous Latent Variable**
SES	-	SCI_ACHV
STUD_CENT	-0.19	

Table 4.34 (cont.)

TEAC_CENT	0.00*	
TUTOR	0.07	
EXPRMT	0.19	
SES	-	
STUD_CENT	0.04	
TEAC_CENT	0.22	INT&SUCC
TUTOR	0.20	
EXPRMT	0.04	

Table 4.35 ß Path Coefficients

Endogenous Latent Variable	**ß Parameter**	**Endogenous Latent Variable**
SCI_ACHV	0.46	INT&SUCC

Estimates for R^2, squared multiple correlation coefficients which was calculated for each variable in the model were given in Table 4.36. These estimates considered as approximate measures of effect sizes. The value R^2 indicates the proportion unique variance and can be used find out how good the observed variables are indicators of latent variables.

Table 4.36 R^2 Values for Observed Variables

Observed Variable	**R^2**	**Observed Variable**	**R^2**
Mother_e	0.68	Int_math	0.40
Father_e	0.54	Int_scie	0.28
Siblings	0.32	Suc_math	0.44
Books	0.36	Suc_scie	0.38

Table 4.36 (cont.)

Stud_les	0.07	Techno	0.32
Stud_dis	0.37	Teac_expe	0.14
Tea_dis	0.47	Stu_expe	0.19
Tea_less	0.14	NF4	0.21
Examples	0.48	NF10	0.36
Tut_scie	0.92	NF14	0.19
Tut_math	0.88	NF16	0.17
Tut_turk	0.84	NF17	0.23

R^2 values for endogenous latent variables were SCI_ACHV and INT&SUCC were given in Table 4.37 below. As stated before, these values can be used for effect size measures. According to Cohen (1988), effect sizes measured in terms of R^2 can be classified as follows: up to 0.01 is small, around 0.09 is medium, and 0.25 or up is large effect size. R^2 values for SCI_ACHV and INT&SUCC are 0.27 and 0.12, respectively. This values are some bit lower than previous values for R^2.

Table 4.37 R^2 Values for Latent Variables

Latent Variables	**R^2**
SCI_ACHV	0.27
INT&SUCC	0.12

Indirect and total effects for the latent variables which were generated by LISREL were given the following two tables, Table 4.37 and 4.38. Those tables show indirect and total effects of the exogenous latent variables (STUD_CEN, EXPRMT, TUTOR and TEAC_CEN) on the endogenous latent variables (SCI_ACHV and INT&SUCC). Like the grade level model, in the model covering school types there is no indirect effect for INT&SUCC since this relationship was not established. And also there is no indirect effect between SCI_ACHV and INT&SUCC since there are just two endogenous latent variables, which total effect of INT&SUCC on SCI_ACHV is 0.46.

In this model, there is no negative indirect effect for exogenous latent variables. The all exogenous latent variables have all positive indirect effects on each other. No non-significant effect was found for either indirect or total. In the Table 4.33, direct effect of TEAC_CENT (?) was stated as negative. But as can be seen from the following two tables, Table 4.38 and 4.39, its indirect effect and total effect were found to be significant.

Table 4.38 Indirect Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	-	-	-	-
SCI_ACHV	-	0.02	0.02	0.09	0.10

Table 4.39 Total Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	0.04	0.04	0.20	0.22
SCI_ACHV	-	-0.17	0.21	0.16	0.10

Lastly, fit indices generated by LISREL indicated a good fit of the model to the data set for the state school type. Loadings have no non-significant relationship estimated at the significance level 0.05. Like the previous the model, while three observed variables, Mother_e, Father_e and Books have positive loadings ($?_x$ = 0.82, 0.74 and 0.60), observed variable Siblings has a negative loading with SES ($?_x$ = -0.57). Latent variable STUD_CENT has three significant and positive loadings ($?_x$ = 0.27, 0.61 and 0.69). Two observed variables of TEAC_CEN, Tea_less and Examples, have positive loadings ($?_x$ = 0.38 and 0.69). TUTOR has three observed variable, Tut_scie, Tut_math and Tut_turk with high loadings ($?_x$ = 0.96, 0.94 and 0.92). EXPRMT has three significant and positive loadings ($?_x$ = 0.56, 0.38 and 0.44) for the observed

variables Techno, Teac_expe and Stu_expe, respectively. Of four loadings, Int_math, Int_scie, Suc_math and Suc_scie of INT&SUCC, have all significant and positive values ($?_y$ = 0.64, 0.53, 0.66 and 0.61). Lastly, for SCI_ACHV, items NF4, NF10 NF14, NF16, and NF17, have the loadings with significant values ($?_y$ = 0.46, 0.60, 0.44, 0.41, and 0.48).

Since at the beginning of the model section, effects of SES were forced to be zero, and no effect exits for either SCI_ACHV or INT&SUCC. Latent variable STUD_CEN has a direct effect on SCI_ACHV, which is negative (? = -0.19), and as a result of an indirect effect of 0.02, its total effect is -0.17. STUD_CEN has only direct and total effect on INT&SUCC, which is 0.04. Exogenous latent variable TEAC_CEN has a zero and non-significant direct effect (? = 0.00) on SCI_ACHV, its indirect effect is significant with a value of 0.10, and therefore total effect of TEAC_CEN on SCI_ACHV is 0.10, which is significant. TEAC_CEN has also a positive direct, also total, effect on INT&SUCC (? = 0.22). Direct effect of TUTOR on SCI_ACHV is positive (? = 0.07), its indirect effect is 0.09. Therefore its total effect on SCI_ACHV is 016. TUTOR has also a positive direct effect on INT&SUCC (? = 0.20). Exogenous latent variable EXPRMT have a negative and significant direct effect on SCI_ACHV (? = 0.19), and its total effect is 0.21 with an indirect effect of 0.02. Total effect of EXPRMT on INT&SUCC is also positive and significant (? = 0.04). Endogenous variable INT&SUCC have a positive direct effect on SCI_ACHV (ß = 0.46), this is also its total effect since there is no indirect effect of it.

The most important remark on the findings about this model is path from TEAC_CEN to SCI_ACHV is non-significant, but its total effect that is the sum of direct and indirect effect is 0.10, which is positive and significant. This means that TEAC_CENT affects SCI_ACHV via INT&SUCC. Also the strongest effect on INT&SUCC is TEAC_CEN, which is a medium effect. STUD_CENT has a negative and medium effect on SCI_ACHV. Lastly, EXPRMT and TUTOR have medium effects on SCI_ACHV.

Regression equations, Y_{SCI_ACHV} and $Y_{INT\&SUCC}$, for the model proposed of the state school type finalize this section. Equations are expressed in terms of standardized total effects as coefficients.

$$Y_{INT\&SUCC} = 0.04X_{STUD\_CEN} + 0.04X_{EXPRMT} + 0.20X_{TUTOR} + 0.22X_{TEAC\_CEN}$$
$$(R^2 = 0.12)$$
$$Y_{SCI\_ACHV} = -0.17X_{STUD\_CEN} + 0.21X_{EXPRMT} + 0.16X_{TUTOR} + 0.10X_{TEAC\_CEN}$$
$$(R^2 = 0.27)$$

R^2 values for the SCI_ACHV (0.27) and INT&SUCC (0.12) indicate large and medium effect sizes, respectively.

4.2.5 Science Achievement Model for Boarding School Type

Results of the model testing for boarding school type (YIBO) were given in this section. As previous model, effect of exogenous latent variable SES was forced to be zero, testing the hypothesis that exogenous latent variable SES has no effect on SCI_ACHV. Since boarding school students stay at school nearly in all the academic period, investigating the frequency of receiving private tutoring for boarding schools is not meaningful. For this reason, latent variable TUTOR was excluded from the proposed model for boarding school type. Fit indices for the model indicated that the hypothesis was rejected. Again PRELIS command language syntax and basic model generated by LISREL were given in the section Appendices. Number of error covariances added to the model is five for boarding school type. The following two figures, Table 4.9 and 4.10, present structural diagrams obtained in terms of standardized coefficients and t-values.

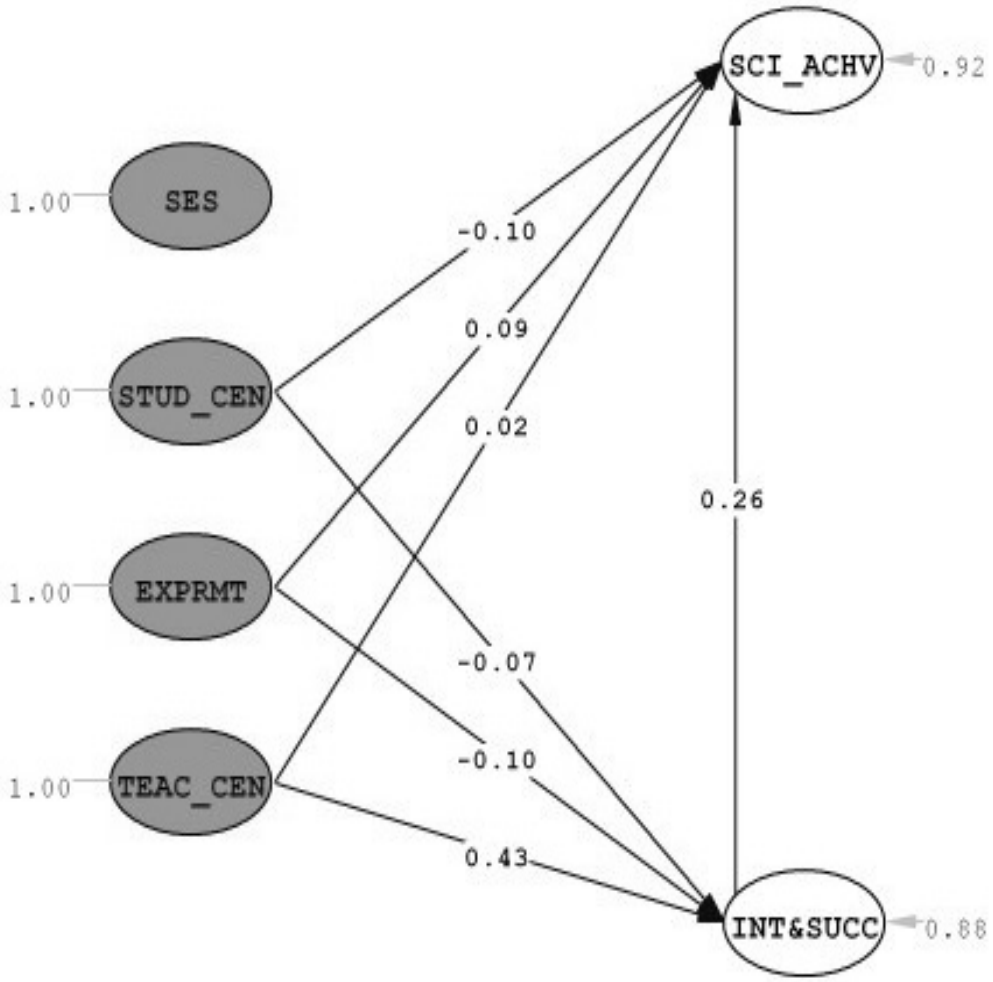


Figure 4.9 Structural Model for Science Achievement for Boarding School Type (Standardized Coefficients)

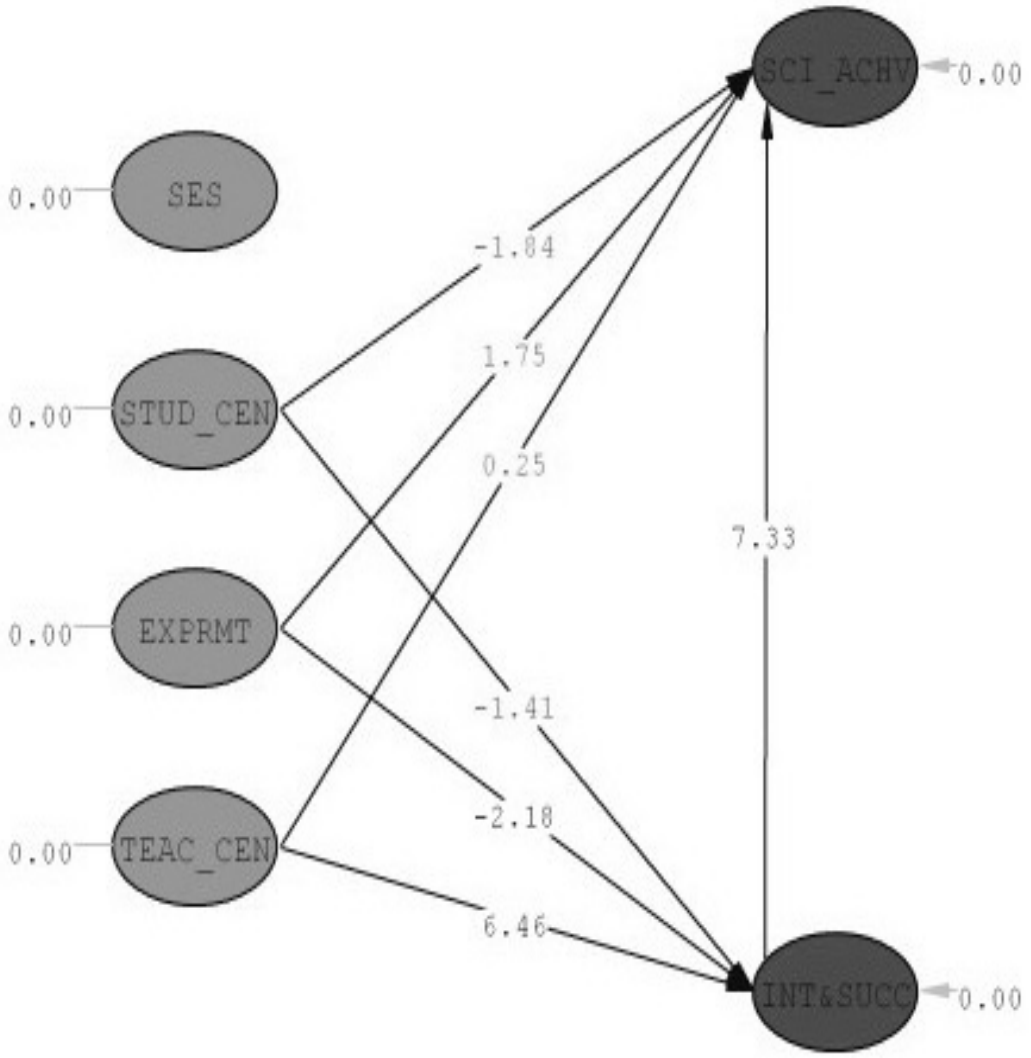


Figure 4.10 Structural Model for Science Achievement for Boarding School Type (t values)

Even tough they are good as for the previous models, fit indices indicates a good fit of the model to the data set. Fit indices for the model generated by LISREL were

given in Table 4.40. All the fit indices indicate the proposed model fit to data set. Since chi-square is very sensitive to the sample size, the fact that chi-square is significant for the model was not considered a fit index for the model.

Table 4.40 Fit Indices for the Model Tested in Boarding School Type

Fit Index	**Criteria**	**Value**
Chi-Square	Non-significant	1001.86 (p = 0.00)
Goodness of Fit Index (GFI)	> 0.9	0.96
Adjusted Goodness of Fit Index (AGFI)	> 0.9	0.95
Root Mean Square Error of Approximation (RMSEA)	<0.05	0.043
Standardized Root Mean Square Residual (S-RMR)	<0.05	0.043

The standardized $?_x$ and $?_y$ coefficients for observed variables are given in Table 4.41. As stated before, there is no non-significant value for $?_x$ and $?_y$ for the model.

Table 4.41 $?_x$ and $?_y$ Path Coefficients

Latent Variable	**Observed Variable**	**? parameter**
SES	Mother_e	0.76 ($?_x$)
	Father_e	0.68 ($?_x$)
	Siblings	-0.48 ($?_x$)
	Books	0.31 ($?_x$)
STUD_CENT	Stud_les	0.38 ($?_x$)
	Stud_dis	0.62 ($?_x$)
	Tea_dis	0.70 ($?_x$)
TEAC_CENT	Tea_less	0.47 ($?_x$)
	Examples	0.66 ($?_x$)

Table 4.41 (cont.)

INT&SUCC	Int_math	0.70 ($?_y$)
	Int_scie	0.68 ($?_y$)
	Suc_math	0.77 ($?_y$)
	Suc_scie	0.63 ($?_y$)
EXPRMT	Techno	0.60 ($?_x$)
	Teac_expe	0.40 ($?_x$)
	Stu_expe	0.46 ($?_x$)
SCI_ACHV	NF3	0.23 ($?_y$)
	NF5	0.68 ($?_y$)
	NF6	0.45 ($?_y$)
	NF8	0.25 ($?_y$)
	NF19	0.37 ($?_y$)

? and ß coefficients in standardized coefficients, generated by LISREL software, were presented in Table 4.41 and 4.42, respectively, for exogenous and endogenous variables. These coefficients can be used to indicate the strength and direction of the effect between exogenous and endogenous latent variables (?) and between endogenous latent variables (ß). There are three ? values which have non-significant values, path from STUD_CENT to SCI_ACHV, TEACH_CENT to SCI_ACHV, and STUD_CENT to INT&SUCC. When indirect effect of TEAC_CENT was added, total effect of it was obtained to be significant. Non-significant values are remarked by a star (*) in the following tables, Table 4.42 and 4.43. Coefficients in the table are in standardized values and indicate direct effects.

Table 4.42 ? Path Coefficients

Exogenous Latent Variable	? Parameter	Endogenous Latent Variable
SES	-	SCI_ACHV
STUD_CENT	-0.11*	
TEAC_CENT	0.01*	
EXPRMT	0.10	
SES	-	INT&SUCC
STUD_CENT	-0.07*	
TEAC_CENT	0.43	
EXPRMT	-0.11	

Table 4.43 ß Path Coefficients

Endogenous Latent Variable	ß Parameter	Endogenous Latent Variable
SCI_ACHV	0.27	INT&SUCC

Squared multiple correlation coefficients, R^2 estimates, were given in Table 4.44. These estimates are approximately equal to the measures of effect sizes. The proportion of unique variance can be used find out how good the observed variables are indicators of latent variables.

Table 4.44 R^2 Values for Observed Variables

Observed Variable	R^2	Observed Variable	R^2
Mother_e	0.58	Suc_math	0.59
Father_e	0.47	Suc_scie	0.39
Siblings	0.23	Techno	0.36
Books	0.10	Teac_expe	0.16
Stud_les	0.14	Stu_expe	0.21
Stud_dis	0.38	NF3	0.05
Tea_dis	0.49	NF5	0.47
Tea_less	0.23	NF6	0.20
Examples	0.44	NF8	0.06
Int_math	0.49	NF19	0.13
Int_scie	0.56		

R^2 values for SCI_ACHV and INT&SUCC were given below, Table 4.45. As stated before, these values can be used for effect size measures. According to Cohen (1988), effect sizes measured in terms of R^2 can be classified as follows: up to 0.01 is small, around 0.09 is medium, and 0.25 or up is large effect size. R^2 values for SCI_ACHV and INT&SUCC are 0.12 and 0.08, which indicates medium effects.

Table 4.45 R^2 Values for Latent Variables

Latent Variables	R^2
SCI_ACHV	0.12
INT&SUCC	0.08

Indirect and total effects of the exogenous latent variables (STUD_CEN, EXPRMT and TEAC_CEN) on the endogenous latent variables (SCI_ACHV and INT&SUCC) were also generated by LISREL on researcher's demand. Indirect and total effects for the latent variables, generated by LISREL software, were given the following two tables, Table 4.45 and 4.46. As before, there is no indirect effect for INT&SUCC

since this relationship was not established. And also there is no indirect effect between SCI_ACHV and INT&SUCC since there are just two endogenous latent variables, which total effect of INT&SUCC on SCI_ACHV is 0.27. There are two negative indirect effects for exogenous latent variables, STUD_CEN and EXPRMT, which have indirect effects of -0.02 and -0.03 on SCI_ACHV. In total effects, STUD_CEN has negative effects on SCI_ACHV.

In this model, there is one non-significant indirect effects, STUD_CEN (-0.02). Also there are non-significant total effects; TEAC_CEN and EXPRMT on SCI_ACHV (0.13 and 0.07, respectively), and STUD_CEN on INT&SUCC (-0.07). In the Table 4.41, direct effect of TEAC_CENT (?) was stated as non-significant. Non-significant values for the indirect effects were remarked by a star (*) in the following table.

Table 4.46 Indirect Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TEAC_CEN**
INT&SUCC	-	-	-	-
SCI_ACHV		-0.02*	-0.03	0.12

Table 4.47 Total Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TEAC_CEN**
INT&SUCC	-	-0.07*	-0.11	0.43
SCI_ACHV	-	-0.13	0.07*	0.13*

To sum up, fit of the model was examined by the fit indices generated by LISREL. Fit indices indicated a good fit of the model to the data set for the boarding school type (YIBO). No non-significant relationship estimated at the significance level 0.05 was found for the loadings. Observed variable Siblings has still a negative loading with SES ($?_x$ = -0.48). Other three observed variables, Mother_e, Father_e and Books

have positive loadings ($?_x$ = 0.76, 0.68 and 0.31). Latent variable STUD_CENT has three significant and positive loadings ($?_x$ = 0.38, 0.62 and 0.70). Tea_less and Examples, have loadings on TEAC_CENT ($?_x$ = 0.47 and 0.66). EXPRMT has three significant and positive loadings ($?_x$ = 0.60, 0.40 and 0.46) for the observed variables Techno, Teac_expe and Stu_expe, respectively. Of four loadings, Int_math, Int_scie, Suc_math and Suc_scie of INT&SUCC, are all significant and positive with the values $?_y$ = 0.70, 0.68, 0.77 and 0.63. At last, items for SCI_ACHV, NF3, NF5, NF6, NF8, and NF19, have positive loadings ($?_y$ = 0.24, 0.68, 0.45, 0.25, and 0.37).

As stated at the beginning of the model section, effects of SES were forced to be zero, so no effect exits for either SCI_ACHV or INT&SUCC. Similarly, latent variable TUTOR was excluded from the analysis for boarding school type. Latent variable STUD_CEN has negative and non-significant direct effects on both SCI_ACHV and INT&SUCC (? = -0.11 and -0.07, respectively). With an indirect effect of -0.02, its total effect is -0.13, which is significant on SCI_ACHV. Direct and total effect of STUD_CENT on INT&SUCC is -0.07, which is non-significant. TEAC_CEN has a non-significant direct effect (? = 0.01) on SCI_ACHV, its indirect effect is 0.12, which is significant, and therefore total effect of TEAC_CEN on SCI_ACHV is significant with value of 0.13. TEAC_CEN has also a positive and significant direct, also total, effect on INT&SUCC (? = 0.43). Exogenous latent variable EXPRMT has non-significant and positive direct effect on SCI_ACHV (? = 0.10), and its total effect is significant with a value of 0.07 with an indirect effect of -0.03, which is also significant. Total effect of EXPRMT on INT&SUCC is negative and significant (? = -0.11). Endogenous variable INT&SUCC have a positive and significant direct, also total, effect on SCI_ACHV (ß = 0.27).

The model proposed for this study produced many non-significant coefficients for the boarding school type. Non-significant effect of STUD_CEN on INT&SUCC is an important finding for the school type tested. TEAC_CEN has non-significant effect of SCI_ACHV. Once again, TEAC_CENT has a high effect on &SUCC in total effects, respectively. Also explained variance for the SCI_ACHV and INT&SUCC are lower than those for previous models.

Y_{SCI_ACHV} and $Y_{INT\&SUCC}$ are the regression equations, for the model proposed of the state school type. Equations are expressed in terms of standardized total effects as coefficients.

$$Y_{INT\&SUCC} = -0.07X_{STUD\_CEN} - 0.11X_{EXPRMT} + 0.43X_{TEAC\_CEN}$$
$$(R^2 = 0.10)$$
$$Y_{SCI\_ACHV} = -0.13X_{STUD\_CEN} + 0.07X_{EXPRMT} - 0.13X_{TUTOR} + 0.13X_{TEAC\_CEN}$$
$$(R^2 = 0.14)$$

R^2 values for the SCI_ACHV (0.12) and INT&SUCC (0.08) indicate both medium effect sizes.

4.2.6 Science Achievement Model for Private School Type

Last section of this chapter was devoted to the results of the model testing to private school type. Again, effect of exogenous latent variable SES was forced to be zero, testing the hypothesis that exogenous latent variable SES has no effect on SCI_ACHV. Fit indices for the model indicated that the hypothesis was rejected. Seven error covariance terms were added to the model based on the modification indices suggested by LISREL software. Seven error covariances were added for improving the fit of the model.

In this model, standardized direct effect values (?) for TEAC_CEN on SCI_ACHV and INT&SUCC were found to be greater than 1. These values were significant at the 0.05 significance level and indicates the change in the exogenous in standard deviations when the standard deviation of endogenous variables are set to 1. Also there was no Heywood Case (situation in which error variance is negative). Therefore these values were not regarded as wrong estimations and researcher was not excluded these values from the analysis. Also literature supports the researcher in this issue (Joreskog 1997; Kline, 1998).

The following two figures, Table 4.11 and 4.12, present structural diagrams obtained in terms of standardized coefficients and t-values

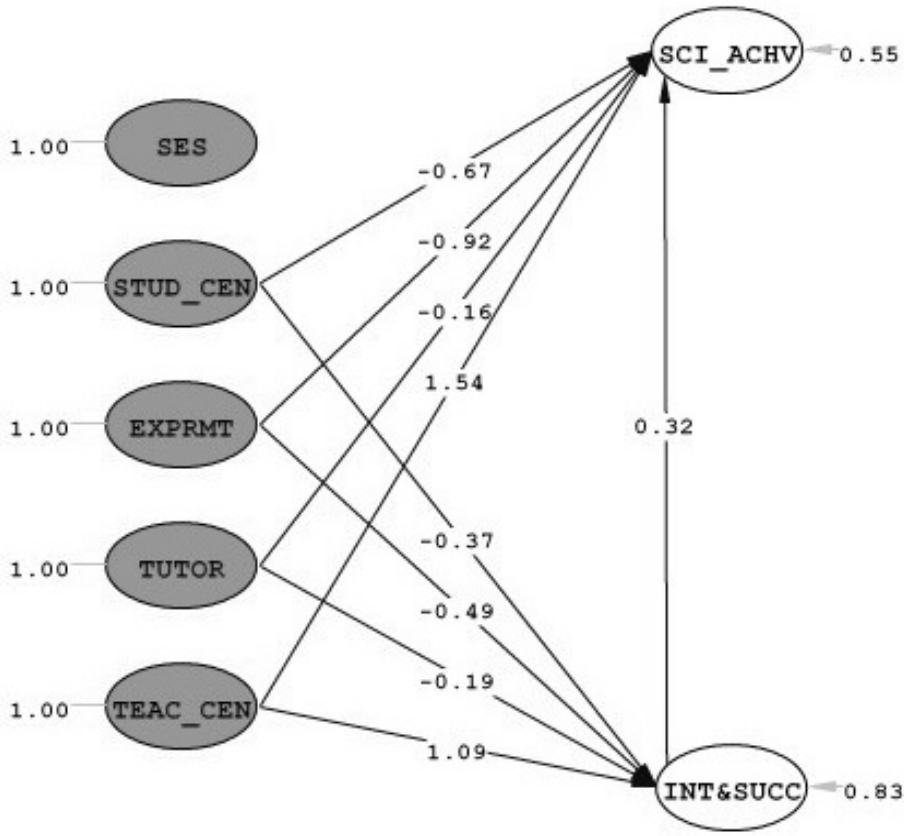


Figure 4.11 Structural Model for Science Achievement for Private School Type (Standardized Coefficients)

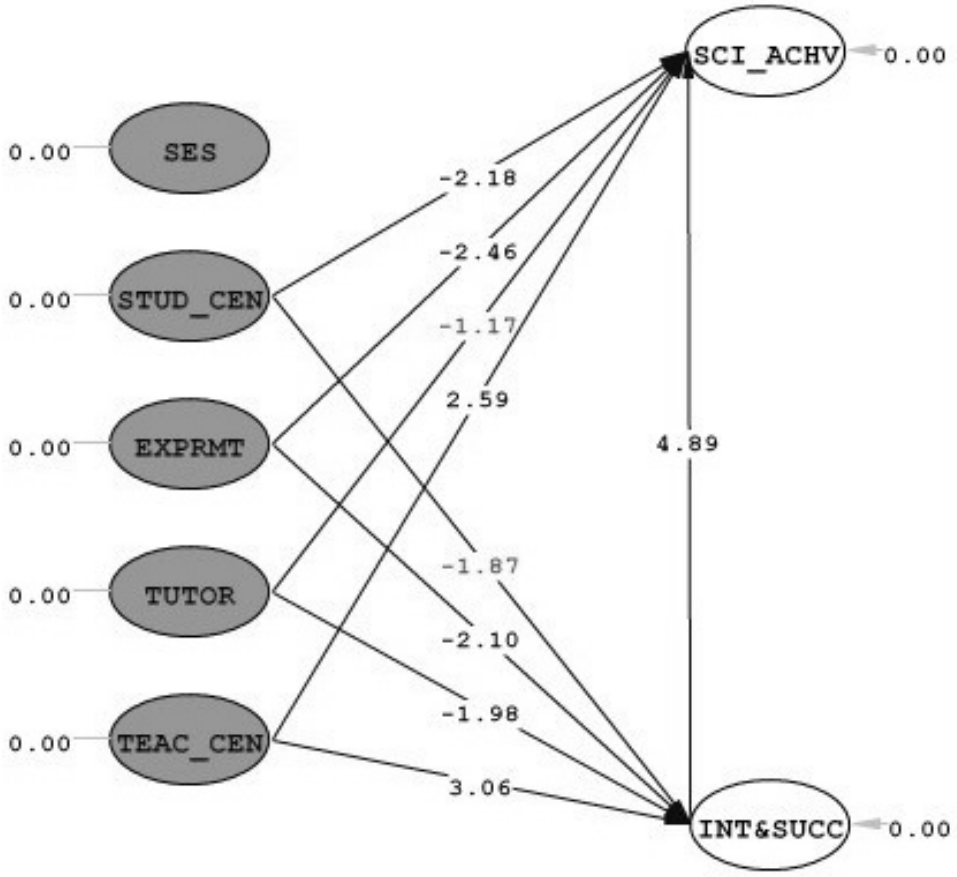


Figure 4.12 Structural Model for Science Achievement for Private School Type (t values)

Fit indices for this model testing are not so good that they meet the goodness of fit criteria hardly. RMSEA values was found to be 0.054, when it was expected to be lower than 0.05. Also S-RMR value was found to be at the bound of the criterion. Table 4.48 presents fit indices for the model generated by LISREL. All the fit indices indicate the proposed model fit to data set. Chi-square is still significant and was not considered a fit index for the model.

Table 4.48 Fit Indices for the Model Tested in Private School Type

Fit Index	Criteria	Value
Chi-Square	Non-significant	1982.24 (p = 0.00)
Goodness of Fit Index (GFI)	> 0.9	0.93
Adjusted Goodness of Fit Index (AGFI)	> 0.9	0.91
Root Mean Square Error of Approximation (RMSEA)	<0.05	0.054
Standardized Root Mean Square Residual (S-RMR)	<0.05	0.050

Table 4.49 shows the standardized $?_x$ and $?_y$ coefficients for observed variables. There is no non-significant value for $?_x$ and $?_y$ for the model.

Table 4.49 $?_x$ and $?_y$ Path Coefficients

Latent Variable	Observed Variable	? parameter
SES	Mother_e	0.81 ($?_x$)
	Father_e	0.81 ($?_x$)
	Siblings	-0.31 ($?_x$)
	Books	0.49 ($?_x$)
STUD_CENT	Stud_les	0.24 ($?_x$)
	Stud_dis	0.57 ($?_x$)
	Tea_dis	0.78 ($?_x$)
TEAC_CENT	Tea_less	0.26 ($?_x$)
	Examples	0.39 ($?_x$)
TUTOR	Tut_scie	0.97 ($?_x$)
	Tut_math	0.95 ($?_x$)
	Tut_turk	0.93 ($?_x$)
INT&SUCC	Int_math	0.62 ($?_y$)

Table 4.49 (cont.)

	Int_scie	0.63 ($?_y$)
	Suc_math	0.68 ($?_y$)
	Suc_scie	0.76 ($?_y$)
EXPRMT	Techno	0.65 ($?_x$)
	Teac_expe	0.23 ($?_x$)
	Stu_expe	0.47 ($?_x$)
SCI_ACHV	NF3	0.49 ($?_y$)
	NF4	0.51 ($?_y$)
	NF5	0.39 ($?_y$)
	NF10	0.38 ($?_y$)
	NF13	0.54 ($?_y$)
	NF14	0.52 ($?_y$)
	NF16	0.59 ($?_y$)
	NF19	0.30 ($?_y$)

? and ß coefficients which indicate direct effects in standardized coefficients, generated by LISREL software, were presented in Table 4.50 and 4.51, respectively, for exogenous and endogenous variables. These coefficients can be used to indicate the strength and direction of the effect between exogenous and endogenous latent variables (?) and between endogenous latent variables (ß). There are two ? values which have non-significant values, path from TUTOR to SCI_ACHV and STUD_CENT to INT&SUCC. Total effect of TUTORING was not found to be significant, while that of STUD_CEN activities was significant. Non-significant values were remarked by a star (*) in the following table.

As stated below, ? values greater than 1 (TEAC_CENT to SCI_ACHV and TEAC_CENT to INT&SUCC) were not regarded as wrong and they kept in the analysis. ? values greater than 1 were remarked by cross (†) in table below. Items with non-signifincant values are those

Table 4.50 ? Path Coefficients

Exogenous Latent Variable	? Parameter	Endogenous Latent Variable
SES	-	SCI_ACHV
STUD_CENT	-0.67	
TEAC_CENT	1.54†	
TUTOR	-0.16*	
EXPRMT	-0.92	
SES	-	INT&SUCC
STUD_CENT	0.37*	
TEAC_CENT	1.09†	
TUTOR	-0.19	
EXPRMT	0.49	

Table 4.51 ß Path Coefficients

Endogenous Latent Variable	ß Parameter	Endogenous Latent Variable
SCI_ACHV	0.32	INT&SUCC

Squared multiple correlation coefficients, R^2 estimates, were given in Table 4.52. These estimates are approximately equal to the measures of effect sizes. The value R^2 indicates the proportion of explained variance of the variable (unique variance) and shows that how good the observed variables are indicators of latent variables.

Table 4.52 R^2 Values for Observed Variables

Observed Variable	R^2	Observed Variable	R^2
Mother_e	0.66	Suc_math	0.46
Father_e	0.66	Suc_scie	0.58
Siblings	0.09	Techno	0.43
Books	0.24	Teac_expe	0.05
Stud_les	0.06	Stu_expe	0.22
Stud_dis	0.32	NF3	0.24
Tea_dis	0.61	NF4	0.26
Tea_less	0.07	NF5	0.15
Examples	0.15	NF10	0.15
Tut_scie	0.95	NF13	0.30
Tut_math	0.90	NF14	0.27
Tut_turk	0.86	NF16	0.35
Int_math	0.38	NF19	0.09
Int_scie	0.39		

Table 4.53 presents R^2 values for SCI_ACHV and INT&SUCC. As stated before, these values can be used for effect size measures. According to Cohen (1988), effect sizes measured in terms of R^2 can be classified as follows: up to 0.01 is small, around 0.09 is medium, and 0.25 or up is large effect size. R^2 values for SCI_ACHV and INT&SUCC are 0.45 (large) and 0.17 (medium), respectively.

Table 4.53 R^2 Values for Latent Variables

Latent Variables	R^2
SCI_ACHV	0.45
INT&SUCC	0.17

LISREL generated indirect and total effects of the exogenous latent variables (SES, STUD_CEN, EXPRMT, TUTOR and TEAC_CEN) on the endogenous latent

variables (SCI_ACHV and INT&SUCC) on researcher's demand. Table 4.53 and 4.54 show indirect and total effects for the latent variables, as generated by LISREL software. As before, there is no indirect effect for INT&SUCC since this relationship was not established. And also there is no indirect effect between SCI_ACHV and INT&SUCC since there are just two endogenous latent variables, which total effect of INT&SUCC on SCI_ACHV is 0.32.

There are three negative indirect effects for exogenous latent variables, STUD_CENT, EXPRMT, and TUTOR. Other exogenous latent variables have all positive and small indirect effects, except. There is no non-significant value for the indirect effects. But total effects of STUD_CEN on INT&SUCC and TUTOR on SCI_ACHV were found to be non-significant. Non-significant values for the indirect effects were remarked by a star (*) in the following table. Again here there are two standardized total effects, which have standardized values greater than 1. As before, these values were kept in the analysis.

Table 4.54 Indirect Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	-	-	-	-
SCI_ACHV	-	-0.12	-0.16	-0.06	0.34

Table 4.55 Total Effects of Exogenous on Endogenous Latent Variables

	SES	**STUD_CEN**	**EXPRMT**	**TUTOR**	**TEAC_CEN**
INT&SUCC	-	-0.37*	-0.49	-0.19	1.09*
SCI_ACHV	-	-0.78	-1.08*	-0.22*	1.88*

As the last model testing section, fit of the model was examined by the fit indices generated by LISREL. Fit indices were not as good as the previous models. RMSEA and S-RMR fit indices were worse than expected. Nevertheless, they indicated a fit of the

model to the data set for the state school type, to some extent. Loadings have no non-significant relationship estimated at the significance level 0.05. Three observed variables, Mother_e, Father_e and Books have positive loadings ($?_x$ = 0.81, 0.81 and 0.49), observed variable Siblings has still a negative loading with SES ($?_x$ = -0.31). Latent variable STUD_CENT have three significant and positive loadings ($?_x$ = 0.24, 0.57 and 0.78). Loadings of TEAC_CEN, Tea_less and Examples, have significant values ($?_x$ = 0.26 and 0.39). Tut_scie, Tut_math and Tut_turk of TUTOR have high loadings on TUTOR, ($?_x$ = 0.97, 0.95 and 0.93). EXPRMT has three significant and positive loadings ($?_x$ = 0.65, 0.23 and 0.47) for the observed variables Techno, Teac_expe and Stu_expe, respectively. Int_math, Int_scie, Suc_math and Suc_scie of INT&SUCC of the latent variable INT&SUCC, are all significant and positive ($?_y$ = 0.62, 0.63, 0.68 and 0.76). Items for SCI_ACHV, NF3, NF4, NF5, NF10, NF13, NF14, NF16 and NF19, have the significant loadings ($?_y$ = 0.49, 0.51, 0.39, 0.38, 0.54, 0.52, 0.59, and 0.30).

Effects of SES were again forced to be zero, therefore o effect exits for either SCI_ACHV or INT&SUCC. Latent variable STUD_CEN has a negative and non-significant direct effect on SCI_ACHV (? = -0.67). With a significant indirect effect of -0.12, its total effect is 0.-78, which is also significant. STUD_CENT has a non-significant effect on INT&SUCC (? = -0.37). TEAC_CEN has a positive and non-significant direct effect (? = 1.54) on SCI_ACHV, its indirect effect is 0.34 which is significant, and therefore total effect of TEAC_CEN on SCI_ACHV is also significant with value of 1.88 which is significant. TEAC_CEN has also a significant direct, also total, effect on INT&SUCC (? = 1.09). Direct effect of TUTOR on SCI_ACHV is non-significant, (? = -0.16), its indirect effect is -0.06, which is significant. Therefore its total effect on SCI_ACHV is -0.22, which is non-significant. TUTOR has a negative and significant direct effect on INT&SUCC (? = -0.19). Exogenous latent variable EXPRMT have significant and negative direct effect on SCI_ACHV (? = -0.92), and its total effect is non-significant with a value of -1.08 with an indirect effect of -0.16. Total effect of EXPRMT on INT&SUCC is negative and significant (? = -0.49). Endogenous variable

INT&SUCC have a positive and significant direct, also total, effect on SCI_ACHV (ß = 0.32).

Model for the private school type did yield many non-significant estimations, indicating that the model proposed did not fit the data set for private schools. Among the major findings of the model for private school types is again TEAC_CENT has strong effect both on SCI_ACHV and INT&SUCC. Also indirect effect of TEAC_CEN on INT&SUCC is large. STUD_CENT has again a negative effect on SCI_ACHV.

Regression equations, Y_{SCI_ACHV} and $Y_{INT\&SUCC}$, for the model proposed of the state school type were given below. Equations are expressed in terms of standardized total effects as coefficients.

$$Y_{INT\&SUCC} = -0.37X_{STUD\_CEN} - 0.49X_{EXPRMT} - 0.19X_{TUTOR} + 1.09X_{TEAC\_CEN}$$
$$(R^2 = 0.17)$$
$$Y_{SCI\_ACHV} = -0.78X_{STUD\_CEN} - 1.08X_{EXPRMT} - 0.22X_{TUTOR} + 1.88X_{TEAC\_CEN}$$
$$(R^2 = 0.45)$$

R^2 values for the SCI_ACHV (0.45) and INT&SUCC (0.17) indicate large and medium effect sizes, respectively.

4.3 Summary of Findings for Structural Equation Modeling

After results of model testing section, this section presents a summary for the results in a single table. This section provides important findings obtained from model testing phase of this study. Discussion and implications of these findings will be presented in the next chapter, Chapter 5: Discussion, Conclusion and Implications. Table 4.54 shows a summary for the three grade levels and three school types in standardized path coefficients, indicating whether non-significant relationships. For paths to SCI_ACHC, both direct and total effects were given in table 4.56, first raw indicating direct effects while second one total effects.

Table 4. 56 Standardized Path Coefficients

			Grade Levels			School Types		
			6th	7th	8th	State	Boarding	Private
SES	(to) SCI_ACHV	direct	0.34	0.45	0.32	-	-	-
		total	0.42	0.49	0.31	-	-	-
STUD_CEN		direct	-0.08	-0.12	-0.07	-0.19	-0.08*	-0.67
		total	-0.05	-0.09	-0.05	-0.21	-0.10*	-0.78
TEAC_CEN		direct	0.18	0.07	0.08	0.00*	0.02*	1.54
		total	0.31	0.14	0.13	0.10	0.14	1.88
TUTOR		direct	-0.22	0.15	0.26	0.07	†	-0.16*
		total	-0.21	0.19	0.36	0.16	†	-0.22*
EXPRMT		direct	-0.12	0.01*	-0.01*	0.19	0.06*	-0.92
		total	-0.14	-0.02*	-0.02*	0.21	0.03*	-1.08
INT&SUCC		direct	0.39	0.33	0.26	0.46	0.27	0.32
SES	(to) INT&SUCC	direct	0.19	0.15	-0.04	-	-	-
STUD_CEN		direct	0.08	0.08	0.05	0.04	-0.06*	-0.37*
TEAC_CEN		direct	0.34	0.21	0.20	0.22	0.42	1.09
TUTOR		direct	0.04	0.15	0.40	0.20	†	-0.19
EXPRMT		direct	-0.07	-0.08	-0.05	0.04	-0.12	-0.49

- not proposed in the modeling for this type
* non-significant t value
† excluded from the analysis

Path coefficients from SES to SCI_ACHV indicated medium to large effects for three all grade levels. Also while STUD_CEN has negative effect on SCI_ACHV for both grade levels and school types (with a non-significant value for boarding school type), TEAC_CEN has positive effects for all grade levels. For school types, there is no definitive pattern of STUD_CEN and TEAC_CEN for SCI_ACHV for grade levels.

Another important finding is the fact that medium to large effect of INT&SUCC on SCI_ACHV for all grade levels and school types. TEAC_CEN has positive effects with medium effect sizes on INT&SUCC. Another interesting finding is the negative effect of EXPRMT on INT&SUCC for all grade levels and school types, with a positive significant value for state school type.

Medium to large effect of SES, negative effect of STUD_CEN, positive effect of TEAC_CEN on SCI_ACHV are the expected findings for this study. Moreover, medium to large effect of INT&SUCC on SCI_ACHV, negative effect of EXPRMT, higher effect of TEAC_CEN than STU_CEN, and positive effect of TUTOR on INT&SUCC are the interesting findings of this study.

Indirect effect of TEAC_CEN on INT&SUCC has nearly same effect on SCI_ACHV. This means that TEAC_CEN affects INT&SUCC, and, in turn, SCI_ACHV. This is an important finding that has to be investigated because this reveals that effect of teacher-centered activities on science achievement of the students is greater than student-centered activities and experiments. Last finding is that indirect effect of TUTOR increases with the grade level.

CHAPTER 5

DISCUSSION, CONCLUSION AND IMPLICATIONS

This chapter presents discussion, conclusion and implications of the study. In this study, factors affecting the science achievement were investigated across grade levels and school types. To this end, structural equation modeling tecnique was used by LISREL 8.30 software package. A general model was proposed using the OBBS-2002 data set. Then this proposed model was tested in three grade levels (6^{th}, 7^{th}, and 8^{th}) and in three school types (state, boarding, and private).

5.1 Discussion of the Results

In this section, first, results of the factor analyses will be presented and interpreted. Then results of testing the model proposed for each grade level and school types will be given and interpretations on the results will be made.

5.1.1 Factor Analysis

Factor analysis for the proposed model was conducted using the merged data file, including the all grade levels and school types in order to obtain a common factor structure for the proposed model. As a result of the factor analysis which was conducted using principal components analysis with varimax rotation, 10 factors yielded. But not

all 10 factors were used in the study. Only factors that were on researcher's interest were selected and included in the analyses.

Items on parental education levels, number of siblings, and number of books at home showed high loadings in a single factor. Since parental education level has a positice relationships with parental consciousness about children, it was expected that parental education level had a high positive loadings. Number of book is also related with parental education level, by means of the affordability. On the other hand, number of siblings has a negative factor loading. This was also expected since families with more children tend to be at lower socioeconomic levels.

Items about the frequency of private tutoring received cumulated on a factor with higher and positive factor loadings. It can be said that frequencies of private tutoring have a strong relationship within themselves. This means that students receiving private tutoring from a course also tend to receive for other courses.

Items about perception of interest and success for science and mathematics collected one a single factor with relatively higher factor loadings. This can be interpreted that there is a correlation between perception of interest and success for science and mathematics for students. Both science and mathematic are quantitative courses and related to each other, higher correlations were expected.

Items about frequencies of group working, in-class discussions and experiments made by students, etc. weighted on a factor. Three items were selected for this factor named as student-centered activities, accordingly. Similarly, items that show teacher-based characteristics such as courses given by teacher and solving examples in the class cumulated in a factor and were named as teacher-centered activities. Researcher formed two separate latent variables to see the effects of student- and teacher-centered activities on science achievement of students separately.

Items about experiments made by teacher and students and usage of technological material in the class were selected from two different factors for researcher's interest. Researcher included these items in the study to see effects of experiments and usage of technological material.

Variances explained by the model for the science achievement are 30.643%, 31.015% and 22.427% and the numbers of factors yielded as a result of PCAs are four,

four and two factor for grade levels 6^{th}, 7^{th}, and 8^{th}, respectively. For school types total variances explained are 27.173%, 41.962% and 31.412% with three, six, and three for state schools, boarding schools and private schools, respectively.

5.1.2 Science Achievement in Grade Levels and School Types

In this study, effect of five exogenous latent variables (SES, STUD_CEN, TEAC_CEN, TUTOR, and EXPRMT) and one intervining latent variable (INT&SUCC) on one endogenous latent variable (SCI_ACHV) were investigated across three grade levels and three school types. While testing the proposed model for grade levels, all the latent variables were included in the analyses. While testing the model for school types, effect of the exogenous latent SES variable was forced to be zero since in the presence of the effect of the latent variable SES, parameter estimates tended to be non-significant. By forcing the effect of latent variable SES to be zero, problem of non-significant estimates was solved.

Socioeconomic status has the strongest effect on the science achievement SCI_ACHV in 6^{th} grade level. This can be interpreted that students from higher socioeconomic status tend to be more successful in science. For the 7^{th} grade level, socioeconomic status has a higher effect on science achievement. Like the previous grade levels, socioeconomic status has a high effect on science achievement for the grade level 8. In short, socioeconomic status has a strong effect on all grade levels investigated. High effect of socioeconomic status on achievement, especially on science achievement, was expected based on the literature review. According to the literature review, families from higher socioeconomic status tend to be more interested in their children's homework, courses, grades, school and/or peer problems, etc (Muller & Kerbow, 1993, as cited by Schiller, 2002). In addition, this kind of families may have better opportunities such as private tutoring, computers, and educational materials due to economic status. Another point is that parents with higher education may transmit their experiences on education to their children and this may be helpful for children to form his/her education (Baker & Stevenson, 1986). Socioeconomic status has positive but small indirect effects on science achievement by perception of interest and success for the grade levels 6 and 7, while in grade level 8, this indirect effect is negative. That is,

students with higher socioeconomic status tend to have a relatively higher perception of interest and success for grade level 6 and 7 and this, in turn, affects student' science achievement, but vice versa for grade level 8. These effects for grade level 6 and 7 can be due to economic power, parental interest on children education and parental consciousness as stated in literature review above. Since effect of socioeconomic status on science achievement was forced to be zero for school types, no information available the effect of this variable for school types.

Teacher-centered activities have high positive effects on science achievement for all grade levels, with the highest effect on grade level 6 and with the smaller and nearly equal effects on grade levels 7 and 8. Especially when consider the indirect effects by perception of interest and success, effects of teacher-centered activities on science achievement reach approximately its double, again with the highest effect on grade level 6 and with the smaller and nearly equal effects on grade levels 7 and 8. This means that students, in the presence of teacher-centered activities, tend to have higher perception of interest and success and, in turn, they tend to be successful in science.

Also it is interesting that teacher-centered activities affect perception of interest and success as much as nearly they do for science achievement. In this study, latent variable representing teacher-centered activities were constituted from two items (lecture is given by teacher and teacher solves examples related to the topic). These two items produce stronger effect on perception of interest and success than they do on science achievement. This means that teacher is very effective in stimulating the perception of success and interest of the students.

When investigated across school types, it can be seen that direct effect of teacher-centered activities on science achievement is absent or low, but indirect effect by perception of interest and success is significant for state and private school, not but boarding schools. Interesting point here is for school types, while direct effect of teacher-centered activities is not significant for state and boarding schools, their indirect effects empower the effect of teacher-centered activities on science achievement and make effects significant. That is teacher-centered activities stimulated students' perception of interest and success somehow, and this, in turn, effects students' science achievement. Therefore, teachers' function should stimulate perception of interest and

success of students. In this way, students with higher perception of interest and success will tend to be more successful in science.

These findings lay the discussion for teacher- and/or student-centered activities for a concrete ground. Ozdemir (2003) and Yayan (2003) reported similar findings in teacher-centered activities. Literature review revealed that pros and cons of teacher-centered activities existed. The National Science Education Standards argued that teacher-centered education did not meet the requirements of 21st science education such as higher order thinking and problem solving skills, etc (National Research Council, 1996). Hayes (1998) observed that in student-centered instruction, students became more social, they enjoyed lessons more and morale of the class was higher in period in which student-centered instruction was exposured. Huffman & Lawrenz's study (2001) revealed that student-based teaching strategies had no effect on students' achievement on grade level 3-4 and 7-8. While there is a tendency for leaving the teacher-centered activities, opposite findings can be due to country's own conditions. Turkish students are accustomed to be disciplined, passive listeners, rather than to be active participants, with no questioning and no reasoning. Because of these results it can be said that teacher-centered activities can be better fit Turkish students' characteristics.

When looked at student-centered activities for the grade levels, its effect on science achievement is negative. Indirect effect of student-centered activities is positive and small for all grade levels, and this increases its effect some bit. It is obvious that student-centered activities affect students' science achievement negatively. When leaving traditional instruction method and propose a new method, it is important to note that whether student are ready for it and/or students have required basic skills to benefit from new methods.

When examined across three school types, a similar pattern is obtained. Effect of student-centered activities is negative in all school types at hand, except boarding schools. Indirect effect of it across school types is also not so much. The situation for boarding school can stem from the fact that quality of student-centered activities could be low or student-centered activities could be not used in the class. Therefore, this can explain why its effect was found to be non-significant. Also the situation can be due that from students' backgrounds. Student profile for the boarding schools includes student

from families with low socioeconomic status, living in rural and less-developed areas. Since these students do not have basic skills required for student-centered activities, effect of it can be non-significant.

Negative effect for state and private schools can be explained that these kind activities do not fit students' characteristics. Explanations that were made for negative effects across grade levels are also valid for the negative effect across school types. Another point to be noted that it is known that private schools provide an education in good quality and students in private schools should have some basic skills for student-centered activities, therefore for students from private schools positive effects of student-centered activities were expected. But like state schools, where students with low socioeconomic status attain, private school students are negatively affected from student-centered activities.

Effect of student-centered activities on perception of interest and success is positive and small for grade levels and non-significant for boarding and private school types. Magnitude of effect of student-centered activities is lower than that of teacher-centered activities. Nevertheless, student-centered activities can be said to increase students' perception of interest and success, and in turn, students' science achievement.

Again, it is important to note that results of this study on student- and teacher-centered activities does not indicate one or other is better for educational purposes. This study does not aim to measure effectiveness of student- and/or teacher-centered activites, rather the study presents current implementation in Turkey. That is, the fact that student-centered activities have generally negative effects on students' science achievement, while teacher-centered activities have positive effects should not be interpreted that student-centered activities have worse and teacher-centered activities are better. A better explanation of this situation can be as following: in current implementation of student-centered activities, there are some drawbacks therefore effect of this kind of activities on students' achievements is negative.

Ozdemir (2003) and Yayan's (2003) studies revealed parallel results in the teacher-centered activities. Ozdemir (2003) found that while teacher-centered activities had a strong positive effect on students' science achievement, student-centered activities had a negative effect on achievement. Yayan (2003) obtained also similar results on

teacher-centered activities. In Turkey, student-centered activities had a negative impact on mathematics achievement, and however teacher-centered activities had a strong positive effect on achievement. On the other hand, Siller (as cited by Hayes, 1998) stated that teachers who provided their students with an opportunity to become an active participant of the class were more effective. Aytac (2003) underlined the importance of student-centered education and listed some of its important points: it takes students' values and backgrounds into consideration, increases social interactions in class, and encourages independent study and creativity, etc.

When investigated in terms of items, latent variable student-centered activities included the following items: frequency of lecture given by students, frequency of that students make discussions among themselves and frequency of that teacher makes discussions with students. Examining these items' contents one can deduce some results about the negative effect of the student-centered activities. This negative effect can be explained by teachers' and student's characteristics. Teacher may not control the discussions effectively, that is, teacher may not ask appropriate and stimulating questions to students. Alternatively, he/she may fail in securing active participation of student in student-centered activities. Also students may not have abilities to conduct a discussion among them. In these discussion hours in the classes, students are interested in anything except discussion. Considering lectures given by students, students may give lectures by memorizing, not questioning what they talk about.

Here the most important component is the teacher since students tend to loss the control of themselves without supervision of teacher. Teacher should guide them, stimulate students' thinking, and make students active participant of the classes. Abilities and proficiencies of teachers should be researched and teacher-training policies should be regulated on the light of the research findings. But while defining the new role of the teacher, characteristics of Turkish students should be considered. If students are more successful by teacher-based instruction, if they need teacher's supervision and guidance, and if they do not gain basic ability for student-centered activities, required steps should be taken according to these facts. Turkey should put own education structure including student-centered activities supported by the teacher-centered activities with teachers

with required abilities and proficiencies and students equipped wit the basic skills. Educational policies should be investigated accordingly.

When considering together, findings for teacher- and student-centered activities show that Turkish students tend to be successful in the traditional teacher-based classrooms, rather than student-based ones. As stated above, this situation is due that traditions of the students. Turkish students accustomed to write down whatever there is on the board, solving and memorizing problems. Students also have no autonomy for discussion, group working, and no ability for self-experimenting, etc.

Tutoring received by children on mathematics, science and Turkish is another point that its effect was investigated on science achievement across grade levels. While in grade level 6, effect of tutor on science achievement is negative, however, in grade levels 7 and 8, it has a positive strong effect with the greater one on grade level 8. Researcher expected that private tutoring would have an effect on science achievement. This was met for grade levels 7 and 8, but not for 6.

Higher effects of tutoring for grade levels 7 and 8 may be due that students start to prepare for the nationwide examinations conducted at the end of 8^{th} year. Private tutoring that students receive in examination preparation period may also support students' school courses. This can be supported by the fact that effect of private tutoring on science achievement for grade level 8 is greater than all of them. In the grade level 8, students receive private tutoring more than before for the examinations that are conducted at the end of that academic year. It is interesting that effect of private tutoring on perception of interest and success increases with grade level (0.4, 0.15 and 0.40). This increasing effect of private tutoring can stem from the fact that students' private tutors and/or private institutions can stimulate students' motivations to higher levels, and this, in turn, affects perception of success. Indirect effect of private tutoring increases in parallel with its effect on perception of interest and success. Private tutors and institutions can try to increase students' interests in order to increase their achievement. Also students choose private tutors which is generally university students for a model for themselves and this may increase effect of perception of interest and success on science achievement. Private tutoring does not generally focus on student's perception of interest and success. In fat, it is only demanded for improving students' grades.

Therefore indirect effect of private tutoring was expected to be low, but findings do not confirm this fact.

Across school types, effect of frequency of receiving private tutoring is positive for state school and non-significant private schools. For state schools, it is common to receive private tutoring to support student in the school, so it is expected that private tutoring has a positive effect on students' science achievement. For private schools, education that students get in school can be enough for them to be successful in science. Therefore, private tutoring does not effect on private school students' science achievement.

Latent variable TUTOR included three items, which were related to frequency of receiving private tutoring for mathematics, science and Turkish. All these three items have a strong effect on the latent variable TUTOR. This can mean that receiving private tutoring for any of these courses has an effect on science achievement.

Since private tutoring is a shadowy phenomenon, it is hard to gather information on. Parties of the private tutoring are not willing to give information. Students do not want their friends learn that they are receive tutoring. In a similar way, private tutors do not want to reveal how many students they have and how much they earn from tutoring (Bray & Kwok, 2003). De Silva (1994, as cited by Bray, 2003) stated that if supplementary tutoring was used suitable to students' needs, students' achievement could be improved strongly. Valdez (2003) reported that just six percent of the students who received private tutoring indicated that tutor had helped him/her if they were failing a class.

Effect of experiments and technological material on science achievement is significant for the grade level 6, but not for 7 and 8. In grade levels 7 and 8, there is no effect of experiments and technological material on science achievement. In grade level 6, effect of it is negative, that is, students who stated that experiments are made by teacher and/or themselves and students who technological materials are used in their classrooms tend to be less successful in science. This negative effect can be due to teachers' low capabilities on experiments and/or technological materials. Ineffective usage of these results in decrease in achievement of the students. Beside teachers, also students may feel anxiety about experimental setups and technological materials. This

may also be a reason for low science achievement. Non-significant effect for grade levels 7^{th} and 8^{th} can stem from the quality or frequency of experiments and technological material usage.

It is interesting to note that effect of experiments and technological material on perception of interest and success is also negative across grade levels. In addition, effect of experiment and perception of interest and success is strongly negative for boarding and private schools. Actually, it was expected that experiments and technological material would have increase perception of interest by stimulating students' interest. Negative effects show the opposite of expectation of researcher. Students may not interest in experiments since they do not know what to do when making experiments themselves. Or when teachers make experiments, teachers may not be successful in stimulating students' interest by effective demonstration methods. Alternatively, students may not understand the core of the topic by experiment.

When investigated across school types, effect of experiments and technological material usage is not significant for boarding schools. And while its effect is high in state schools, it is negative in private schools. In state schools, effect of it is positive, that is, students who make experiments by teacher and/or themselves and students who in their class technological materials are used in their classrooms tend to be more successful in science. In boarding schools, no effect has been found in experiments and technological material usage. Last, in private schools, its effect is negative and this means that students who make experiment made by teacher and/or themselves and who technological material is used in their classrooms tend to be less successful in science. Reason for this negative effect for private schools may be stem from the non-interestedness of the students or teachers' capabilities. Positive effect of it in state schools can be a result of appropriate implementation of technology and experiments in the classes.

It is interested to note that when effect of experiments were investigated according to those who made experiments, effect of experiments made by students is generally higher on science achievement than that of experiments done by teachers. This can be interpreted that when students do experiments, they understand better what is

going on. When these findings merged with the teacher-based pattern on classes, when students made experiments, teacher should provide students with a good guidance.

Technological materials usage in classes such as over-head projector, computer, etc, are materials that Turkish students are not accustomed to. For this reason, when teachers give lecture by using technology, students may not understand the topic at hand. And this results in an decrease in science achievement of the students. Even if there is no decrease in science achievement significantly, it is obvious that there is no increase as well. After all, findings on effect of experiments/technological material usage conflicted with the researcher's expectations. Researcher expected effect of them would be positive and significant.

Lastly, effect of perception of interest and success decreases with grade level. While it is in peak in grade level 6, in grade level 8 it is at bottom in magnitude. Nevertheless, in all three grades, effect of it is high. This is also valid for the school types; in all school types, effect of perception of interest and success in science and mathematics has a strong effect on science achievement. This means that students who have higher perception of interest and success tend to be successful in science achievement. An interesting finding is that students' perception of interest and success tend to decrease with the grade level. Students come to 6^{th} grade level with a higher perception of interest and success and they start to loss it with the increasing grade level.

In the literature, it is generally reported that there was positive relationship between perception of interest and success and achievement. Paolucci (2001) reported that there was a high relationship between science interests and science and math achievement both for boys and girls and that mathematics and science achievement was a strong predictor of science achievement for both boys and girls. Findings of Berberoglu et al (2003) revealed that perception of failure / success was one of strongest factor influencing the science achievement both for mathematics and science courses and it was stated that science achievement factor and perception of failure / success had a reciprocal relationship. Study of Jinks and Morgan (1997) revealed that there was a positive relationship between students' science grades and sense of academic efficacy. On the other hand, IEA (2000) stated that some of the countries with the highest

achievement were those whose students had the most negative perception of success, namely Japan, Korea, and Hong Kong.

Here teachers have an important role on stimulating students' perception of interest and success. Teacher should be able to make students gain perception of interest by different methods such as demonstration, interest presentations, and examples, etc. Also teacher should not be exerted to pressure of unsuccessfulness to students.

5.2 Conclusions

This section is devoted to the conclusions of the study. In this study, effects of factors affecting science achievement were investigated based on the OBBS-2002 data. The main technique used in the study was structural equation modeling (SEM), for determining the effects of the factors simultaneously. The study covered three grade levels (6^{th}, 7^{th}, and 8^{th}) school types (state, boarding, and private).

The following items list the conclusions:

1. Socioeconomic status has a strong effect for all grade levels investigated. This means that students from families with higher socioeconomic status tend to be successful in science. Effect of socioeconomic status was excluded from the analyses for school types. Therefore, its effect across school types could not be investigated.

2. Socioeconomic status has positive indirect effects on science achievement by perception of interest and success for the grade levels 6 and 7, while in grade level 8, this effect is negative. That is, student with higher socioeconomic status tend to have a higher perception of interest and success for grade level 6 and 7, but vice versa for grade level 8.

3. Teacher-centered activities have positive effects on science achievement for all grade levels. This means that students, in the presence of teacher-centered activities, tend to be more successful in science.

4. With indirect effects by perception of interest and success, effects of teacher-centered activities on science achievement reach approximately its double for all grade levels. That is, teacher centered activities increase science achievement by affecting perception of interest and success as well.

5. Teacher-centered activities affect perception of interest and success as much as nearly they for science achievement. This is an interested finding that teacher-centered activities affect students' perception of interest and success.

6. Direct effect of teacher-centered activities is not significant for state and boarding schools, but their indirect effects strengthen the effect of teacher-centered activities on science achievement. That is, teacher-centered activities stimulated students' perception of interest and success somehow, and this, in turn, affects students' science achievement for school types.

7. When looked at student-centered activities for the grade levels, its effect on science achievement is negative .That is, students, in the presence of student-centered activities, tend to be less successful in science.

8. Effect of student-centered activities on perception of interest and success is positive and small for all grade levels. This means that student-centered activities do affect students' perception of interest and success.

9. When examined across three school types, a similar pattern was obtained. Effect of student-centered activities is negative in all school types at hand, except boarding schools.

10. Effect of tutor on science achievement is negative for grade level 6; however, in grade levels 7 and 8 it has a positive strong effect. Effect of tutor increases wit grade levels. This means that tutor has an important effect on students' science achievement.

11. Across school types, effect of frequency of receiving private tutoring across school types is positive for state school and non-significant private schools.

12. Effect of private tutoring on perception of interest and success also increases with grade levels. This also increases students' science achievement by indirect effect of perception of interest and success.

13. Tutor has a positive effect on perception of interest and success for state and negative for private schools. Highest effect is in state schools.

14. Effect of experiments and technological material on science achievement is negative for the grade level 6. That is, students who stated that experiments are made by teacher and/or themselves and who technological material is used in their classrooms tend to be less successful in science achievement. In grade levels, 7 and 8, there is no effect of experiments and technological material on science achievement.

15. Effect of experiments and technological material usage is not significant for boarding schools. And while its effect is high in state schools, it is negative in private schools.

16. It is interesting to note that direct effect of experiments and technological material on perception of interest and success is also negative for all grade levels and school types, except state schools, in which it is positive. This means that students tend to be less successful in science if experiments are made and technological material is used in the class.

17. Effect of perception of interest and success has a strong effect on science achievement across all grade levels. This is also valid for all school types.

This means that students who have higher perception of interest and success tend to be successful in science achievement.

18. The fact that effect of perception of interest and success decreases with the grade levels is another important point that has to be investigated. With grade level increases, students tend to loss their perception of interest and success.

5.3 Implications

As a result of the study, following implications can be suggested:

1. It was generally found that while teacher-centered activities affect students' science achievement in a positive way, student-centered activities affect it in a negative way. New regulations should be done considering this issue. Here the most important component is the teacher since students tend to loss the control of themselves without teacher's guidance. Teacher should supervise them and stimulate students' thinking, make students active participants of the classes. Abilities and proficiencies that teachers are required to have should be researched and teacher training policies and in-service trainings should be regulated on the light of the findings.
2. While defining the new role of the teachers, characteristics of Turkish students should be considered. If students are more successful by teacher-based instruction, if they need teacher supervision and guidance, and if they do not gain basic abilities for student-centered activities, these facts should not be regarded. Teacher-centered activities should be weighted on the class. Student-centered activities should be integrated to the classes, which is mainly teacher-centered.
3. It is a consensus that student-centered activities have positive effects in general. But as a result of this study, supported by Yayan (2003) and Ozdemir (2003), this technique does not give what was expected in Turkish education system. Turkish student are accustomed to be disciplined, passive listeners, rather than active participants, with no questioning and no

reasoning. Because of these results, teacher-centered activities can be fit Turkish students' characteristics better.

4. Turkey should put own education structure including student-centered activities supporting the teacher-centered activities for teacher with required abilities and proficiencies and students equipped wit the basic skills.
5. Family factor should not be regarded. Family's effect on student is very strong. Therefore, parents should be educated to support their children and to get interested their children's education. Arranging meetings with the participation of pedagogy experts, teacher and parents can be arranged to tell parent how much important they are in their children's education.
6. Students' perception of interest and success should be used to improve their motivation at higher levels, in turn, their science achievement. Teacher should frequently encourage students to fell themselves as successful. Also teacher should find the ways to stimulate students' interest. To this end, in-service training may help.
7. Perception of interest and success decreases with the grade levels. Teachers should prevent this by keeping students perceptions of interests and success at higher levels. Since perception of interest and success has a strong effect on students' science achievement, teachers should keep students' perceptions stimulated in all grade levels.
8. Effect of experiments made by students is higher on science achievement than that of experiments done by teachers. This can be interpreted that when students do experiments, they understand better what is going on. When students made experiments, teacher should be able to guide students. In teacher training policies, this issue should be considered.
9. Experiments and usage of technological material in the class negatively affect students' perception of interest and success. This is the opposite of what was expected. Teachers may have some problems on stimulating students' interest with experiments. Teachers may not able to explain what is going on, asking questions for arising interest among students etc, may be experimental setups are not interesting for students. Negative effect of

experiments and usage of technological material in the class is a problem to be handled. In teacher's education and in material developing this point should be considered.

10. Private tutoring affects science achievement with an increasing level for grade levels. It is interesting that private tutoring has an effect on perception of interest and success. This fact can be used for education system. Study hours, discussions for motivating students, etc. can be arranged to increase students' perception of interest and, in turn, increase their achievement.

5.4 Limitations

In this study, a number of limitations arose. When commenting on results of the study, these limitations should not be missed.

1. To make possible the comparison among grade levels and school types, one single model proposed at the beginning of the study based on the factor analysis and researcher's interest. And this proposed model was tested across grade levels and school types. This model is not the best one, explaining factor of all the grade levels and school types. Rather this is a common model formed for comparison purposes. Better models can be proposed for each different grade level and school types.
2. Items of OBBS-2002 were developed based on curriculum of MoNE. Therefore students' achievement levels were measured based on curricular dimension. No information is available for students's background knowledge and/or their basic skill. Results of this study should be interpreted accordingly.
3. In the modeling and estimation stage, Maximum Likelihood Estimation method was used. Actually, this method is for using with continuous variable, but it is very robust for using under variables, which was made continuous by researcher. Researcher regarded the scale of 2, 4 and 5 as continuous and used accordingly in the analyses and correlations were estimated under this assumption.

4. Some items have not met the normality assumption since they cumulated on some answer for most of the students. These items were excluded from the analyses as much as possible. However, some of them were included for researcher's interest based on the robustness of the estimation model used (MLE).
5. Standardized coefficients generated by LISREL software is interpreted as quantity of change in observed variable for a change of one standard unit in affected variable. Standardized coefficients create different metrics for different variables, with a variance of one. (Jaccard & Wan, 1996). For this reason, when comparing the variables which have different metrics one should be warned about this issue. Since the student questionnaire has different scales (2, 4, and 5), this is also valid for this study. Comparing the effects of variables that have different metrics should be done using unstandardized coefficients, rather than standardized ones.

5.5 Suggestions for Further Research

Researcher of this study presents the following suggestions for further researchers on this subject:

1. This was a comparative study for the model explaining science achievement of the students across three grade levels (6^{th}, 7^{th}, and 8^{th}) and three school types (state, boarding, and private). Specific models can be proposed for each grade level and school type separately and tested.
2. Factor affecting science achievement of the students can be investigated in detail. Also replication studies for this study can be provide scientific grounds for policy making studies.
3. Other latent variables that were obtained using factor analysis and excluded in this study can be included in further modeling studies.
4. As a technical issue, asymptotic covariance variance matrix which can be better for ordinal variables can be used for see difference between this study and those conducted by asymptotic covariance matrix.

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APPENDIX A

UNIVARIATE DISTRIBUTIONS

FOR ORDINAL VARIABLES

Table A.1 Legend for Student Questionnaire

Mother_e = Mother's education level
- 1 = illiterate
- 2 = elementary
- 3 = middle school
- 4 = high school
- 5 = university

Father_e = Father's education level
- 1 = illiterate
- 2 = elementary
- 3 = middle school
- 4 = high school
- 5 = university

Siblings = Number of siblings
- 1 = none
- 2 = 1
- 3 = 2-3
- 4 = 4-6
- 5 = equal to or more than 7

Books = Number of books at home
- 1 = 0-10
- 2 = 11-24
- 3 = 25-100
- 4 = 100-200
- 5 = more than 200

Tut_sci = Frequency of receiving private tutoring for science in one week
1 = none
2 = less than 1 hour
3 = 1-2 hour
4 = 3-5 hours
5 = more than 5 hours

Tut_math = Frequency of receiving private tutoring for mathematics in one week
1 = none
2 = less than 1 hour
3 = 1-2 hour
4 = 3-5 hours
5 = more than 5 hours

Tut_tur = Frequency of receiving private tutoring for Turkish in one week
1 = none
2 = less than 1 hour
3 = 1-2 hour
4 = 3-5 hours
5 = more than 5 hours

Int_math = How much interest do you have toward mathematics
1 = none
2 = I don't like
3 = I like
4 = I like it very much

Int_sci = How much interest do you have toward science
1 = none
2 = I don't like
3 = I like
4 = I like it very much

Suc_math = How successful do you fell yourself in mathematics
1 = very unsuccessful
2 = unsuccessful
3 = successful
4 = very unsuccessful

Suc_sci = How successful do you fell yourself in science
1 = very unsuccessful
2 = unsuccessful
3 = successful
4 = very unsuccessful

Tea_less = Frequency of lessons given by teacher
1 = none
2 = rarely
3 = frequently
4 = very frequently

Stu_less = Frequency of lessons given by student
1 = none
2 = rarely
3 = frequently
4 = very frequently

Stu_disc = Frequency of student discussion in class
1 = none
2 = rarely
3 = frequently
4 = very frequently

Tea_disc = Frequency of teacher discussion in class
1 = none
2 = rarely
3 = frequently
4 = very frequently

Examples = Frequency of solving examples in class by teacher
1 = none
2 = rarely
3 = frequently
4 = very frequently

Techno = Frequency of using technological material in class
1 = none
2 = rarely
3 = frequently
4 = very frequently

Tea_expe = Frequency of experiments done by teacher
1 = none
2 = rarely
3 = frequently
4 = very frequently

Stu_expe = Frequency of experiments done by student
1 = none
2 = rarely
3 = frequently
4 = very frequently

Table A.2 Univariate Distributions for Grade Level 6

NF5	Frequency	Percentage	Bar Chart
0	5954	60.2	••
1	3938	39.8	••••••••••••••••••••••••••••

NF10	Frequency	Percentage	Bar Chart
0	962	9.7	•••••
1	8930	90.3	••

NF12	Frequency	Percentage	Bar Chart
0	5975	60.4	••
1	3917	39.6	••••••••••••••••••••••••••••

NF15	Frequency	Percentage	Bar Chart
0	2997	30.3	••••••••••••••••••••
1	6895	69.7	••

NF17	Frequency	Percentage	Bar Chart
0	4147	41.9	••••••••••••••••••••••••••••••
1	5745	58.1	••

Mother_e	Frequency	Percentage	Bar Chart
1	2534	25.6	••••••••••••••••••••
2	4861	49.1	••
3	1034	10.5	••••••••
4	1012	10.2	••••••••
5	451	4.6	••••

Father_e	Frequency	Percentage	Bar Chart
1	676	6.8	•••••••
2	4466	45.1	••
3	1871	18.9	••••••••••••••••••
4	1799	18.2	••••••••••••••••••
5	1080	10.9	••••••••••

Siblings	Frequency	Percentage	Bar Chart
1	530	5.4	•••••••
2	2464	24.9	••••••••••••••••••••••••••••••
3	3535	35.7	••
4	2395	24.2	••••••••••••••••••••••••••••••
5	968	9.8	••••••••••••

Books	Frequency	Percentage	Bar Chart
1	4478	45.3	••
2	2300	23.3	••••••••••••••••••••••••
3	1938	19.6	••••••••••••••••••••
4	738	7.5	••••••••
5	438	4.4	•••••

Tut_sci	Frequency	Percentage	Bar Chart
1	8546	86.4	••
2	404	4.1	••
3	570	5.8	•••
4	260	2.6	•
5	85	0.9	

Tut_math	Frequency	Percentage	Bar Chart
1	7900	79.9	••
2	594	6.0	••••
3	877	8.9	•••••
4	409	4.1	••
5	101	1.0	•

Tut_tur	Frequency	Percentage	Bar Chart
1	8368	84.6	••
2	497	5.0	•••
3	667	6.7	••••
4	229	2.3	•
5	115	1.2	•

Int_math	Frequency	Percentage	Bar Chart
1	289	2.9	•••
2	1003	10.1	••••••••••
3	3651	36.9	••••••••••••••••••••••••••••••••••
4	4929	49.8	•••

Int_sci	Frequency	Percentage	Bar Chart
1	306	3.1	•••
2	1038	10.5	••••••••••
3	4200	42.5	•••
4	4331	43.8	•••

Suc_math	Frequency	Percentage	Bar Chart
1	409	4.1	••••
2	2328	23.5	••••••••••••••••••••
3	4898	49.5	•••
4	2231	22.6	••••••••••••••••••••

Suc_sci	Frequency	Percentage	Bar Chart
1	331	3.3	•••
2	1968	19.9	•••••••••••••••
3	5494	55.5	•••
4	2081	21.0	•••••••••••••••••

Tea_less	Frequency	Percentage	Bar Chart
1	214	2.2	••
2	1991	20.1	••••••••••••••••••••
3	4124	41.7	•••
4	3532	35.7	••••••••••••••••••••••••••••••••••••

Stu_less	Frequency	Percentage	Bar Chart
1	1298	13.1	•••••••••
2	6446	65.2	•••
3	1574	15.9	••••••••••••
4	542	5.5	••••

Stu_disc	Frequency	Percentage	Bar Chart
1	1877	19.0	••••••••••••••
2	5746	58.1	•••
3	1619	16.4	•••••••••••••
4	628	6.3	•••••

Tea_disc	Frequency	Percentage	Bar Chart
1	1195	12.1	•••••••••••••
2	4322	43.7	•••
3	3094	31.3	••••••••••••••••••••••••••••••••
4	1246	12.6	••••••••••••••

Examples	Frequency	Percentage	Bar Chart
1	476	4.8	•••••
2	2745	27.7	••••••••••••••••••••••••••••••
3	4080	41.2	•••
4	2548	25.8	••••••••••••••••••••••••••••

Techno	Frequency	Percentage	Bar Chart
1	3308	33.4	••••••••••••••••••••••••••••••••••••
2	3783	38.2	•••
3	1810	18.3	••••••••••••••••••••
4	954	9.6	••••••••••••

Tea_expe	Frequency	Percentage	Bar Chart
1	1090	11.0	••••••••••••
2	3891	39.3	•••
3	3040	30.7	••••••••••••••••••••••••••••••••••
4	1829	18.5	••••••••••••••••••••

Stu_expe	Frequency	Percentage	Bar Chart
1	2914	29.5	•••••••••••••••••••••
2	4893	49.5	•••
3	1431	14.5	••••••••••••••
4	617	6.2	••••••

Table A.3 Univariate Distributions for Grade Level 7

NF1	Frequency	Percentage	Bar Chart
0	6799	76.7	••
1	2064	23.3	••••••••••••••

NF6	Frequency	Percentage	Bar Chart
0	3553	40.1	••••••••••••••••••••••••••••
1	5310	59.9	•••

NF7	Frequency	Percentage	Bar Chart
0	4138	46.7	••••••••••••••••••••••••••••••••••••
1	4725	53.3	•••

NF8	Frequency	Percentage	Bar Chart
0	5556	62.7	•••
1	3307	37.3	••••••••••••••••••••••••••

NF14	Frequency	Percentage	Bar Chart
0	6202	70.0	•••
1	2661	30.0	••••••••••••••••••••

NF16	Frequency	Percentage	Bar Chart
0	5515	62.2	•••
1	3348	37.8	••••••••••••••••••••••••••

Mother_e	Frequency	Percentage	Bar Chart
1	2177	24.6	••••••••••••••••••••
2	4569	51.6	•••
3	811	9.2	••••••••
4	921	10.4	•••••••••
5	385	4.3	••••

Father_e	Frequency	Percentage	Bar Chart
1	489	5.5	••••••
2	4147	46.8	•••
3	1745	19.7	••••••••••••••••••••
4	1579	17.8	•••••••••••••••••
5	903	10.2	•••••••••

Siblings	Frequency	Percentage	Bar Chart
1	390	4.4	••••••
2	2109	23.8	••••••••••••••••••••••••••••
3	3264	36.8	•••
4	2242	25.3	••••••••••••••••••••••••••••••
5	858	9.7	••••••••••••

Books	Frequency	Percentage	Bar Chart
1	3729	42.1	•••
2	2148	24.2	••••••••••••••••••••••••••
3	1850	20.9	••••••••••••••••••••••
4	744	8.4	•••••••••
5	392	4.4	•••••

Tut_sci	Frequency	Percentage	Bar Chart
1	7276	82.1	•••
2	324	3.7	••
3	782	8.8	•••••
4	371	4.2	••
5	110	1.2	•

Tut_math	Frequency	Percentage	Bar Chart
1	6811	76.8	••
2	443	5.0	•••
3	1008	11.4	•••••••
4	496	5.6	•••
5	105	1.2	•

Tut_tur	Frequency	Percentage	Bar Chart
1	7302	82.4	••
2	487	5.5	•••
3	697	7.9	••••
4	281	3.2	••
5	96	1.1	•

Int_math	Frequency	Percentage	Bar Chart
1	438	4.9	•••••
2	1206	13.6	••••••••••••••
3	3749	42.3	•••
4	3470	39.2	••

Int_sci	Frequency	Percentage	Bar Chart
1	519	5.9	••••••
2	1349	15.2	•••••••••••••••
3	4045	45.6	••
4	2950	33.3	•••••••••••••••••••••••••••••••••

Suc_math	Frequency	Percentage	Bar Chart
1	488	5.5	••••••
2	2945	33.2	•••••••••••••••••••••••••••••••••
3	3959	44.7	••
4	1471	16.6	•••••••••••••••••

Suc_sci	Frequency	Percentage	Bar Chart
1	469	5.3	•••••
2	2577	29.1	••••••••••••••••••••••••••
3	4517	51.0	••
4	1300	14.7	••••••••••••••

Tea_less	Frequency	Percentage	Bar Chart
1	156	1.8	••
2	1456	16.4	•••••••••••••••••
3	4042	45.6	••
4	3209	36.2	••••••••••••••••••••••••••••••••••••

Stu_less	Frequency	Percentage	Bar Chart
1	1033	11.7	••••••••
2	6127	69.1	••
3	1297	14.6	•••••••••••
4	406	4.6	•••

Stu_disc	Frequency	Percentage	Bar Chart
1	1474	16.6	••••••••••••••
2	5439	61.4	••
3	1482	16.7	••••••••••••••
4	468	5.3	••••

Tea_disc	Frequency	Percentage	Bar Chart
1	873	9.8	•••••••••••
2	3945	44.5	••
3	3014	34.0	••••••••••••••••••••••••••••••••••••
4	1031	11.6	••••••••••••

Examples	Frequency	Percentage	Bar Chart
1	367	4.1	•••••
2	2172	24.5	••••••••••••••••••••••••••••
3	3615	40.8	•••
4	2709	30.6	••••••••••••••••••••••••••••••••••

Techno	Frequency	Percentage	Bar Chart
1	3350	37.8	•••
2	3351	37.8	•••
3	1470	16.6	••••••••••••••••••••
4	692	7.8	•••••••••

Tea_expe	Frequency	Percentage	Bar Chart
1	1008	11.4	••••••••••••••
2	3097	34.9	•••
3	2972	33.5	•••
4	1786	20.2	••••••••••••••••••••••••

Stu_expe	Frequency	Percentage	Bar Chart
1	2861	32.3	••••••••••••••••••••••••••••••
2	4443	50.1	•••
3	1050	11.8	••••••••••••
4	509	5.7	•••••

Table A.4 Univariate Distributions for Grade Level 8

NF1	Frequency	Percentage	Bar Chart
0	5310	60.6	••
1	3451	39.4	••••••••••••••••••••••••••••••

NF3	Frequency	Percentage	Bar Chart
0	3168	36.2	••••••••••••••••••••••••••
1	5593	63.8	•••

NF5	Frequency	Percentage	Bar Chart
0	6372	72.7	••
1	2389	27.3	••••••••••••••••••

NF6	Frequency	Percentage	Bar Chart
0	5489	62.7	••
1	3272	37.3	••••••••••••••••••••••••••

NF10	Frequency	Percentage	Bar Chart
0	3964	45.2	••••••••••••••••••••••••••••••••••
1	4797	54.8	•••

NF12	Frequency	Percentage	Bar Chart
0	4944	56.4	••
1	3817	43.6	••••••••••••••••••••••••••••••••

NF14	Frequency	Percentage	Bar Chart
0	3621	41.3	••••••••••••••••••••••••••••••
1	5140	58.7	•••

NF15	Frequency	Percentage	Bar Chart
0	4199	47.9	••••••••••••••••••••••••••••••••••••
1	4562	52.1	•••

NF16	Frequency	Percentage	Bar Chart
0	4133	47.2	••••••••••••••••••••••••••••••••••••
1	4628	52.8	•••

NF17	Frequency	Percentage	Bar Chart
0	5798	66.2	••
1	2963	33.8	••••••••••••••••••••••••

NF18	Frequency	Percentage	Bar Chart
0	5193	59.3	•••
1	3568	40.7	••••••••••••••••••••••••••••••

Mother_e	Frequency	Percentage	Bar Chart
1	2103	24.0	••••••••••••••••••••
2	4660	53.2	•••
3	783	8.9	••••••••
4	848	9.7	•••••••••
5	367	4.2	••••

Father_e	Frequency	Percentage	Bar Chart
1	454	5.2	•••••
2	4324	49.4	•••
3	1607	18.3	••••••••••••••••
4	1507	17.2	•••••••••••••••
5	869	9.9	•••••••••

```
Siblings Frequency Percentage Bar Chart
      1     324         3.7    •••••
      2    2089        23.8    ••••••••••••••••••••••••••••••
      3    3158        36.0    ••••••••••••••••••••••••••••••••••••••••••••••
      4    2255        25.7    •••••••••••••••••••••••••••••••
      5     935        10.7    •••••••••••••

Books    Frequency Percentage Bar Chart
      1    3458        39.5    ••••••••••••••••••••••••••••••••••••••••••••••••••
      2    2048        23.4    •••••••••••••••••••••••••••
      3    2027        23.1    •••••••••••••••••••••••••••
      4     797         9.1    ••••••••••••
      5     431         4.9    ••••••

Tut_sci  Frequency Percentage Bar Chart
      1    6410        73.2    ••••••••••••••••••••••••••••••••••••••••••••
      2     316         3.6    ••
      3     997        11.4    ••••••••
      4     744         8.5    •••••
      5     294         3.4    ••

Tut_math Frequency Percentage Bar Chart
      1    6123        69.9    ••••••••••••••••••••••••••••••••••••••••••••
      2     379         4.3    •••
      3    1092        12.5    •••••••••
      4     867         9.9    ••••••••
      5     300         3.4    ••

Tut_tur  Frequency Percentage Bar Chart
      1    6394        73.0    ••••••••••••••••••••••••••••••••••••••••••••
      2     423         4.8    •••
      3    1173        13.4    ••••••••••
      4     529         6.0    ••••
      5     242         2.8    ••

Int_math Frequency Percentage Bar Chart
      1     706         8.1    •••••••••
      2    1550        17.7    ••••••••••••••••••
      3    3868        44.2    ••••••••••••••••••••••••••••••••••••••••••••••
      4    2637        30.1    ••••••••••••••••••••••••••••••••

Int_sci  Frequency Percentage Bar Chart
      1     366         4.2    ••••
      2    1091        12.5    ••••••••••••
      3    4246        48.5    ••••••••••••••••••••••••••••••••••••••••••••••
      4    3058        34.9    •••••••••••••••••••••••••••••••••

Suc_math Frequency Percentage Bar Chart
      1     762         8.7    •••••••••
      2    3524        40.2    ••••••••••••••••••••••••••••••••••••••••••••
      3    3441        39.3    •••••••••••••••••••••••••••••••••••••••••••
      4    1034        11.8    ••••••••••••

Suc_sci  Frequency Percentage Bar Chart
      1     315         3.6    •••
      2    2105        24.0    ••••••••••••••••••
      3    4986        56.9    ••••••••••••••••••••••••••••••••••••••••••••••
      4    1355        15.5    ••••••••••••
```

Tea_less	Frequency	Percentage	Bar Chart
1	73	0.8	•
2	1362	15.5	••••••••••••••
3	4296	49.0	•••
4	3030	34.6	••••••••••••••••••••••••••••••••

Stu_less	Frequency	Percentage	Bar Chart
1	952	10.9	•••••••
2	6498	74.2	•••
3	1062	12.1	••••••••
4	249	2.8	••

Stu_disc	Frequency	Percentage	Bar Chart
1	1389	15.9	••••••••••••
2	5612	64.1	•••
3	1383	15.8	••••••••••••
4	377	4.3	•••

Tea_disc	Frequency	Percentage	Bar Chart
1	835	9.5	•••••••••
2	3992	45.6	•••
3	3041	34.7	••••••••••••••••••••••••••••••••
4	893	10.2	••••••••••

Examples	Frequency	Percentage	Bar Chart
1	364	4.2	•••••
2	2226	25.4	••••••••••••••••••••••••••••
3	3651	41.7	•••
4	2520	28.8	••••••••••••••••••••••••••••••••

Techno	Frequency	Percentage	Bar Chart
1	3045	34.8	••••••••••••••••••••••••••••••••••••
2	3542	40.4	•••
3	1474	16.8	••••••••••••••••••
4	700	8.0	•••••••••

Tea_expe	Frequency	Percentage	Bar Chart
1	1325	15.1	•••••••••••••••••
2	3292	37.6	•••
3	2784	31.8	••••••••••••••••••••••••••••••••••••
4	1360	15.5	••••••••••••••••••

Stu_expe	Frequency	Percentage	Bar Chart
1	3140	35.8	••••••••••••••••••••••••••••••••
2	4324	49.4	•••
3	959	10.9	•••••••••••
4	338	3.9	••••

Table A.5 Univariate Distributions for State School Type

NF4	Frequency	Percentage	Bar Chart
0	12105	51.3	••
1	11479	48.7	••

NF10	Frequency	Percentage	Bar Chart
0	9187	39.0	••••••••••••••••••••••••••••
1	14397	61.0	•••

NF14	Frequency	Percentage	Bar Chart
0	12795	54.3	••
1	10789	45.7	••••••••••••••••••••••••••••••••••••

NF16	Frequency	Percentage	Bar Chart
0	12776	54.2	••
1	10808	45.8	••••••••••••••••••••••••••••••••••••

NF17	Frequency	Percentage	Bar Chart
0	14388	61.0	••
1	9196	39.0	•••••••••••••••••••••••••••••

Mother_e	Frequency	Percentage	Bar Chart
1	5747	24.4	••••••••••••••••••••
2	12856	54.5	•••
3	2307	9.8	••••••••
4	2087	8.8	••••••••
5	587	2.5	••

Father_e	Frequency	Percentage	Bar Chart
1	1258	5.3	•••••
2	11597	49.2	••
3	4768	20.2	•••••••••••••••••••
4	4214	17.9	••••••••••••••••••
5	1747	7.4	•••••••

Siblings	Frequency	Percentage	Bar Chart
1	947	4.0	•••••
2	5677	24.1	•••••••••••••••••••••••••••
3	8863	37.6	••
4	5923	25.1	•••••••••••••••••••••••••••••
5	2174	9.2	••••••••••••

Books	Frequency	Percentage	Bar Chart
1	10368	44.0	••
2	5806	24.6	••••••••••••••••••••••••
3	4948	21.0	••••••••••••••••••••
4	1682	7.1	••••••••
5	780	3.3	••••

Tut_sci	Frequency	Percentage	Bar Chart
1	19480	82.6	••
2	793	3.4	••
3	1832	7.8	••••
4	1098	4.7	•••
5	359	1.5	•

Tut_math	Frequency	Percentage	Bar Chart
1	18243	77.4	••
2	1118	4.7	•••
3	2410	10.2	••••••
4	1435	6.1	••••
5	371	1.6	•

Tut_tur	Frequency	Percentage	Bar Chart
1	19216	81.5	••
2	1110	4.7	•••
3	2062	8.7	•••••
4	836	3.5	••
5	349	1.5	•

Int_math	Frequency	Percentage	Bar Chart
1	1281	5.4	••••••
2	3329	14.1	•••••••••••••••
3	9823	41.7	•••
4	9136	38.7	•••

Int_sci	Frequency	Percentage	Bar Chart
1	1048	4.4	•••••
2	2964	12.6	••••••••••••
3	10828	45.9	•••
4	8729	37.0	••••••••••••••••••••••••••••••••••••

Suc_math	Frequency	Percentage	Bar Chart
1	1472	6.2	•••••••
2	7821	33.2	•••••••••••••••••••••••••••••••••
3	10480	44.4	•••
4	3787	16.1	•••••••••••••••••

Suc_sci	Frequency	Percentage	Bar Chart
1	966	4.1	••••
2	5730	24.3	••••••••••••••••••••••
3	12901	54.7	•••
4	3972	16.8	••••••••••••••

Tea_less	Frequency	Percentage	Bar Chart
1	382	1.6	••
2	4244	18.0	•••••••••••••••••
3	10851	46.0	•••
4	8086	34.3	••••••••••••••••••••••••••••••••••

Stu_less	Frequency	Percentage	Bar Chart
1	2619	11.1	••••••••
2	16398	69.5	•••
3	3482	14.8	•••••••••••
4	1058	4.5	•••

Stu_disc	Frequency	Percentage	Bar Chart
1	4116	17.5	••••••••••••
2	14527	61.6	•••
3	3690	15.6	••••••••••••
4	1235	5.2	••••

Tea_disc	Frequency	Percentage	Bar Chart
1	2557	10.8	•••••••••••
2	10659	45.2	•••
3	7709	32.7	••••••••••••••••••••••••••••••••
4	2629	11.1	••••••••••••

Examples	Frequency	Percentage	Bar Chart
1	1075	4.6	•••••
2	6302	26.7	••••••••••••••••••••••••••••
3	9824	41.7	•••
4	6345	26.9	••••••••••••••••••••••••••••

Techno	Frequency	Percentage	Bar Chart
1	9028	38.3	••
2	8907	37.8	•••
3	3766	16.0	••••••••••••••••••
4	1852	7.9	•••••••••

Tea_expe	Frequency	Percentage	Bar Chart
1	3076	13.0	••••••••••••••
2	8827	37.4	•••
3	7438	31.5	••••••••••••••••••••••••••••••••••••
4	4206	17.8	••••••••••••••••••••

Stu_expe	Frequency	Percentage	Bar Chart
1	7932	33.6	••••••••••••••••••••••••••••••
2	11646	49.4	•••
3	2774	11.8	••••••••••••
4	1201	5.1	•••••

Table A.6 Univariate Distributions for Boarding School Type

NF3	Frequency	Percentage	Bar Chart
0	844	41.4	••••••••••••••••••••••••••••••
1	1193	58.6	•••

NF5	Frequency	Percentage	Bar Chart
0	1271	62.4	•••
1	766	37.6	••••••••••••••••••••••••••

NF6	Frequency	Percentage	Bar Chart
0	1246	61.2	•••
1	791	38.8	••••••••••••••••••••••••••••

NF8	Frequency	Percentage	Bar Chart
0	1125	55.2	•••
1	912	44.8	••••••••••••••••••••••••••••••••••

NF19	Frequency	Percentage	Bar Chart
0	1247	61.2	•••
1	790	38.8	••••••••••••••••••••••••••••

Mother_e	Frequency	Percentage	Bar Chart
1	1021	50.1	•••
2	886	43.5	••••••••••••••••••••••••••••••••••••••
3	82	4.0	••••
4	32	1.6	•
5	16	0.8	•

Father_e	Frequency	Percentage	Bar Chart
1	356	17.5	••••••••••••••
2	1200	58.9	•••
3	272	13.4	••••••••••••
4	129	6.3	•••••
5	80	3.9	•••

Siblings	Frequency	Percentage	Bar Chart
1	38	1.9	••
2	161	7.9	•••••••••
3	497	24.4	••••••••••••••••••••••••••••
4	782	38.4	•••
5	559	27.4	••••••••••••••••••••••••••••••••

Books	Frequency	Percentage	Bar Chart
1	1245	61.1	•••
2	491	24.1	••••••••••••••••••
3	213	10.5	••••••••
4	57	2.8	••
5	31	1.5	•

Tut_sci	Frequency	Percentage	Bar Chart
1	1675	82.2	•••
2	127	6.2	••••
3	159	7.8	••••
4	49	2.4	•
5	24	1.2	•

Tut_math	Frequency	Percentage	Bar Chart
1	1601	78.6	•••
2	169	8.3	•••••
3	174	8.5	•••••
4	62	3.0	••
5	28	1.4	•

Tut_tur	Frequency	Percentage	Bar Chart
1	1628	79.9	••
2	151	7.4	••••
3	162	8.0	•••••
4	52	2.6	••
5	41	2.0	•

Int_math	Frequency	Percentage	Bar Chart
1	114	5.6	•••••••
2	297	14.6	•••••••••••••••••
3	799	39.2	•••
4	824	40.5	•••

Int_sci	Frequency	Percentage	Bar Chart
1	85	4.2	••••
2	311	15.3	••••••••••••••••
3	892	43.8	•••
4	747	36.7	••••••••••••••••••••••••••••••••••••

Suc_math	Frequency	Percentage	Bar Chart
1	140	6.9	•••••••
2	574	28.2	••••••••••••••••••••••••••••
3	956	46.9	•••
4	365	17.9	•••••••••••••••••••

Suc_math	Frequency	Percentage	Bar Chart
1	89	4.4	••••
2	480	23.6	••••••••••••••••••••
3	1145	56.2	•••
4	320	15.7	••••••••••••••

Tea_less	Frequency	Percentage	Bar Chart
1	56	2.7	•••
2	485	23.8	••••••••••••••••••••••••••
3	851	41.8	•••
4	635	31.2	••••••••••••••••••••••••••••••••••

Stu_less	Frequency	Percentage	Bar Chart
1	253	12.4	•••••••••
2	1357	66.6	•••
3	308	15.1	••••••••••••
4	114	5.6	••••

Stu_disc	Frequency	Percentage	Bar Chart
1	336	16.5	••••••••••••••
2	1142	56.1	•••
3	404	19.8	•••••••••••••••••
4	149	7.3	••••••

Tea_disc	Frequency	Percentage	Bar Chart
1	204	10.0	•••••••••••
2	875	43.0	•••
3	676	33.2	••••••••••••••••••••••••••••••••••
4	277	13.6	••••••••••••••

Examples	Frequency	Percentage	Bar Chart
1	97	4.8	••••••
2	570	28.0	••••••••••••••••••••••••••••••
3	811	39.8	•••
4	554	27.2	••••••••••••••••••••••••••••••

Techno	Frequency	Percentage	Bar Chart
1	449	22.0	••••••••••••••••••••••
2	963	47.3	••
3	438	21.5	••••••••••••••••••••••
4	181	8.9	•••••••••

Techno	Frequency	Percentage	Bar Chart
1	190	9.3	•••••••••••
2	808	39.7	••
3	688	33.8	••••••••••••••••••••••••••••••••••••••
4	346	17.0	••••••••••••••••••••

Stu_expe	Frequency	Percentage	Bar Chart
1	575	28.2	••••••••••••••••••••••••
2	1072	52.6	•••
3	285	14.0	••••••••••••
4	99	4.9	••••

Table A.7 Univariate Distributions for Private School Type

NF3	Frequency	Percentage	Bar Chart
0	325	17.2	••••••••••
1	1570	82.8	••

NF4	Frequency	Percentage	Bar Chart
0	483	25.5	••••••••••••••••
1	1412	74.5	••

NF5	Frequency	Percentage	Bar Chart
0	669	35.3	•••••••••••••••••••••••••
1	1226	64.7	••

NF10	Frequency	Percentage	Bar Chart
0	497	26.2	••••••••••••••••
1	1398	73.8	••

NF13	Frequency	Percentage	Bar Chart
0	584	30.8	••••••••••••••••••••
1	1311	69.2	••

NF14	Frequency	Percentage	Bar Chart
0	592	31.2	••••••••••••••••••••
1	1303	68.8	••

NF16	Frequency	Percentage	Bar Chart
0	566	29.9	•••••••••••••••••••
1	1329	70.1	••

NF19	Frequency	Percentage	Bar Chart
0	785	41.4	•••••••••••••••••••••••••••••••
1	1110	58.6	••

Mother_e	Frequency	Percentage	Bar Chart
1	46	2.4	•••
2	348	18.4	•••••••••••••••••••••••••
3	239	12.6	•••••••••••••••••
4	662	34.9	••
5	600	31.7	•••

Father_e	Frequency	Percentage	Bar Chart
1	5	0.3	
2	140	7.4	••••••
3	183	9.7	••••••••
4	542	28.6	•••••••••••••••••••••••••
5	1025	54.1	••

Siblings	Frequency	Percentage	Bar Chart
1	259	13.7	••••••••••••••
2	824	43.5	••
3	597	31.5	••••••••••••••••••••••••••••••••••
4	187	9.9	••••••••••••
5	28	1.5	••

Books	Frequency	Percentage	Bar Chart
1	52	2.7	••••
2	199	10.5	••••••••••••
3	654	34.5	••
4	540	28.5	••••••••••••••••••••••••••••••••••••
5	450	23.7	••••••••••••••••••••••••••••••

Tut_sci	Frequency	Percentage	Bar Chart
1	1077	56.8	••
2	124	6.5	•••••
3	358	18.9	••••••••••••••••
4	228	12.0	•••••••••••
5	106	5.6	•••••

Tut_math	Frequency	Percentage	Bar Chart
1	990	52.2	••
2	129	6.8	••••••
3	393	20.7	••••••••••••••••••
4	275	14.5	••••••••••••••
5	107	5.6	•••••

Tut_tur	Frequency	Percentage	Bar Chart
1	1220	64.4	••
2	146	7.7	••••••
3	313	16.5	••••••••••••
4	151	8.0	••••••
5	63	3.3	••

Int_math	Frequency	Percentage	Bar Chart
1	38	2.0	••
2	133	7.0	••••••
3	646	34.1	••••••••••••••••••••••••••
4	1076	56.8	••

Int_sci	Frequency	Percentage	Bar Chart
1	58	3.1	•••
2	203	10.7	••••••••••
3	771	40.7	••••••••••••••••••••••••••••••••••••
4	863	45.5	••

Suc_math	Frequency	Percentage	Bar Chart
1	47	2.5	•••
2	402	21.2	••••••••••••••••••••
3	862	45.5	••
4	584	30.8	••••••••••••••••••••••••••••••

Suc_math	Frequency	Percentage	Bar Chart
1	60	3.2	•••
2	440	23.2	••••••••••••••••••••
3	951	50.2	••
4	444	23.4	••••••••••••••••••••

Tea_less	Frequency	Percentage	Bar Chart
1	5	0.3	
2	80	4.2	••••
3	760	40.1	••••••••••••••••••••••••••••••••
4	1050	55.4	••

Stu_less	Frequency	Percentage	Bar Chart
1	411	21.7	••••••••••••••••
2	1316	69.4	••
3	143	7.5	•••••
4	25	1.3	•

Stu_disc	Frequency	Percentage	Bar Chart
1	288	15.2	••••••••••••
2	1128	59.5	••
3	390	20.6	••••••••••••••••
4	89	4.7	••••

Tea_disc	Frequency	Percentage	Bar Chart
1	142	7.5	•••••••••
2	725	38.3	••
3	764	40.3	•••
4	264	13.9	••••••••••••••••

Examples	Frequency	Percentage	Bar Chart
1	35	1.8	••
2	271	14.3	••••••••••••••••
3	711	37.5	•••••••••••••••••••••••••••••••••••••
4	878	46.3	•••

Techno	Frequency	Percentage	Bar Chart
1	226	11.9	••••••••••••••
2	806	42.5	•••
3	550	29.0	••••••••••••••••••••••••••••••••
4	313	16.5	•••••••••••••••••••

Teac_expe	Frequency	Percentage	Bar Chart
1	157	8.3	••••••••••••
2	645	34.0	••
3	670	35.4	•••
4	423	22.3	••••••••••••••••••••••••••••

Stu_expe	Frequency	Percentage	Bar Chart
1	408	21.5	••••••••••••••••••••
2	942	49.7	•••
3	381	20.1	••••••••••••••••••
4	164	8.7	••••••••

APPPENDIX B

BASIC MODELS
FOR GRADE LEVELS AND SCHOOL TYPES

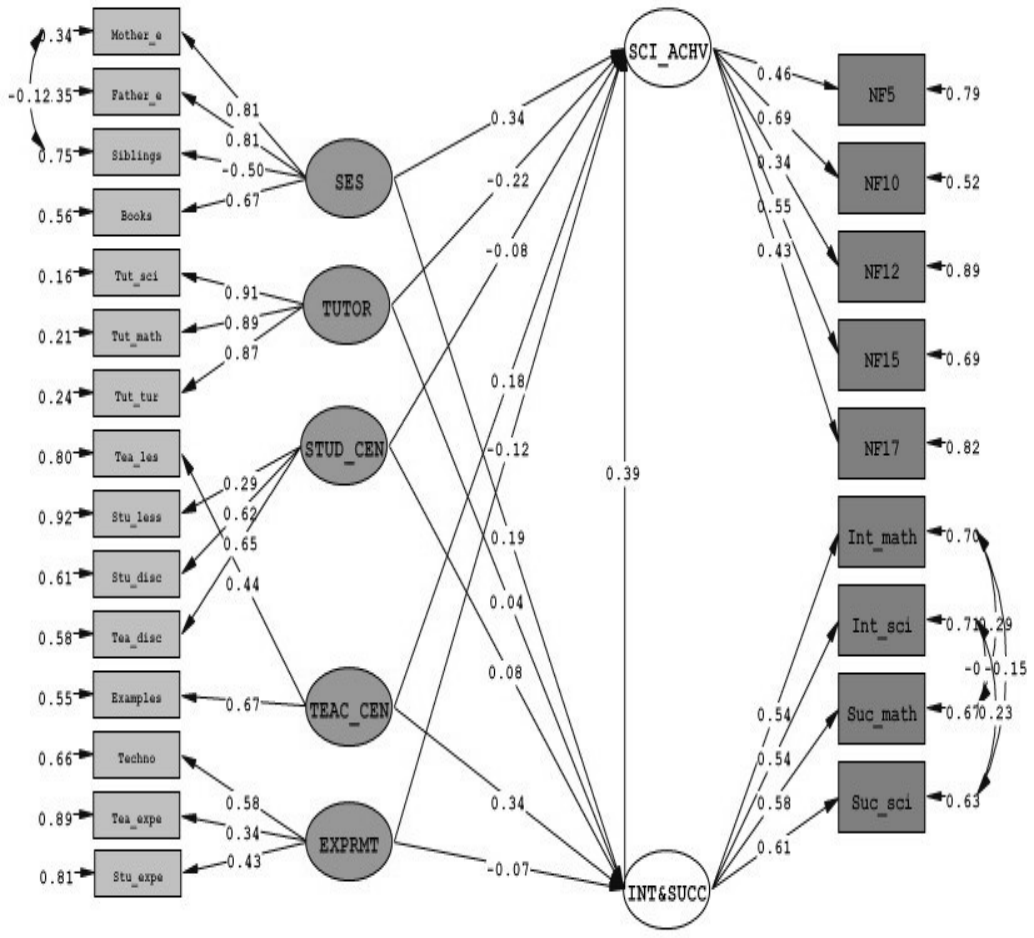

Figure B.1 Model for Grade Level 6 with standardized coefficients

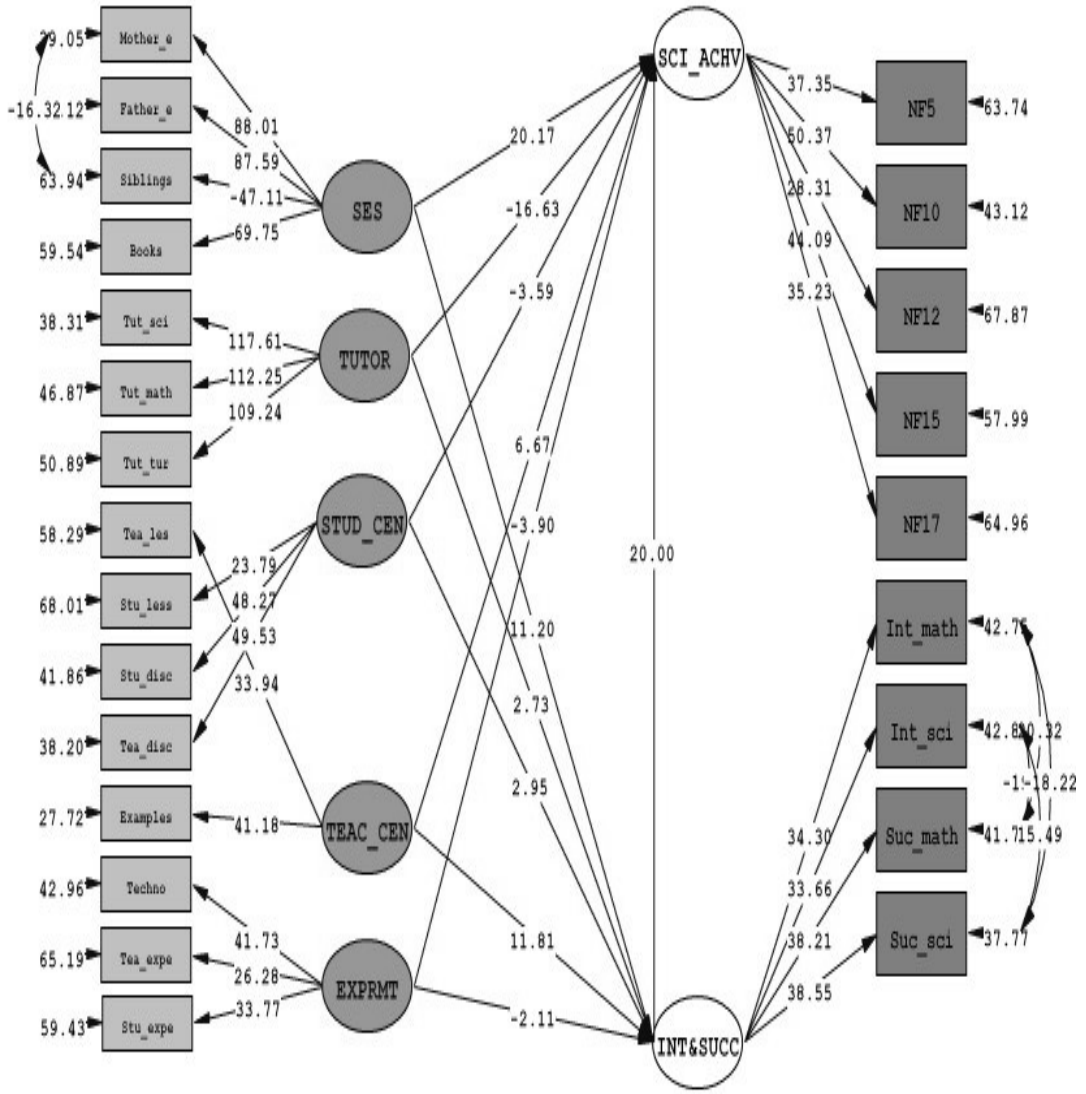

Figure B.2 Model for Grade Level 6 with t values

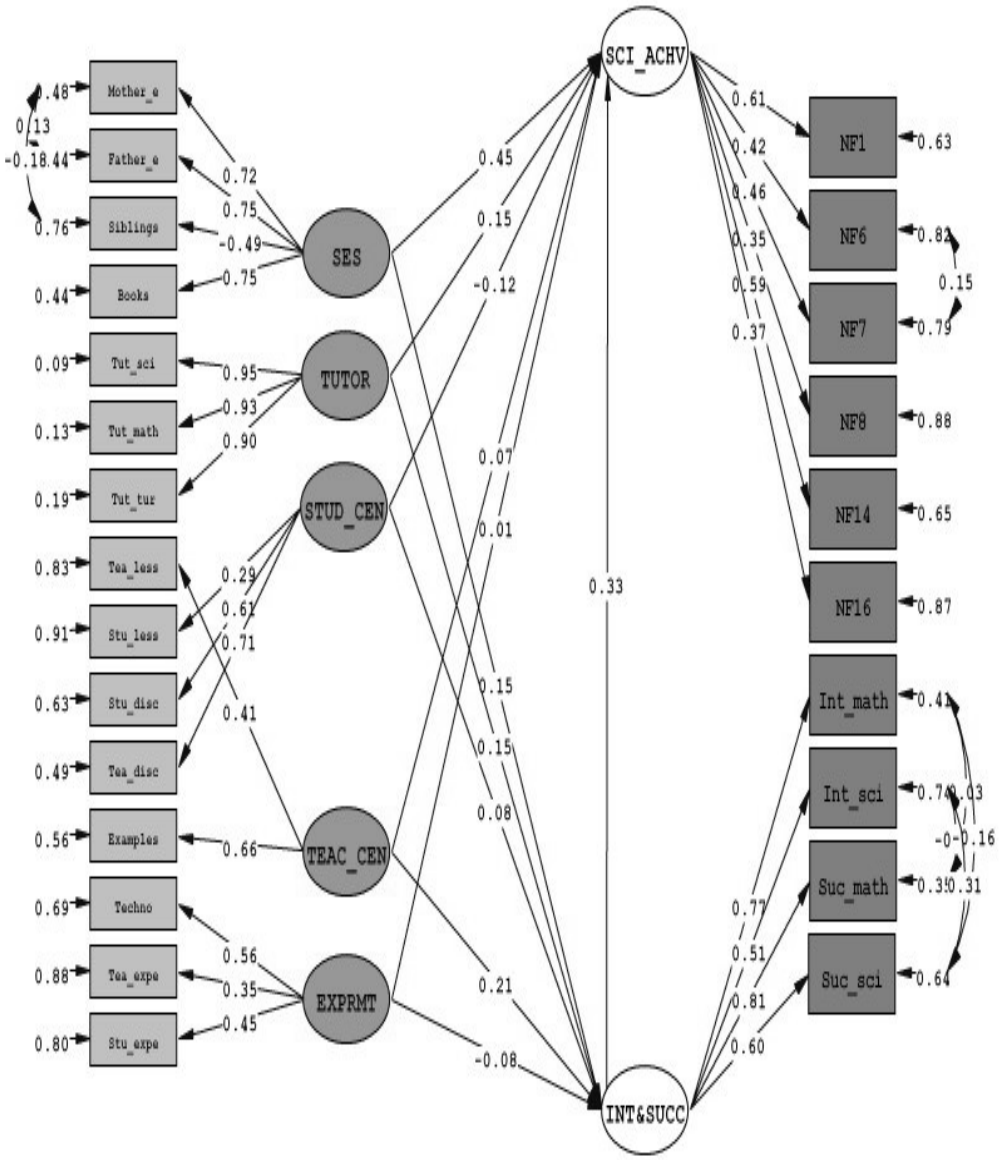

Figure B.3 Model for Grade Level 7 with standardized coefficients

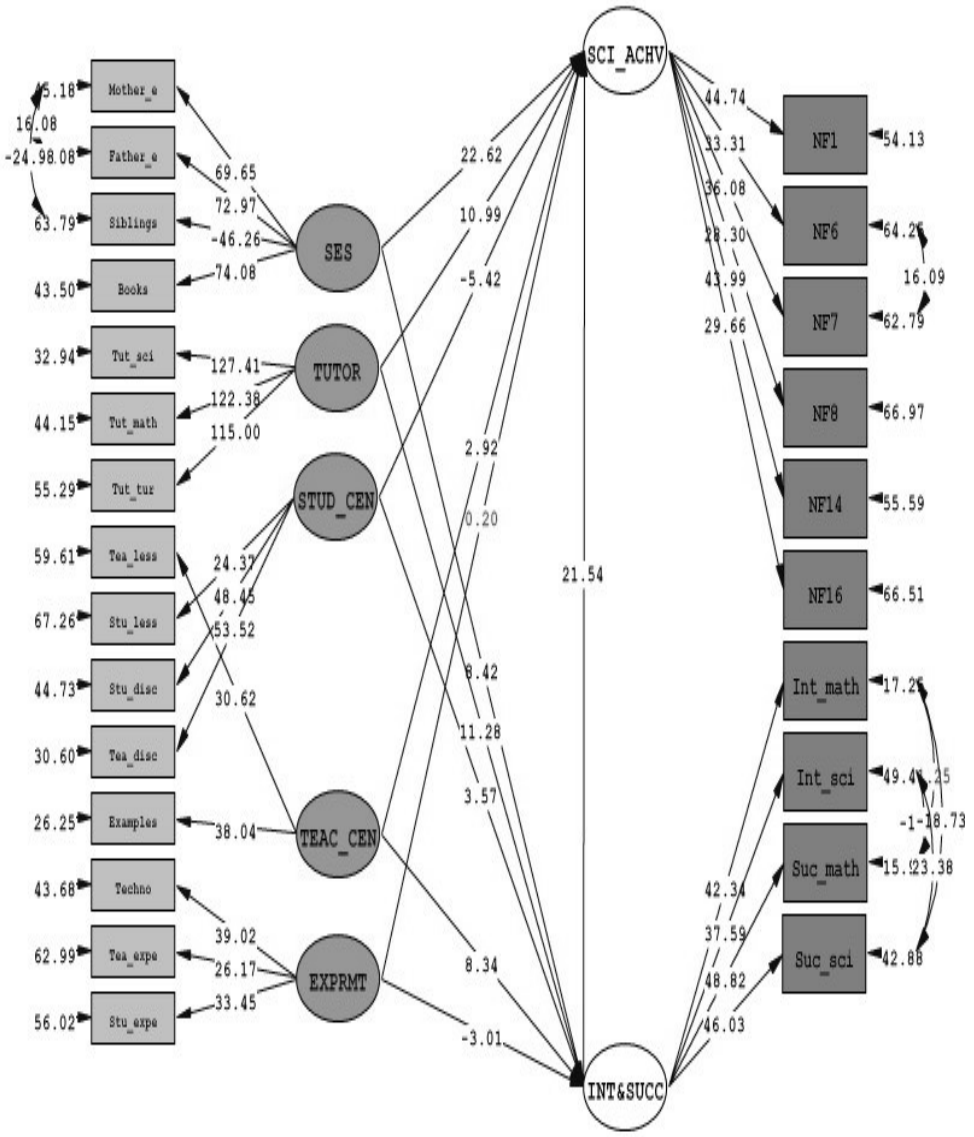

Figure B.4 Model for Grade Level 7 with t values

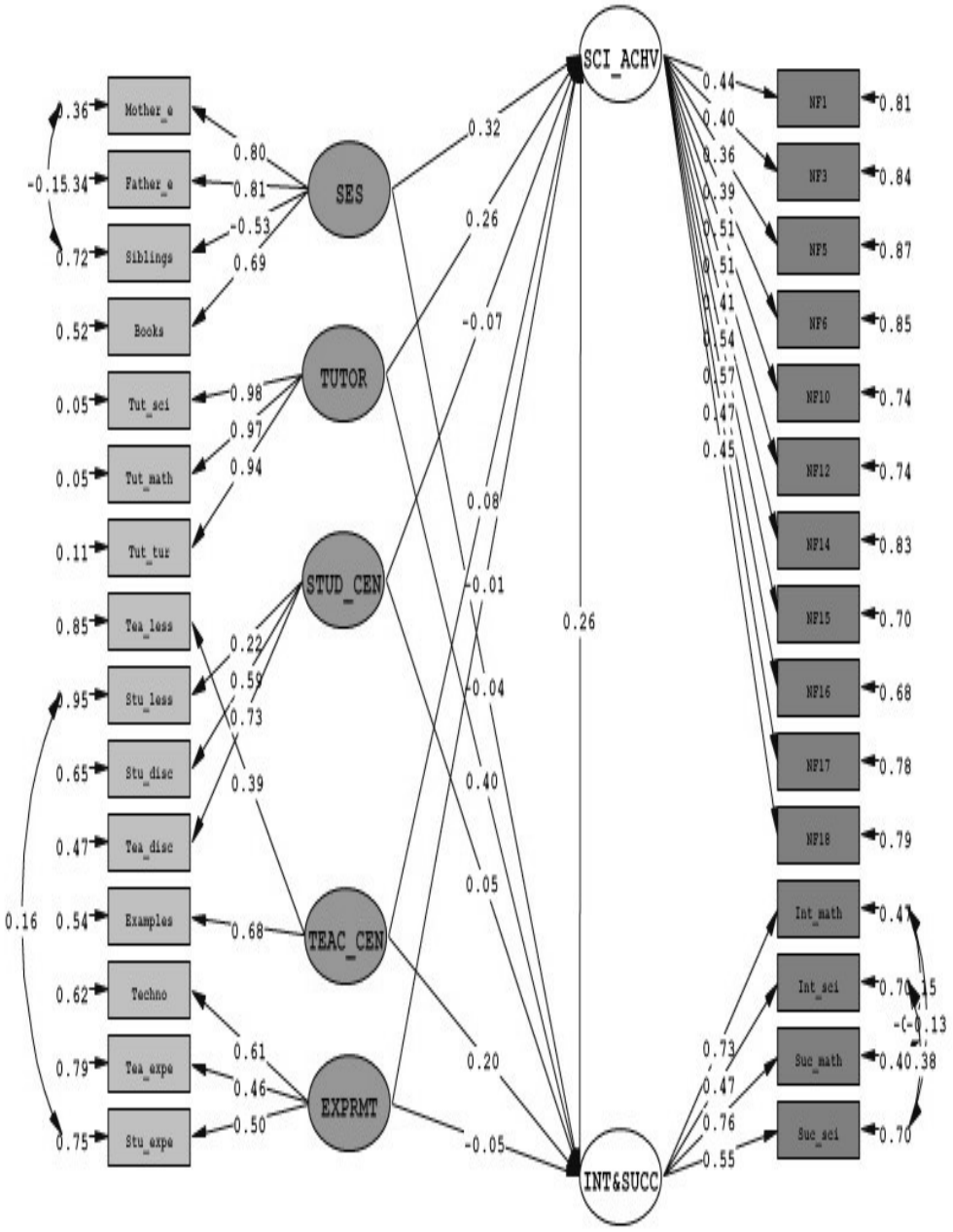

Figure B.5 Model for Grade Level 8 with standardized coefficients

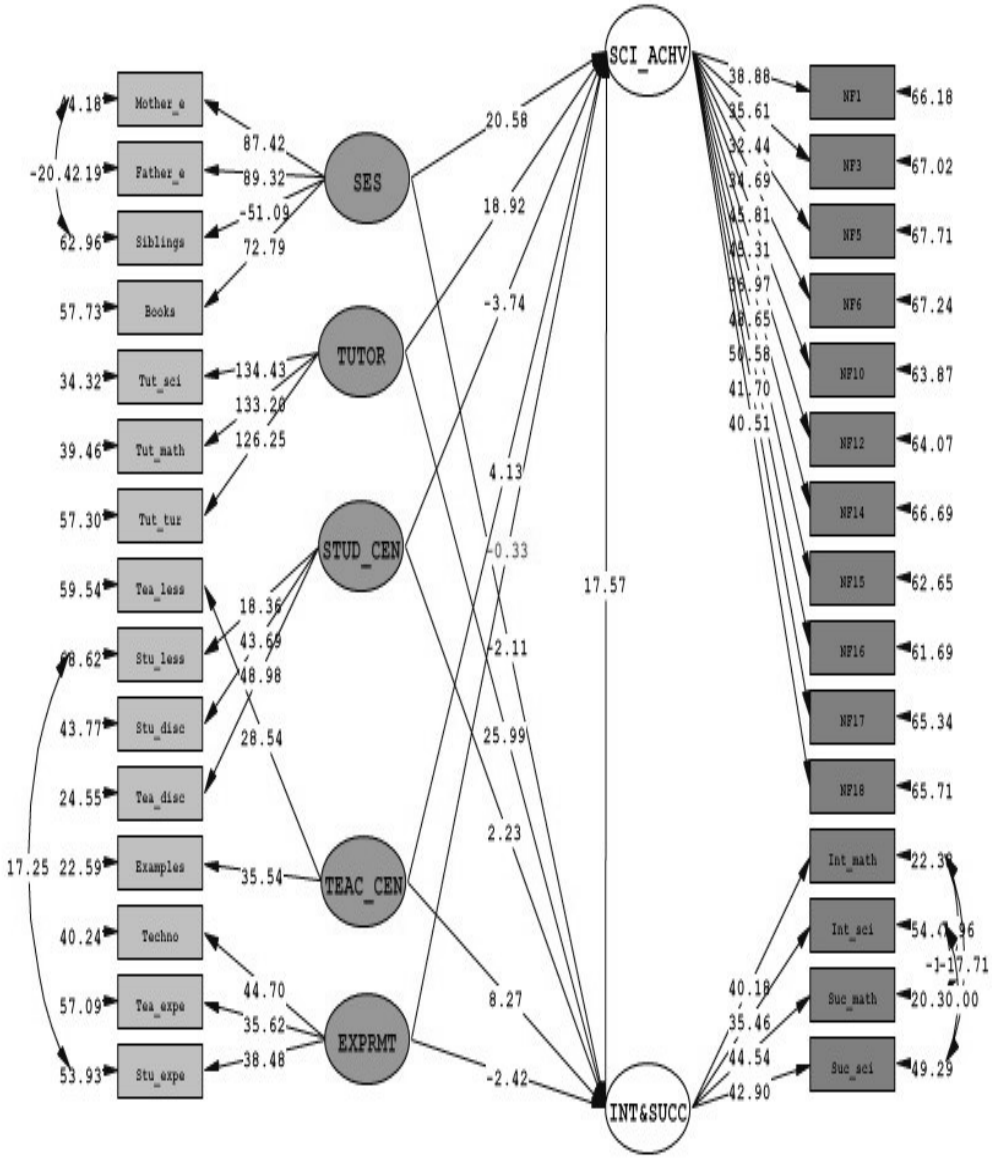

Figure B.6 Model for Grade Level 8 with t values

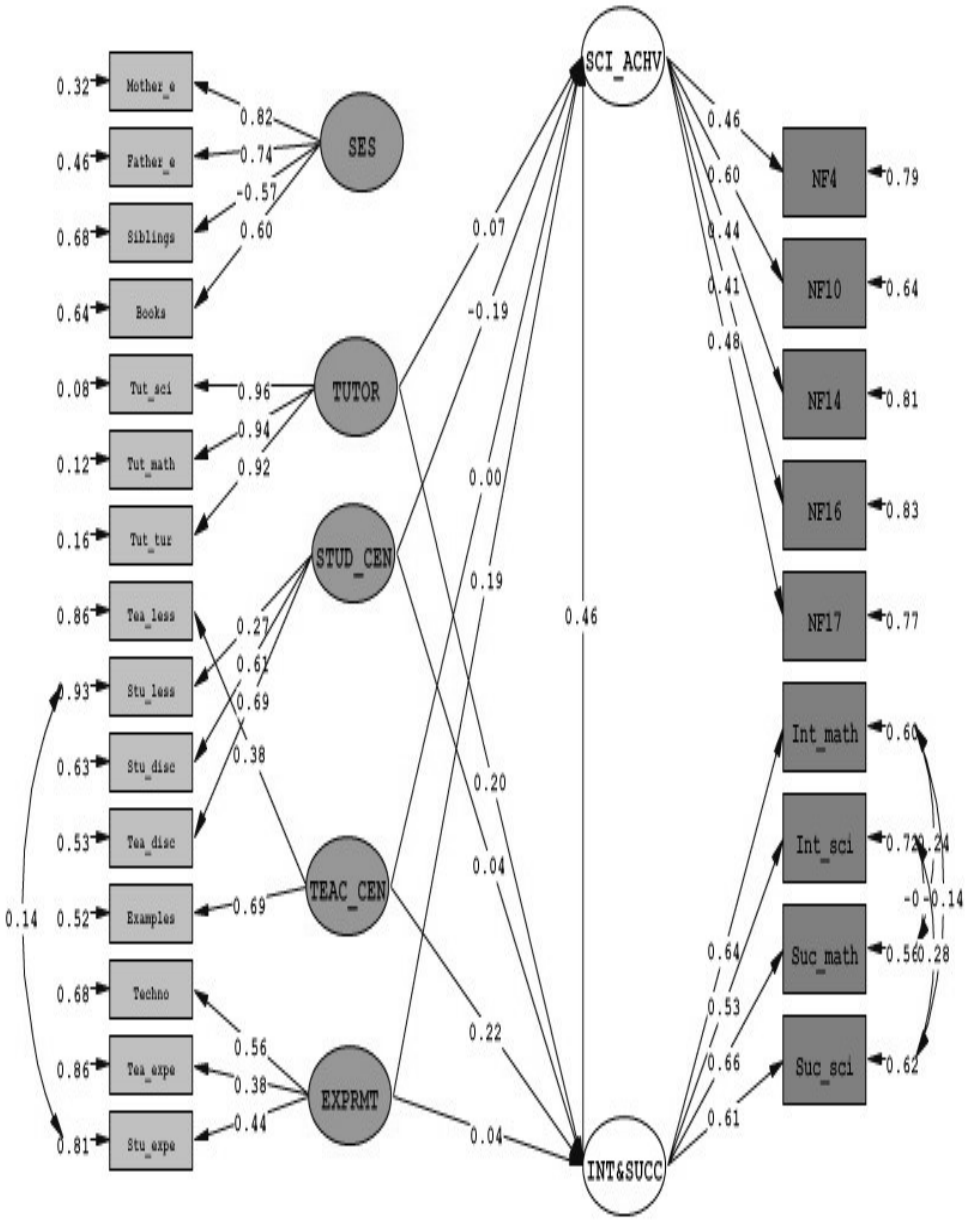

Figure B.7 Model for State School Type with standardized coefficients

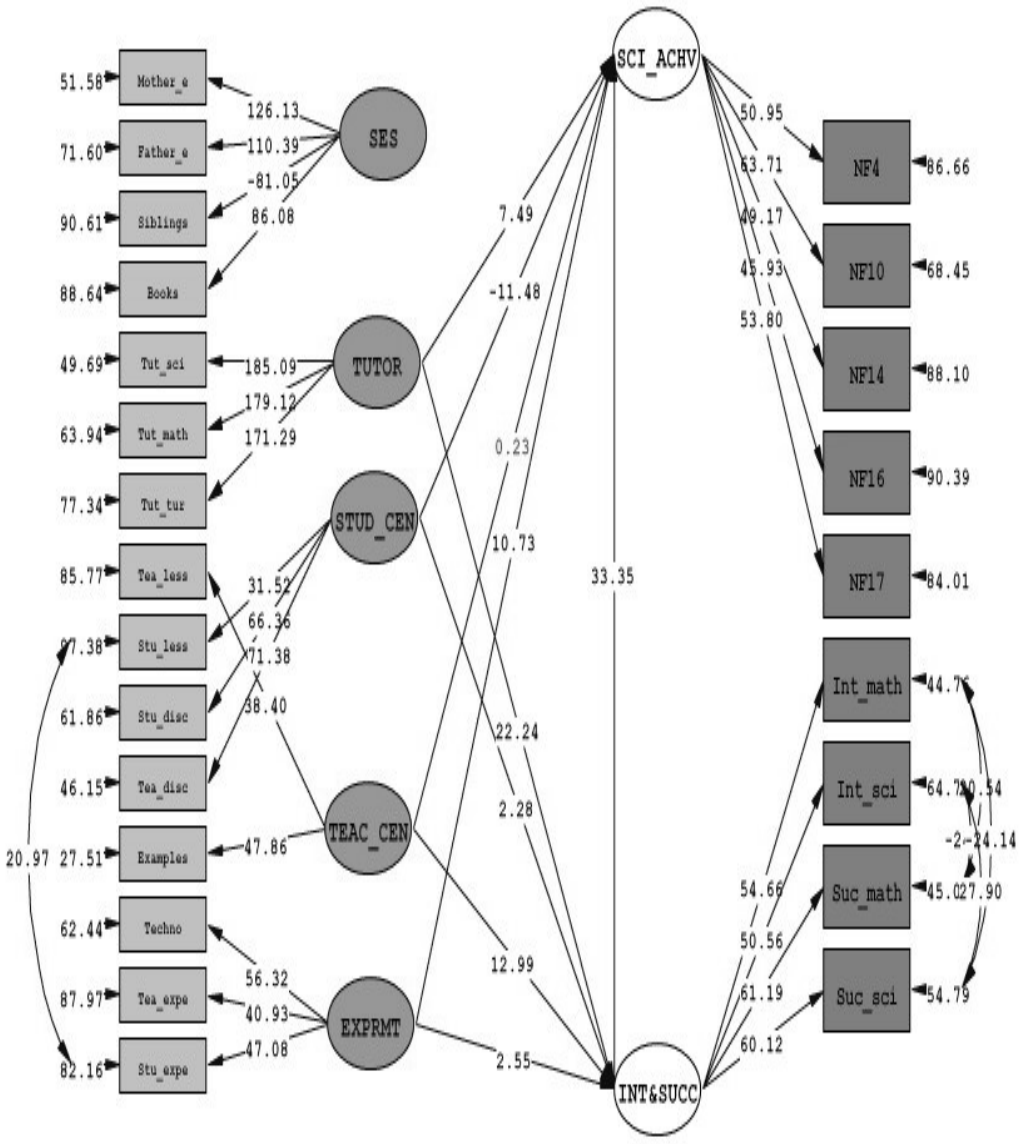

Figure B.8 Model for State School Type with t values

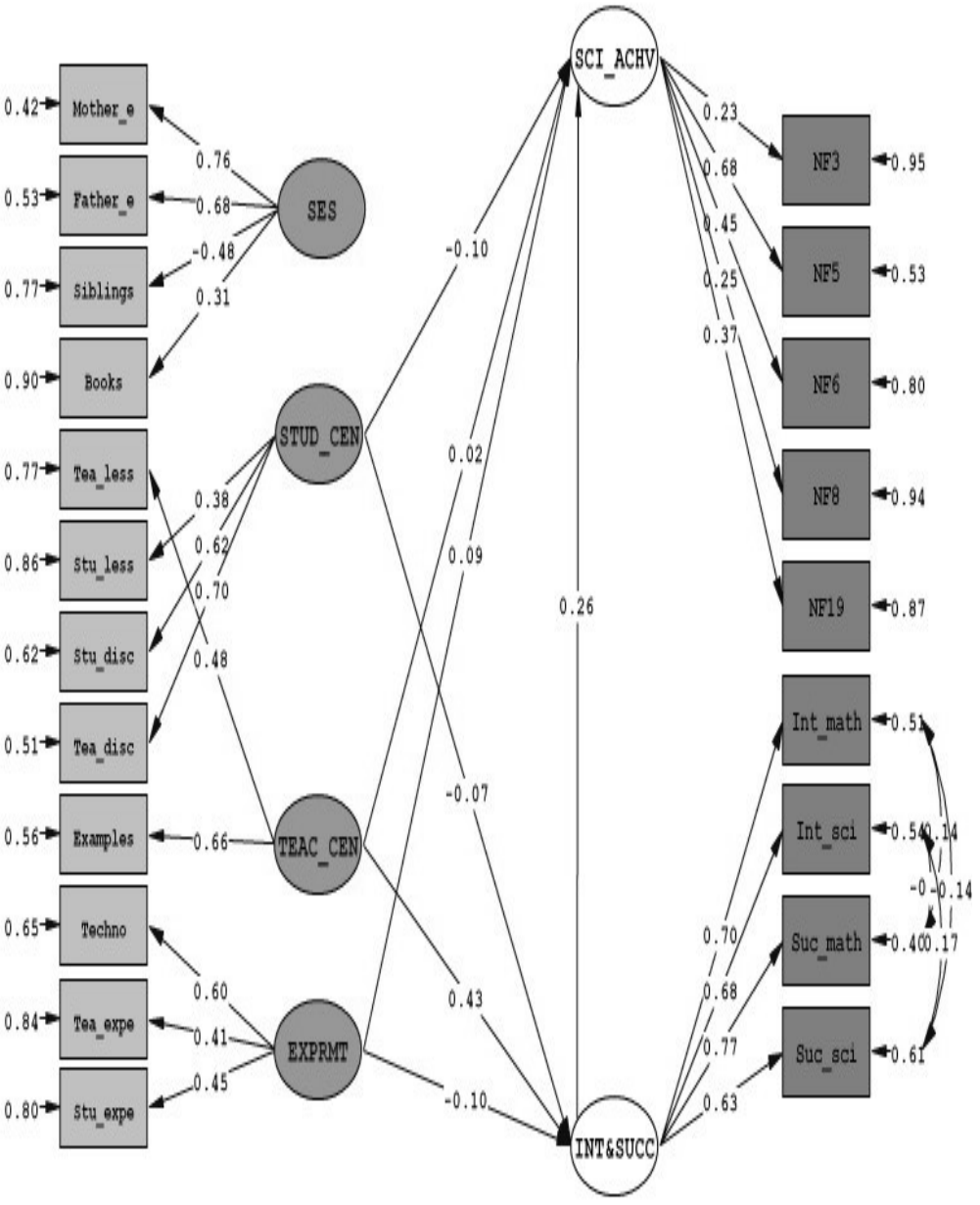

Figure B.9 Model for Boarding School Type with standardized coefficients

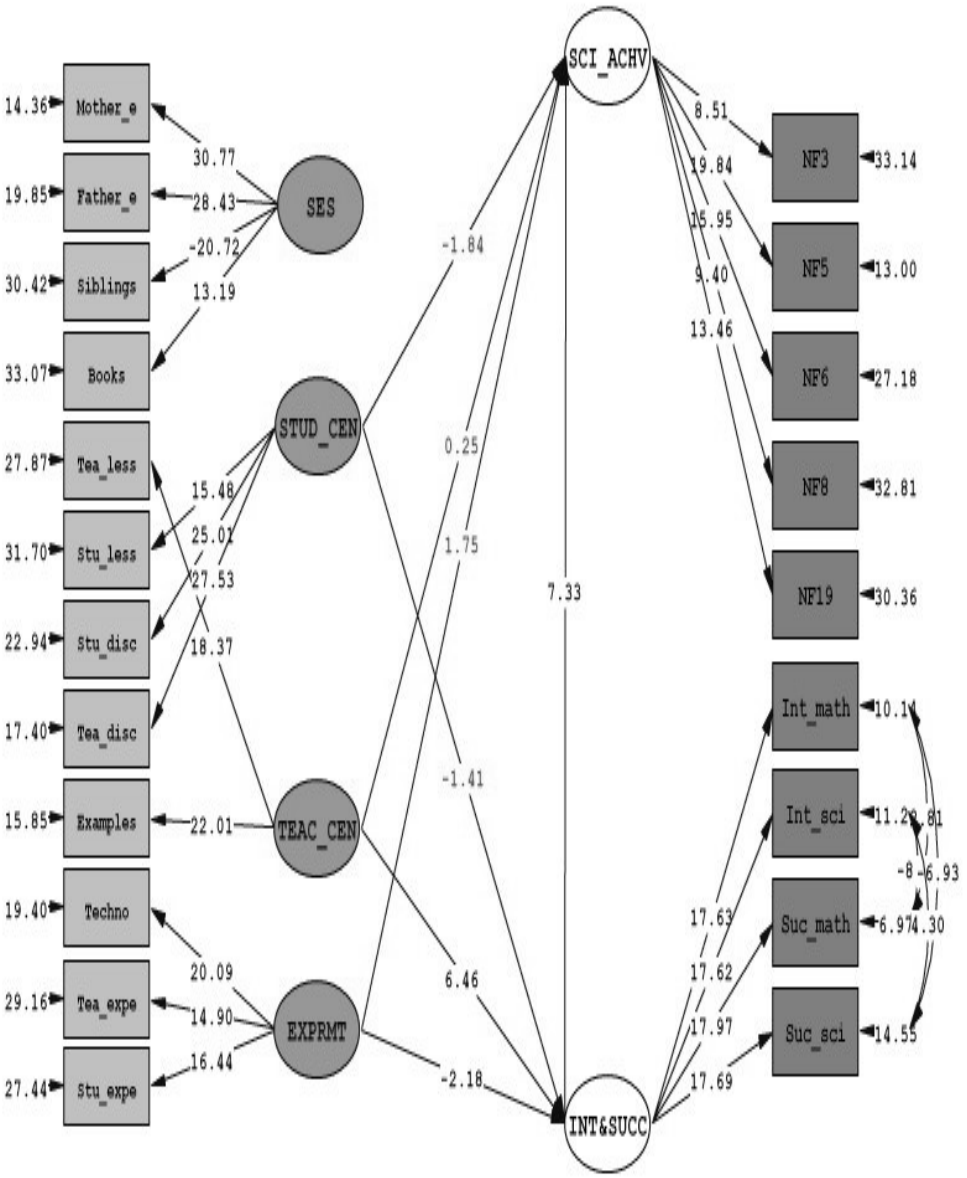

Figure B.10 Model for Boarding School Type with t values

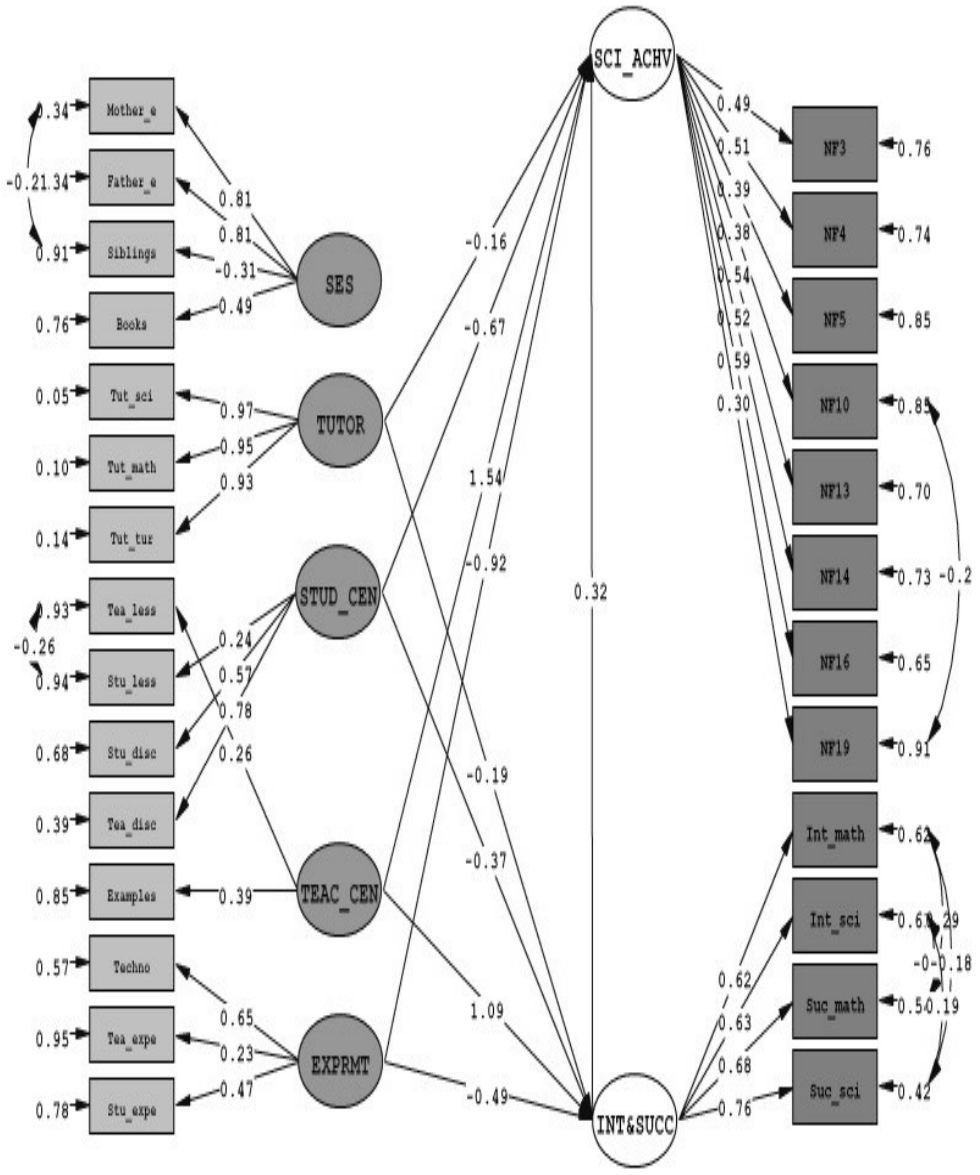

Figure B.11 Model for Private School Type with standardized coefficients

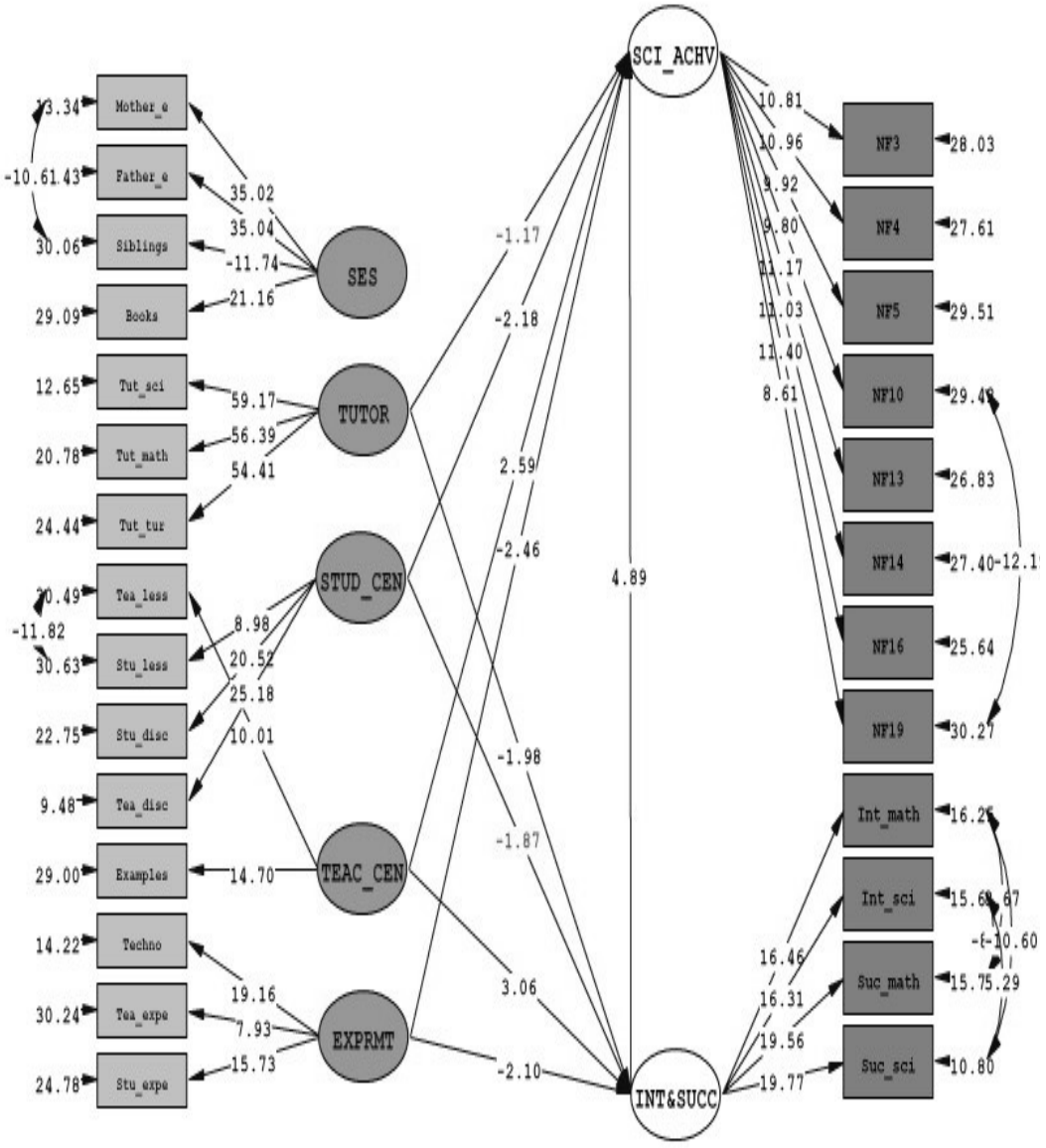

Figure B.12 Model for Private School Type with t values

APPPENDIX C

SIMPLIS SYNTAXES

FOR GRADE LEVELS AND SCHOOL TYPES

Model for Grade Level 6

Factors Affecting Science Achievement
Observed Variables
Mother_e Father_e Siblings Books Stu_les Stu_disc Tea_Disc Tea_less Examples
Tut_scie Tut_math Tut_turk Int_sci Int_mat Suc_sci Suc_math Techno Tea_expe
Stu_expe NF5 NF10 NF12 NF15 NF17

Covariance Matrix from file: lisrel6b.cov
Sample Size = 10307
Latent Variables SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
SCI_ACHV

Relationships
Mother_e Father_e Siblings Books = SES
Stu_les Stu_disc Tea_Disc = STUD_CENT
Techno Tea_expe Stu_expe = EXPRMT
Tut_scie Tut_math Tut_turk = TUTOR
Int_sci Int_mat Suc_sci Suc_math = INT&SUCC
Tea_less Examples = TEAC_CENT

NF5 NF10 NF12 NF15 NF17 = SCI_ACHV
SCI_ACHV = SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
INT&SUCC = SES STUD_CENT EXPRMT TUTOR TEAC_CENT
SCI_ACHV = INT&SUCC

Let the Error of Mother_e and Siblings Correlate
Let the Error of Int_math and Suc_sci Correlate
Let the Error of Int_sci and Suc_sci Correlate
Let the Error of Int_math and Suc_math Correlate
Let the Error of Int_sci and Suc_math Correlate

LISREL output: EF SC
Path Diagram
Method of Estimation: Maximum Likelihood
End of Problem

Model for Grade Level 7

Factors Affecting Science Achievement
Observed Variables
Mother_e Father_e Siblings Books Stu_les Stu_disc Tea_Disc Tea_less Examples
Tut_scie Tut_math Tut_turk Int_sci Int_mat Suc_sci Suc_math Techno Tea_expe
Stu_expe NF1 NF6 NF7 NF8 NF14 NF16

Covariance Matrix from file: lisrel7b.cov
Sample Size = 9985
Latent Variables SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
SCI_ACHV

Relationships
Mother_e Father_e Siblings Books = SES
Stu_les Stu_disc Tea_Disc = STUD_CENT
Techno Tea_expe Stu_expe = EXPRMT
Tut_scie Tut_math Tut_turk = TUTOR
Int_sci Int_mat Suc_sci Suc_math = INT&SUCC
Tea_less Examples = TEAC_CENT

NF1 NF6 NF7 NF8 NF14 NF16 = SCI_ACHV
SCI_ACHV = SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
INT&SUCC = SES STUD_CENT EXPRMT TUTOR TEAC_CENT
SCI_ACHV = INT&SUCC

Let the Error of NF6 and NF7 Correlate
Let the Error of Mother_e and Father_e Correlate
Let the Error of Mother_e and Siblings Correlate
Let the Error of Int_math and Suc_sci Correlate
Let the Error of Int_sci and Suc_sci Correlate
Let the Error of Int_math and Suc_math Correlate
Let the Error of Int_sci and Suc_math Correlate

Path Diagram
LISREL output: EF SC
Method of Estimation: Maximum Likelihood
End of Problem

Model for Grade Level 8

Factors Affecting Science Achievement
Observed Variables
Mother_e Father_e Siblings Books Stu_les Stu_disc Tea_Disc Tea_less Examples Tut_scie Tut_math Tut_turk Int_sci Int_mat Suc_sci Suc_math Techno Tea_expe Stu_expe NF1 NF3 NF5 NF6 NF10 NF12 NF14 NF15 NF16 NF17 NF18
Covariance Matrix from file: lisrel8b.cov
Sample Size = 9960
Latent Variables SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT SCI_ACHV

Relationships
Mother_e Father_e Siblings Books = SES
Stu_les Stu_disc Tea_Disc = STUD_CENT
Techno Tea_expe Stu_expe = EXPRMT
Tut_scie Tut_math Tut_turk = TUTOR
Int_sci Int_mat Suc_sci Suc_math = INT&SUCC
Tea_less Examples = TEAC_CENT

NF1 NF3 NF5 NF6 NF10 NF12 NF14 NF15 NF16 NF17 NF18 = SCI_ACHV
SCI_ACHV = SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
INT&SUCC = SES STUD_CENT EXPRMT TUTOR TEAC_CENT
SCI_ACHV = INT&SUCC

Let the Error of Mother_e and Siblings Correlate
Let the Error of Int_math and Suc_sci Correlate
Let the Error of Int_sci and Suc_sci Correlate
Let the Error of Int_math and Suc_math Correlate
Let the Error of Int_sci and Suc_math Correlate
Let the Error of Stu_les and Stu_expe Correlate

LISREL output: EF SC
Path Diagram
Method of Estimation: Maximum Likelihood
End of Problem

Model for State School Type

Factors Affecting Science Achievement
Observed Variables
Mother_e Father_e Siblings Books Stu_les Stu_disc Tea_Disc Tea_less Examples
Tut_scie Tut_math Tut_turk Int_sci Int_mat Suc_sci Suc_math Techno Tea_expe
Stu_expe NF4 NF10 NF14 NF16 NF17

Covariance Matrix from file: okul-1.cov
Sample Size = 20736
Latent Variables SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
SCI_ACHV

Relationships
Mother_e Father_e Siblings Books = SES
Stu_les Stu_disc Tea_Disc = STUD_CENT
Techno Tea_expe Stu_expe = EXPRMT
Tut_scie Tut_math Tut_turk = TUTOR
Int_sci Int_mat Suc_sci Suc_math = INT&SUCC
Tea_less Examples = TEAC_CENT

NF4 NF10 NF14 NF16 NF17 = SCI_ACHV
SCI_ACHV = 0*SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
INT&SUCC = 0*SES STUD_CENT EXPRMT TUTOR TEAC_CENT
SCI_ACHV = INT&SUCC

Let the Error of Int_math and Suc_sci Correlate
Let the Error of Int_sci and Suc_sci Correlate
Let the Error of Int_math and Suc_math Correlate
Let the Error of Int_sci and Suc_math Correlate
Let the Error of Stu_les and Stu_expe Correlate

LISREL output: EF SC
Path Diagram
Method of Estimation: Maximum Likelihood
End of Problem

Model for Boarding School Type

Factors Affecting Science Achievement
Observed Variables
Mother_e Father_e Siblings Books Stu_les Stu_disc Tea_Disc Tea_less Examples Tut_scie Tut_math Tut_turk Int_sci Int_mat Suc_sci Suc_math Techno Tea_expe Stu_expe NF3 NF5 NF6 NF8 NF19

Covariance Matrix from file: okul-2.cov
Sample Size = 2379
Latent Variables SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT SCI_ACHV

Relationships
Mother_e Father_e Siblings Books = SES
Stu_les Stu_disc Tea_Disc = STUD_CENT
Techno Tea_expe Stu_expe = EXPRMT
Int_sci Int_mat Suc_sci Suc_math = INT&SUCC
Tea_less Examples = TEAC_CENT

NF3 NF5 NF6 NF8 NF19 = SCI_ACHV
SCI_ACHV = 0*SES STUD_CENT EXPRMT INT&SUCC TEAC_CENT
INT&SUCC = 0*SES STUD_CENT EXPRMT TEAC_CENT
SCI_ACHV = INT&SUCC

Let the Error of Int_math and Suc_sci Correlate
Let the Error of Int_sci and Suc_sci Correlate
Let the Error of Int_math and Suc_math Correlate
Let the Error of Int_sci and Suc_math Correlate

LISREL output: EF SC
Path Diagram
Method of Estimation: Maximum Likelihood
End of Problem

Model for Private School Type

Factors Affecting Science Achievement
Observed Variables
Mother_e Father_e Siblings Books Stu_les Stu_disc Tea_Disc Tea_less Examples Tut_scie Tut_math Tut_turk Int_sci Int_mat Suc_sci Suc_math Techno Tea_expe Stu_expe NF3 NF4 NF5 NF10 NF13 NF14 NF16 NF19

Covariance Matrix from file: okul-3.cov
Sample Size = 1980
Latent Variables SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT SCI_ACHV

Relationships
Mother_e Father_e Siblings Books = SES
Stu_les Stu_disc Tea_Disc = STUD_CENT
Techno Tea_expe Stu_expe = EXPRMT
Tut_scie Tut_math Tut_turk = TUTOR
Int_sci Int_mat Suc_sci Suc_math = INT&SUCC
Tea_less Examples = TEAC_CENT

NF3 NF4 NF5 NF10 NF13 NF14 NF16 NF19 = SCI_ACHV
SCI_ACHV = 0*SES STUD_CENT EXPRMT TUTOR INT&SUCC TEAC_CENT
INT&SUCC = 0*SES STUD_CENT EXPRMT TUTOR TEAC_CENT
SCI_ACHV = INT&SUCC

Let the Error of Mother_e and Siblings Correlate
Let the Error of Int_math and Suc_sci Correlate
Let the Error of Int_sci and Suc_sci Correlate
Let the Error of Int_math and Suc_math Correlate
Let the Error of Int_sci and Suc_math Correlate
Let the Error of Stu_les and Teac_less Correlate
Let the Error of NF10 and NF19 Correlate

LISREL output: EF SC
Path Diagram
Method of Estimation: Maximum Likelihood
End of Problem