MODELING THE RELATIONSHIP BETWEEN THE SCIENCE TEACHER CHARACTERISTICS AND EIGHTH GRADE TURKISH STUDENT SCIENCE ACHIEVEMENT IN TIMSS-R

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ABSTRACT

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Teachers are perceived as playing a primary role in a students' learning process. To adequately perform this role, certain teacher characteristics are potentially more valuable for encouraging student learning. In an attempt to discern those characteristics related to student learning and teacher behavior in the science classroom, numerous studies have been conducted. The aim of this study is modeling the relationship between the teacher characteristics and the student science achievement. Modeling analysis was carried out by using the data collected for the Third International Math and Science Study (TIMSS, 1999) for Turkey with Science Teacher Background Questionnaire and students' achievement test scores. For the analysis LISREL package program was used.

The results show that students of teachers who prefer student-centered learning activities got low scores from science achievement test in TIMSS. Also teachers believe that disruptive and uninterested student in the class negatively affect science achievement. Moreover, there is a positive significant relationship between science achievement and tasks that includes analyze relationship, explain reasoning, and work on problems. In the present study you can find a analysis about the contradiction of the some of the results of the study with the current literature in the field of education.

Keywords: Teacher Characteristics, Science Achievement, TIMSS-R, Structural Equation Modeling

ÖZ

ÖĞRETMEN KAREKTERİSTİKLERİ iLE TÜRKİYE' DEKİ SEKİZİNCİ SINIF ÖĞRENCİLERİNİN FEN BİLGİSİ BAŞARISININ TIMSS-R VERİLERİ KULLANILARAK MODELLENMESİ

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Öğretmenler öğrencinin öğrenme sürecinde ana role sahip olarak görülürler.Bu rolü yeterli şekilde yerine getirebilmek için bazı öğretmen karakteristikleri öğrenci öğrenimini motive etmek için potansiyel olarak diğerlerinden daha değerlidirler.Fen sınıfında ki öğrencinin öğrenimi ve öğretmen davranışlarıyla ilgili olan bu öğretmen karakteristiklerini diğerlerinden ayırt etmek için bir çok çalışma yapılmaktadır.Bu çalışmanın amacı öğretmen karakteristikleri ile öğrenci başarısı arasındaki ilişkiyi modellemektir.Modelleme çalışmasında kullanılan veriler Üçüncü Uluslararası Fen ve Matematik çalışması için Fen Öğretmenleri anketi ve Öğrenci başarı testleri ile toplanan verilerdir. Analizler için LISREL paket programı kullanılmıştır.

Çalışma sonuçları sınıfta öğrenci merkezli eğitim yaptığını söyleyen öğretmenlerin öğrencileri fen başarı testinden düşük puanlar almışlardır. Ayrıca öğretmenler sınıf içerisindeki dağınık ve ilgisiz öğrencilerin sayısının artmasının sınıfın fen bilgisi başarısını negatif yönde etkilediğini savunmuşlardır. Bununla birlikte, öğretmen tarafından ilişkilerin analizine, bir gerçeğin arkasındaki mantığın açıklanmasına ve probleme dayalı öğrenme görevlerinin seçimi öğrencilerin fen bilgisi başarılarını artırmaktadır. Bu çalışmada ortaya çıkan bazı sonuçlarının eğitim alanındaki literatürle neden çeliştiğinin bir analizini de bulabilirsiniz.

Anahtar Kelimeler: Öğretmen Karakteristikleri, Fen Başarısı, TIMSS, Yapısal Denklem Modellemesi

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I wish to thank my mother and my father who shared all the difficulties and stresses during my study and always support me.

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To My Family

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LIST OF ABBREVIATIONS

TIMSS = Third International Mathematics and Science Study

TIMSS-R = Third International Mathematics and Science Study- Repeat

STBQ = Science Teacher Background Questionnaire

SAT = Science Achievement Test

IEA = International Association for the Evaluation of Educational Achievement

SEM = Structural Equation Modeling

NRCs = National Research Coordinators

ISC = International Study Center

CHAPTER 1

INTRODUCTION

1.1 Science Achievement

There is a saying that intelligence is what intelligence test measure. This saying is an even more appropriate description of academic achievement. What does it mean to achieve in a subject matter domain such as science. Of course achievement must include knowing important facts and concepts within the domain but achieving in science should go beyond this. “Learning science” has been described, at least in part, as a process of building an increasingly sophisticated knowledge; that is as a process of becoming expert in a science domain (Shavelson & Ruiz-Primo, 1998).

Achievement is the core concept in the educational setting. Every step is being done to reach expected outcomes in student domain. Naturally, educators use some assessment techniques whether the students attain or not to intended achievement level. To adequately perform this step educators searching different assessment techniques which require students’ performance. In recent years, performance-based or portfolio assessments have been highly focused on. Also factors affecting student achievement is the most widely studied topic by the researchers.

Ministries of education and schools around the world that are assessing the rigor and quality of their mathematics and science curricula and working to raise student achievement need concrete information about how their students perform in these subjects. Moreover, they want to know how their students compare with the best in the world. The IEA's Third International Mathematics and Science Study (TIMSS) provides this information, showing what students know and can do in mathematics and science and which students around the world are performing best.

1.2 Third International Mathematics and Science Study (TIMSS)

TIMSS 1999 represents the continuation of a long series of studies conducted by the International Association for the Evaluation of Educational Achievement (IEA). The Third International Mathematics and Science Study (TIMSS), conducted in 1995-1996, was the largest and most complex IEA study to date, and included both mathematics and science at third and fourth grades, seventh and eighth grades, and the final year of secondary school. In 1999, TIMSS again assessed eighth-grade students in both mathematics and science to measure trends in student achievement since 1995. This study was also known as TIMSS-Repeat, or TIMSS-R.

TIMSS in 1995 had as its target population students enrolled in the two adjacent grades that contained the largest proportion of 13-year-old students at the time of testing, which were seventh and eighth-grade students in most countries. TIMSS in 1999 used the same definition to identify the target grades, but assessed students in the upper of the two grades only, the eighth grade in most countries. 38 countries participated in TIMSS-R and Turkey was one of the participating country. Table 1.1 shows the participated countries to TIMSS.

Under the sponsorship of the International Association for the Evaluation of Educational Achievement (IEA), the Third International Mathematics and Science Study (TIMSS) provides unprecedented opportunities for cross-national analyses of educational systems throughout the world (Shen, 2002).

To describe the international benchmarks in terms of what students reaching those points know and can do, the TIMSS International Study Center conducted an in-depth analysis to determine the mathematics and science content knowledge and understandings associated with each benchmark for the fourth and eighth grades. As countries examine their mathematics and science curricula, they can look to the TIMSS benchmarks to find out what top-performing students know and can do and how their own students and curricula measure up. Together, the percentages of students in each country reaching each international benchmark show the strengths and weaknesses of fourth and eighth graders around the world.

By articulating performance at the TIMSS international benchmarks, ``world class" achievement has been defined (Kelly, 2002).

Table 1.1 Countries Participants in TIMSS 1999

Participated Countries in TIMSS at the 8^{th} Grade Level			
Australia	Hong Kong	Lithuania	Singapore
Belgium (Flemish)	Hungary	Macedonia	Slovak Republic
Bulgaria	Indonesia	Malaysia	Slovenia
Canada	Iran	Moldova	South Africa
Chile	Israel	Morocco	Thailand
Chinese Taipei	Italy	Netherlands	Tunisia
Cyprus	Japan	New Zealand	Turkey
Czech Republic	Jordan	Philippines	United States
England	Korea	Romania	
Finland	Latvia	Russia Federation	

1.3 Present Study

1.3.1 Research Question

In the present study teacher-related factors affecting student science achievement was studied. To perform this, structural model was proposed to explain the variance of student science achievement. To construct a model the science teacher background questionnaire data collected for the TIMSS-R was used. By using the questionnaire data principle component factor analysis was carried out to form latent variables that are going to be used in the structural equation modeling analysis.

After the factor analysis nine factors were obtained. By using LISREL package program Structural Equation Modeling (SEM) was run. Finally, the model was obtained and some modifications were done to get the finest model.

The problem of the study can be stated as follow;

“What linear structural model explains the relationships between the teacher-related latent variables which were obtained by using the data of Science Teachers Background Questionnaire (STBQ) and the student science achievement in Third International Mathematics and Science Study-Repeat data collected for the Turkish students who were eighth graders?”

1.3.2 Definition of Important Terms

1. *Third International Science and Mathematics Study*

TIMSS 1999 represents the continuation of a long series of studies conducted by the International Association for the Evaluation of Educational Achievement (IEA). The Third International Mathematics and Science Study (TIMSS), conducted in 1995-1996, was the largest and most complex IEA study to date, and included both mathematics and science at third and fourth grades, seventh and eighth grades, and the final year of secondary school (TIMSS Technical Report, 2000)

2. *Science Achievement*

What does it mean to achieve in a subject matter domain such as science? Surely such achievement must include knowing important facts and concepts within the domain but our notion of what it means to achieve in science goes beyond this idea. Science achievement can be defined as a process of building an increasingly sophisticated knowledge structure; that is, as a process of becoming an expert in a science domain (Shavelson and Ruiz-Primo, 1998).

3. *Principal Component Analysis*

Principle component analysis is a technique for determining whether many variables observed in an instrument can be described by a few factors by searching for clusters of variables that are correlated with each other (Fraenkel & Wallen, 1996).

4. Structural Equation Modeling

The philosophy of Structural Equation Modeling is to describe a theory about the relationships among variables. The theory could be thought of as an explanation of correlations among variables (Kelloway, 1998). Fraenkel and Wallen (1996) warns that correlations, in social sciences, give some idea about relations, however, correlations can not be used solely to explain the nature of the relationships between variables.

5. Science Teacher Background Questionnaire (STBQ)

The questionnaire is addressed to teachers of science, who are asked to supply information about their academic and professional backgrounds, instructional practices, and attitudes towards teaching science. The questionnaire had two sections. The first section covered general background information on preparation, training, and experience, and about how teachers spend their time in school, and probed their views on mathematics and science. The second section related to instructional practices in the class selected for TIMSS 1999 testing. To obtain information about the implemented curriculum, teachers were asked how many periods the class spent on a range of mathematics and science topics, and about the instructional strategies used in the class, including the use of calculators and computers. Teachers also responded to questions about teaching emphasis on the topics in the curriculum frameworks (TIMSS Technical Report, 2000).

1.3.3 Significance of the Study

All of the activities in the educational system were made to reach to a goal that is to educate our students. In the educational frame work we measure the level of expected student attainment by different techniques and called as student achievement. Student achievement is one of the most important factor in education. There are lots of factors or variables affecting student science achievement.

Numerous studies carried out to find out what factors are more affective in achievement and a lot of money is invested to reach this goal. One of the studies that designed to reach the same goal is Third International Mathematics and Science Study (TIMSS). TIMSS aims to identify what factors affect student learning and drawing a international profile for science and mathematics achievement. These factors can be grouped in three categories.

First category includes student-related factors (SES, student self esteem, student perception, etc.), teacher-related factors (classroom activities, homework, perception of science teaching) can be counted as a second category. Last category is the external variables such as school facilities, classroom climate, number of students in the class, and physical facilities.

Teacher is one of the most crucial segment of education puzzle. In 1999, Turkey participated to TIMSS-Repeat at the eight grade level. This international study provides to check our educational system and to make conclusions about work done in the schools. In Turkey, there are limited number of studies about international studies results. Some studies (İş, 2003, Özdemir, 2003) were carried out concerning the student related dimension of the results of TIMSS. In our educational system teachers still have important roles and of course factors related to teacher preparation, background and classroom activities that the teacher prefers are important as well.

This study aims to investigate the proposed model concerning the teacher and activities in the classroom and facilities related factors affecting student science achievement. At the end, this study will say some of the factors significantly affective in science achievement and by concerning the results of this study some educational settings will be modified on the light of this study.

The present study will serve a road map to understand what the TIMSS-R results in the dimension of teacher and classroom activities actually say to us and may be gives some tips to educators to modified their educational environment to get the effective learning framework and expected outcomes.

CHAPTER 2

LITERATURE REVIEW

This chapter is devoted to review the related literature about factors affecting student science achievement. The reviewed articles was grouped under four categories includes studies concerning the teacher factor, studies about science achievement, studies about Structural Equation Modeling, and the related studies. Findings of previous studies were summarized at the end of the literature review chapter.

2.1 Studies About Teacher Factor

A trend appears to have emerged in teacher education toward a competency performance-based instruction system. This trend demands that teacher education should focus more on how to teach. In order to achieve this, the art and science of teaching must be critically examined and the effective teacher characteristics carefully identified. He suggested that the ultimate test of teacher effectiveness should be its consequences for students. Since two generally accepted desirable consequences of science education are increased achievement and improvement in student attitude toward science, these outcomes could serve as criteria for successful teaching (Chidolue, 1996).

Staff development lies at the heart of the nearly every educational effort to improve student achievement. In a 1985 national survey, teachers ranked in-service training as their least effective source of learning. The researchers noted that nearly every major work on the topic of staff development disparaged its effectiveness. The results imply that poor understanding of teachers' motivations and a lack of insight into both the individual and environmental factors in the process of change (Supovitz & Turner, 2000).

Teachers are perceived as playing a primary role in a students' learning process. To adequately perform this role, certain teacher characteristics are potentially more valuable for encouraging student learning. In an attempt to discern those characteristics related to student learning and teacher behavior in the science classroom, numerous studies have been conducted (Druva and Anderson, 1983).

Chidolue (1996) carried out a study to examine the relationship between teacher characteristics, learning environment and student achievement and attitude. An ex-post-facto design was used which involved 11 biology teachers and 375 form four biology students in 11 high schools located in Enugu local government area of Anambra state, Nigeria. Classes were selected on the basis of their having common topics in their study program. Consequently the sample was a selected rather than a random sample. He administered pre and post tests to determine how much was achieved cognitively and how much progress was made effectively and also he tried to control for the students' socioeconomic status in view of the results of previous research which indicates that socioeconomic status contributes significantly to students' learning outcomes.

To derive teacher characteristics Chidolue (1996) used teacher background questionnaire (TBQ) and to assess classroom environment he administered the modified version of an Interaction Analysis Instrument developed by Fischler and Zimmer. TBQ was constructed by Chidolue. After the analysis of the instruments Chidolue found the significant but inverse relationship between teacher qualification and gain in students' attitude and achievement. This means that the higher teachers' qualifications the less effective they were in motivating their students to greater achievement and attitude gains. He explained the reason for this is that majority of the teachers studies were young and relatively inexperienced graduates. He found that there is a significant positive correlation of teacher experience with students' means gains in attitude and achievement (Chidolue, 1996).

Also Chidolue found that there is a significant and positive correlation between the locality and the students' and the students' achievement suggest that locality is indeed one of the teacher characteristics that positively influence students' affective and cognitive development and therefore should not be ignored when identifying effective teacher characteristics (Chidolue, 1996).

Druva and Anderson (1983) carried out a meta-analysis research that examine the science teacher characteristics by teacher behavior and by student outcome. Druva and Anderson took the teacher characteristics as one of the independent variables. The science teacher characteristics factor was partitioned into a background information section and a personality section. The background section contains information belonging to teacher sex, IQ, level of knowledge specific to a given topic, age, level of education, and teaching experience. The personality section contains 70 variables that may be grouped under the titles of positivism, self-concept, independence, receptivity, friendliness, motivation and direction, intellect, social behavior, values, and attitudes. They found 481 correlation coefficients between a teacher behavior and a teacher characteristic by summarizing 65 studies. Druva and Anderson summarized their findings as follows;

Teacher Characteristics and Teacher Behavior

1. Teaching effectiveness is positively related to training and experience
2. Teachers with a more positive attitude toward curriculum they are teaching tend to be those with a higher grade point average, more experience teaching, and a higher degree of intellectuality.
3. Better classroom discipline is associated with the teacher characteristics of restraint and reflectivity
4. Higher level, more complex questions tend to be employed more often by teachers with greater knowledge and less experience.

Teacher Characteristics and Student Outcomes

1. Student achievement is positively related to teacher characteristics of self actualization, heterosexuality, and masculinity. It is also related positively to the number of biology courses taken in the case of biology teachers, the number of science courses taken, and attendance at academic institutes. Finally, cognitive pattern similarity is positively related to achievement of students.
2. With respect to the student outcome of process skills, there is a relationship with three teacher characteristics which may be viewed as having some communality. These three are a negative relationship to achievement and self concept along with a positive relationship to abasement. Process skill outcomes of students also are positively associated with the number of science courses taken by teachers. Finally,

there is a negative association between the process skills and the political and theoretical values of on the part of teachers.

3. The third student outcome area, a positive affect toward science, is positively associated with the number of science courses taken by the teachers and the number of years of teaching experience for biology teachers.
4. Teacher age and student outcomes are positively associated
5. student outcomes are positively associated with the preparation of the teacher especially science training, but also preparation in education and academic work generally (Druva and Anderson, 1983)

Another study was carried out on the topic of the effects of Professional Development on science teaching practices and classroom culture by Supovitz and Turner (2000). Using data from a National Science Foundation Teacher Enhancement program called the Local Systemic Change Initiative, they aimed to examine linear relationship between the Professional development and the reformers' vision of teaching practice. Supovitz and Turner used the data that contains 3464 science teachers and 666 principals in the 24 localities. They took the teacher attitudes' towards reforms, their content preparation, their conception of principal support, and their available resources as additional predictor variables in to the model. Also they put some school characteristics into the model as predictor. To investigate the relationship between the Professional development and reform indicators of inquiry-based teaching practices and investigative classroom culture, they used a series of hierarchical linear models. Finally after the analysis of the statistical techniques they found that increasing amounts of Professional development were statistically associated with both greater teacher use of inquiry-based teaching practices and higher levels of investigative classroom culture (Supovitz & Turner, 2000).

Supovitz and Turner found in the examination of the individual teacher characteristics revealed several differences in both practices and classroom culture of teachers associated with different background characteristics. They found that gender was one of the effective characteristics. Male teachers were more traditional in both their investigative practices and in the culture of their classroom than female teacher, but they noted that these gender differences were statistically significant (at the level of 0.05) only in the model of investigative classroom culture. Also they found that teaching experience was negatively associated with investigative classroom culture, but was not related to inquiry-based teaching practices. The most powerful individual differences on both teaching practices and investigative classroom culture were teachers' content preparation and attitudes toward reforms (Supovitz & Turner, 2000).

Anderson et al. (1988) examined relationship between and among teachers' and students' sense of efficacy, thinking skills, and student achievement. Twenty-four teachers were selected from all grade 3 and 6 teachers in three school districts on the basis of their sense of personal and teaching efficacy scores. They administered a test of reasoning skills and an efficacy scale at the beginning and at the end of the school year. They found that teachers' personal efficacy beliefs at the beginning of the school year do affect student achievement, particularly at the grade level three.

Anderson et al. (1988) measured the teachers' sense of efficacy by using 16-item scale created and validated by Gibson and Dembo (as cited in Anderson et al., 1988). Both teachers and students thinking skills were measured by the New Jersey Test of Reasoning Skills and for the students' achievement scores Canadian Achievement Test were used. Anderson et al. (1988) used two sets of stepwise multiple regression analyses were performed in order to determine which of the study variables were best able to account for differences in student achievement scores. The teachers' sense of efficacy is related to student achievement. Furthermore teachers' sense of efficacy attitudes is situation-specific. Efficacy beliefs are not uni dimensional and, consequently can be expected to have different relationships to different subject matter, depending on teachers' beliefs about the subject matter being taught and the students in the class. They conclude that the promotion of a high sense of efficacy in teachers and students must become an educational aim as important as academic achievement (Anderson et al., 1988).

Teachers' differential behavior toward higher and lower achieving students and its relation to selected teacher characteristics were examined by Mitman. Mitman (1985) used 12 volunteer third-grade teachers and their students in the study as subjects. Teacher attitudes specific to teaching and students were measured with an instrument called the Attitudes of Elementary Teachers Questionnaire. Examining the relation between teachers' differential behavior and several teacher characteristics produced some promising results (Mitman, 1985).

Results of Mitman study state that individual differences in teachers' differential behavior can be conceptualized in a meaningful way and that this behavior may be mediated by perpetual tendencies of teachers as well as instructional competence. Although it is improbable that research will provide a few broadly applicable schemes for categorizing teacher characteristics and behavior, it nonetheless may be possible to devise teacher-training programs for specific context that address important individual differences among teachers and thus facilitate the optimal treatment of lower achievers within the framework of effective teaching (Mitman, 1985).

Glass (2002) reviewed the characteristics of teachers that might be identified and used in the initial hiring of teachers to increase their students' achievement. Glass (2002) stated that teacher characteristics can include qualities of teachers that are viewed as personal – such as mental ability, age, ethnicity, gender and the like – or as "experiential" – such as certification status, educational background, previous teaching experience and the like. He claimed that psychometric measures of teacher characteristics are not useful for initial teacher selection implies that candidates be selected by other means – staff interviews, recommendations by peers or past supervisors, and the like. Glass (2002) summarized his findings as follow;

- Paper-and-pencil tests are not useful predictors of teaching candidates' potential to teach successfully and should not be used as such.
- Teaching candidates' academic record (e.g., GPA) is not a useful
- Predictor of their eventual success as teachers. A candidate's record of success in pre-service (undergraduate) technical courses (mathematics and science, for example) may contain useful information about that candidate's success in teaching secondary school mathematics and science.

- The selection of teachers who will best contribute to their students' academic achievement should focus on peer and supervisor evaluation of interns, student teachers, substitute teachers and teachers during their probationary period (Glass, 2002).

The core of educational system is the student achievement. In the classroom climate teacher and the student interaction is one of the most important factors in the student achievement. According to literature teaching experience, content preparation, Professional development of the teacher, self-efficacy, attitude toward teaching are the important teacher characteristic on the basis of student achievement. The teacher is one of most important factor that influences the student achievement.

In the view of the fact that teacher experience is essential in students' affective and cognitive development, it has been proposed that teachers should be adequately motivated in order to ensure that they remain in profession.

2.2 Studies About Science Achievement

Shavelson and Ruiz-Primo (1988) studied the effect of performance-based assessment on science achievement. They review the related literature and they summarized that teachers matter and differ in effectiveness. The most important influence on individual differences in teacher effectiveness is teachers' general cognitive ability, followed by experience and content knowledge. Masters' degrees and accumulation of college credits have little effect, while specific coursework in the material to be taught is useful. They stated that all teachers can do a better job when supported by good curriculum, good schools, and good state policy (Shavelson & Ruiz-Primo, 1988).

Another factor affect student achievement is homework. Few issues in educational research affect students and their families as directly as homework. In recent years interest in homework-related issues has identified in response to the results of the TIMSS in the middle and upper-secondary school. The TIMSS found that the performance of students in countries such as United States and Germany compares unfavorably with that of their counterparts in countries such as Japan and South Korea. This dimension was reviewed by Trautwein and Köller. A critical review of twentieth-century homework studies reveals only weak empirical support for the assumption that larger amounts of homework enhance achievement at the class level. Moreover; the relationship between time spent on homework and achievement gains at the student level is unclear (Trautwein & Köller, 2003).

Trautwein and Köller (2003) illustrated a class-level and student-level effect of homework. Figure 2.1 shows the relationship between the time spent on homework and achievement.

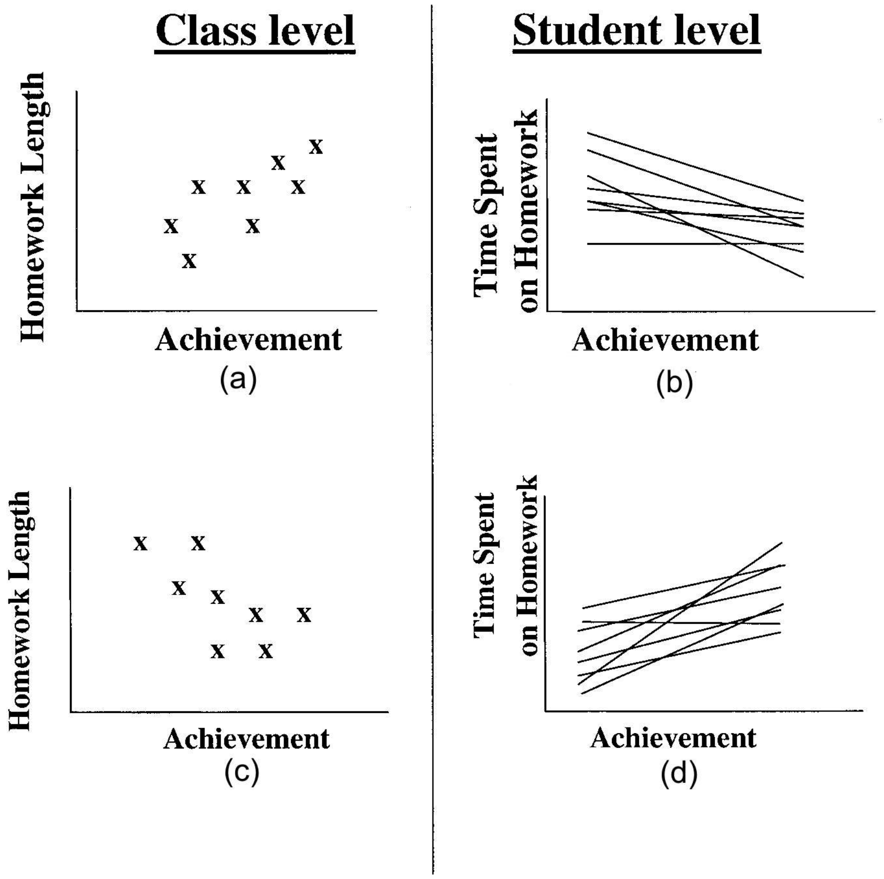

Figure 2.1 Schematic Illustration of Homework effect at the student and teacher level

Classes with more homework evidence higher achievement; hence, a positive relationship is shown between the amount of homework assigned and achievement.

Such a pattern suggests that teachers should assign large amounts of homework. Figure 2.1 (c) shows the opposite pattern. In this example, classes in which students are assigned a lot of homework have lower achievement scores. Figures 2.1 (a) and (c) exemplify class-level effects, whereas Fig. 2.1 (b) and (d) illustrates student-level effects for a few classes. Although the relation between time spent on homework and achievement shown in Fig. 2.1(b) varies from one class to the next, the emerging pattern suggests that those members of a class who report spending less time on homework have higher achievement scores. In Fig. 2.1(d), the opposite effect is illustrated. More time spent on homework is associated with greater achievement in a class (Trautwein & Köller, 2003).

Parents are also important factor in student school life. San Diego County Office of Education (1997) searched to find the answer of the question “What is the influence of parental involvement on student achievement?”. According to review results student achievement improves when parents express high (but not unrealistic) expectations for their children’s achievement and future careers, parents become involved in their children’s education at the school and in the community, parents are enabled to play four key roles (as teachers, supporters, advocates, and decision-makers) in their children’s learning.

Lawrenz (1976) tried to predict student attitude toward science from the student perception of the classroom learning environment. The data were collected from a sample of classes stratified on levels of population from three general mid western regions, which included 12 states. Sample consisted of 238 high school science classes. The instruments used in the study were SAI and LEI. Of the two tests used in his study SAI measures science attitudes with 60 likert-type items and a test-retest reliability of 0.93. The second instrument LEI has 10 scales which describes aspects of classroom social situations. The stepwise multiple-regression analysis was used. Students’ perception of classroom learning environment related to student achievement in science and also related to student attitudes toward science (Lawrenz, 1976).

Betts, Zau and Rice (2003) surveyed the school and the classroom factor affecting student achievement. The study defined school resources not as funding per pupil but rather in terms of class size and teacher training (including years of teaching experience, certifications and subject authorizations, highest academic degree, and field of study in college). The researchers divided students into five equal size groups. They found that in most cases lowest socioeconomic status (SES) schools received fewer resources. To examine student achievement, the researchers focused on individual students' test scores on California's Standardized State Test, comparing students' achievement at a point in time as well as gains in achievement over time (Betts, Zau & Rice, 2003).

Among other factors, the researchers found that class size does influence reading achievement in the elementary grades, especially among English Learners, but they found no evidence that class size matters in middle and high schools. With regard to teacher qualifications, they found varying effects between elementary, middle, and high schools, as wel as between math and reading achievement. In general class size appears to matter more in lower grades than in upper grades, whereas teacher qualifications such as experience, level of education, and subject area knowledge appear to matter more in upper grades (Betts, Zau & Rice, 2003).

2.3 Studies About Structural Equation Modeling (SEM)

Structural equation modeling (SEM) has become a standard tool in many scientific disciplines for investigating the plausibility of theoretical models that might explain the inter correlations among a set of variables. A structural equation model represents a series of hypotheses about how two variables in the analysis are generated and related (Hu & Bentler, 1999).

Webster and Fischer (2001) studied a two-step approach to modelling student performance and they decribed the methodology used to investigate influences on student mathematics achievement and addresses the techniques of secondary analysis and its associated limitations and includes a two-step approach to modelling. All of the Australian schools that participated in the TIMSS study were invited to also participate in the school level environment study. A total of 57 Australian schools were surveyed and data collected from 620 teachers and 4645 students. The two-step model building approach consisted of the analysis of two conceptually distinct models. They proposed an explanatory model of student performance incorporating the student home background, student attitudes towards mathematics, success attribution, instructional practices and school-level environment factors. The proposed model by the Webster and Fischer is presented in Figure 2.2.

These results show that there is an indirect effect of the school environment as perceived by teachers and student achievement, a result of the school environment having a direct effect on the way teachers convey the curriculum content. The better the environment for the teachers the more the instruction in classrooms is teacher-centred. The way teachers convey the curriculum content in their classrooms has a strong and positive effect on student attitudes, having a significant effect on student achievement. The more teacher-centred the instruction the more positive the attitudes of students and the better the achievement is. In this model, instructional practices positively affect success attribution. There were no significant relationships between success attribution and other variables in the model. The model fit with these data did not allow for any paths showing the influence of success attribution (Webster & Fischer, 2001).

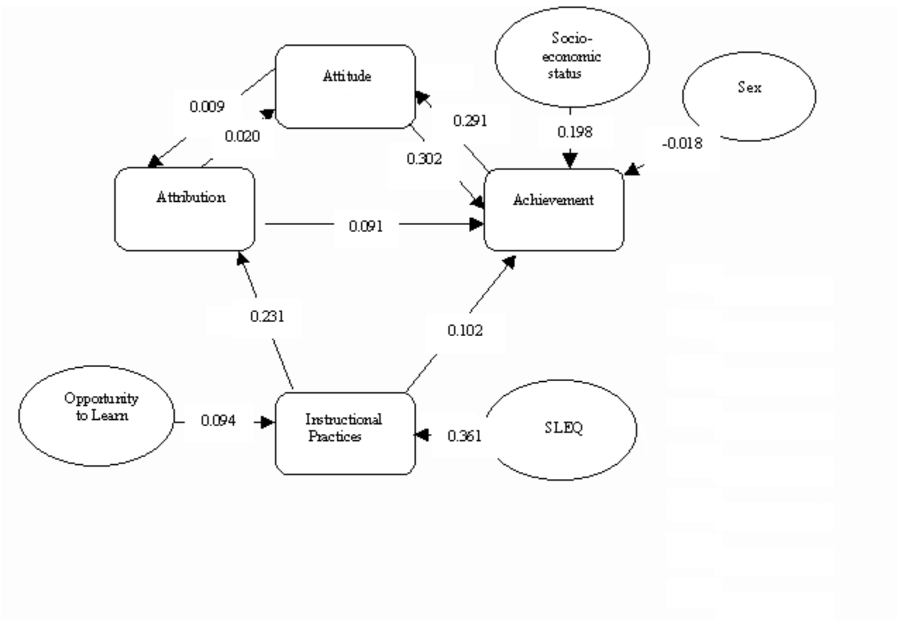

Figure 2.2 Hypothesized Model for the Student Achievement in the study of Webster and Fischer (2001)

Mathematics achievement in a comparative study based on TIMSS data were studied by Bos and Kuiper (1999). They used the data of 10 participated countries which were Belgium-Flemish, Czech Republic, Netherlands, Belgium-French, Germany, England, Norway, Denmark, Sweden, and Lithuania. The sample of the study was 21635. They used path analysis statistical procedure to identify the relationships in the proposed model. it was founded that the resulting general path model explains 19% of the variance in achievement in mathematics. In many systems, it was observed that home educational background and students' attitude towards mathematics have a positive relation with achievement in mathematics, however, out-of-school activities has a negative relation with achievement in mathematics (Bos & Kuiper, 1999).

Also in Turkey some modeling studies were carried out by using the data of International studies such as TIMSS and PISA. İş (2003) investigated the factors affecting mathematical literacy of 15-year-old students in Programme for International Student Assessment (PISA) across different cultural settings which are

Brasil, Japan and Norway. The study explored how mathematical literacy is stimulated by predictors related to the students, the families and the school. The researher tested the following model for selected three countries.

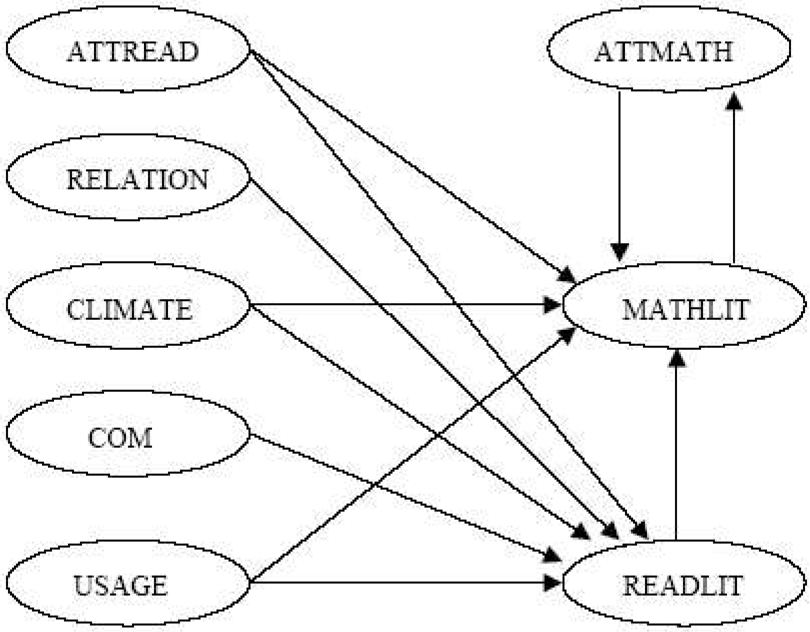

Figure 2.3 The Predictive Model of İş (2003)

İş (2003) found that reading literacy significantly and positively influences mathematical literacy in all three countries. There is a reciprocal relationship between the attitudes towards mathematics and mathematical literacy. Also the attitudes towards reading have a negative direct effect and a positive indirect effect on mathematical literacy.

Another modeling study is Özdemir's study which used TIMSS data to test the hypothesized model in his study. Özdemir tested the model given in Figure 2.4.

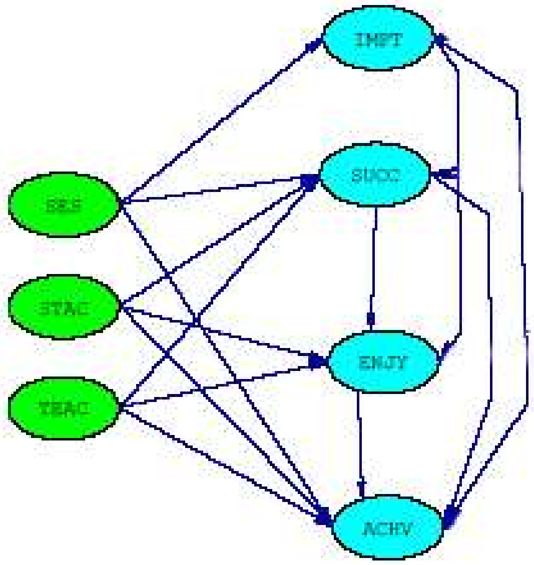

Figure 2.4 Özdemir's Hypothesized Model

He used the TIMSS student sample for Turkey and student achievement test and questionnaire was used. At the end of the SEM analysis he found that the largest relationship existed between science achievement and SES of students. It was also observed that students' enjoyment of science did not seem to have a significant contribution on science achievement. In addition, science achievement had a negative relationship with the classroom activities considered as student-centered. On the other hand, the activities considered as teacher-centered had a positive impact on the science achievement scores of the TIMSS tests.It was also observed that science achievement and perception of success/failure in science were highly related with each other (Özdemir, 2003).

In literature, it is possible to reach some other studies modeling TIMSS data for different countries. Papanastasiou (2000) studied how predictors related to the family and the school stimulate mathematics outcomes. He used TIMSS data for Cyprus, Japan and the US to construct a working path model. The model implied that, the factor having the strongest direct influence on attitudes toward mathematics was teaching in Cyprus and Japan, and reinforcement in the US. The model also seemed to indicate that attitudes and self-beliefs could not be used to predict students' achievements in mathematics (Papanastasiou, 2000).

Abu-Hilal (2000) conducted a study in order to test a model of mathematics achievement and its relations to subsequent factors using structural equation modeling. 394 elementary school students in Al-Ain school district completed an Arabic version of the self-description as sample of the study. Students completed a questionnaire including their perception of the importance of mathematics, anxiety about it and the amount of effort they exerted in studying. Mathematics grades were obtained from the official school records. The model of the study is presented in Figure 2.5.

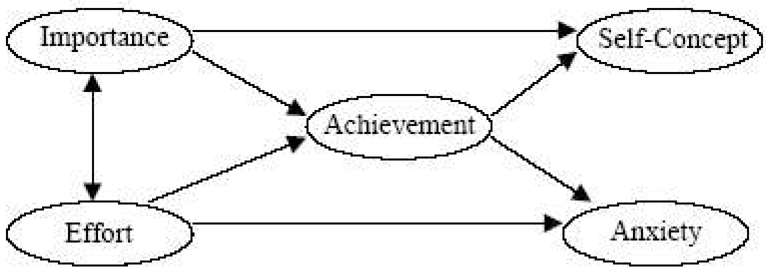

Figure 2.5 The Structural Model of Abu-Hilal

The results indicated that mathematics importance or attitude towards mathematics relates positively to achievement in mathematics. Moreover, importance of mathematics is positively, directly related to self-concept, and students who give more importance to and perform well in mathematics tend to develop positive perceptions of their abilities (Abu-Hilal, 2000).

2.4 Related Studies

Goldhaber and Anthony (2003) studied the teacher quality and student achievement, their study was a review of studies on teacher characteristics and education. Goldhaber and Anthony (2003) found that in their review; measures of teacher academic skills are better predictors of teacher effectiveness than other measures, such as degree and experience level. Also they indicated that the relationship between teacher experience and student achievement does matter more early in a teacher's career. Moreover Goldhaber and Anthony (2003) argued that progress may be made through a series of reforms that involve a re conceptualization of how we think about teacher licensure, recruiment, compensation and ultimately a teaching career.

Rothman studied the relationship between teacher characteristics and student learning. The sample consisted of 51 teachers selected at random from a list of about 17.000 American physics teachers compiled by the National Science Teachers Association. For the teacher background variables; years of physics teaching experience, number of semester hours of physics and physics education; mathematics; scores on the test on selected topics in Physics (TSTP), and scores on the test on Understanding Science (TOUS) were selected. Tests TSTP and TOUS were used and these tests have the KR_{20} reliability of 0.82 and 0.76 respectively. Rothman used χ^2 approximation of Wilk's λ for the test of the hypothesis and he found that students of teachers with a good knowledge of physics and well prepared in mathematics gain more in their general understabding of science (TOUS). In addition, students of teachers who have taught physics for many years and who are well prepared in physics and mathematics gain most in their interest in physical science (Rothman, 1969).

Rothman also studied physics teacher characteristics and student learning with Welch and Walberg (1969). Rothman, Welch, and Walberg (1969) examined in a national sample of physics classes the relationships between teacher characteristics (training, teaching experience, attitudes towards teaching, personality, and values) and student learning. The sample consisted of 35 male physics teachers from various parts of the United States and Canada who had volunteered to teach experimental high school physics. For the measurement of teacher characteristics Test on Selected Topics in Physics (TSTP) with a KR_{20} reliability of 0.82, Scores on Minnesota

Teacher Attitude Inventory (MTAI) with a split-half reliability of 0.87 and Edwards Personal Preference Schedule (EPPS) with a test-retest reliability of 0.74 were used. They found that teachers' personalities and value systems are more strongly related to students' changes in physics achievement, attitude toward physics, and interest in science than are the extent of teachers' preparation in physics, their knowledge of physics, and their years of physics teaching experience (Rothman, Welch, & Walberg, 1969).

Another study about impacts of teacher and school on student achievement is Miller's study. This brief was based on McREL's meta-analysis of quantitative research on teacher, school and leadership practices. According to Miller, 80% of variance in student achievement can be explained by student-related factors. Teacher factor explained 13% of the variance of student achievement by itself and the rest variance (7%) was explained by school factor. Miller claimed that effective teaching begins with effective teacher preparation programs should be based on strong content expertise and research-based instructional strategies (Miller, 2003).

Marzano's study is parallel to the study of Miller (2003). He identified nine instructional strategies that enhance student achievement;

- Identifying similarities and differences
- Summarizing and note taking
- Reinforcing effort and providing recognition
- Homework and practice
- Nonlinguistic representations
- Cooperative learning
- Setting goals and providing feedback
- Generating and testing hypotheses
- Activating prior knowledge (Marzano, 1998)

To positively influence teachers' effectiveness in the classroom, schools need to implement coherent, meaningful professional development programs and ensure that teacher are given adequate time and supports to put what they have learned in to practice (Miller, 2003).

Factors influencing high school student achievement was studied by Subedi (2003) in Nepal. Subedi searched to explore how student classroom achievement is affected by class size, avaliability of resources and use of such resources by teachers in the high schools in Nepal. The target population for the study compraside all the teachers at government and private high schools of Lalitpur district. 20 % of target population was taken as sample by using random samples. In total 30 schools out of 152 (20%) were selected. Subedi implemented a survey forms to collect the data. Hierarchical linear modeling technique, using the HLM program was employed for the data analysis. He found that the resource variable at the teacher level provided a substantial contribution to the average classroom achievement which means teachers cam maximize class achievement by optimizing the use of the available resources controlling for the effect of class size at the same time. Also he found that negative effect of class size on classroom achievement.

Another study searching the teacher pay on student achievement was the Kingdon's (1996) study. He studied the instructional factors that improve student achievement in India. For the study data were collected 902 children aged 13-14 years old in a sample survey of 30 schools in India, 1991. Each student in the sample took two cognitive skill tests, one in numeracy and the other in literacy. The results of the beliefs that teacher training, experience and to some extent even post-graduate education are good indicators of teachers' effectiveness in importing cognitive skills to students. Also he found that class size or pupil teacher ratio has no significant relationship with overall student achievement of all institutional variables, ones that affect student achievement most are school resources, length of instructional time per week, school management-type and teachers' own cognitive skills. However class size, teacher training, teacher experience is not important to student learning in his data (Kingdon, 1996).

Numerous studies were carried out to show impact of teacher on student achievement. Rockoff's (2003) study is one of these studies. He used panel data to estimate teacher fixed effects while controlling for fixed student characteristics and classroom specific variables. The empirical evidence in his paper suggests that raising teacher may be a key instrument in improving student outcomes. However in an environment where many observable teacher characteristics are not related to teacher quality, policies that focus on recruiting and retaining teachers with particular credentials may be less effective than policies that reward teachers based on performance (Rockoff, 2003).

2.5 Summary

In summary section the findings from the reviewed literature for the present study were listed below.

1. There is a significant but inverse relationship between teacher qualification and gain in students' attitude and achievement. This means that the higher teachers' qualifications the less effective they were in motivating their students to greater achievement and attitude gains (Chidolue, 2000; Miller, 2003).
2. Teacher effectiveness is positively related to training and experience (Druva and Anderson, 1983).
3. Student outcomes are positively associated with the preparation of the teacher especially science training, but also preparation in education and academic work generally (Druva & Anderson, 1983; Supovitz & Turner, 2000; Mitman, 1985).
4. Teachers' sense of efficacy is related to student achievement. Furthermore teachers' sense of efficacy attitudes is situation-specific (Anderson et al., 1988).
5. The positive relationship is shown between the amount of homework assigned and achievement (Anderson et al., 1988).

6. When parents express high (but not unrealistic) expectations for their children's achievement and future careers, parents become involved in their children's education at the school and in the community, parents are enabled

to play four key roles (as teachers, supporters, advocates, and decision-makers) in their children's learning (San Diego County of Education, 1997).

7. The way teachers deliver the curriculum in their classrooms has a strong and positive effect on student attitudes, which has already been reported as having a significant effect on student achievement. The more teacher-centered the instruction the more positive the attitudes of students and the better the achievement is (Webster & Fischer, 2001; Özdemir, 2003).

8. Home educational background and students' attitude towards mathematics have a positive relation with achievement in mathematics. However, out-of-school activities have a negative relation with achievement in mathematics (Bos & Kuiper, 1999).
9. Science achievement and SES of students have positive and strong relationship. Students' enjoyment of science did not seem to have a significant contribution on science achievement (Özdemir, 2003).
10. Science achievement had a negative relationship with the classroom activities considered as student-centered. On the other hand, the activities considered as teacher-centered had a positive impact on the science achievement (Özdemir, 2003; Webster & Fischer, 2001).
11. Effective teaching begins with effective teacher preparation programs should be based on strong content expertise and research-based instructional strategies (Miller, 2003).
12. Resource variable at the teacher level provided a substantial contribution to the average classroom achievement which means teachers can maximize class achievement by optimizing the use of the available resources controlling for the effect of class size at the same time (Subedi, 2003).
13. Class size effect achievement in classroom negatively (Subedi, 2003; Kingdon, 1996).

CHAPTER 3

METHODOLOGY

In this part of this thesis research design, sampling procedure, instruments used in the thesis, statistical analysis which includes factor analysis and modeling analysis were explained. Also validity and reliability of the developed model were discussed.

3.1 Research Design

The present study aims to find out factors which are related to classroom activities and learning tasks preferred by the teacher and teachers' perceptions about science teaching and style. This study is used structural equation modeling which is an advanced statistical technique to clarify the relationships exist between the dependent and independent variables. Due to this study is a correlational study, the results describes the degree to which two or more variables are related and it does so by use of a correlational coefficient (Fraenkel & Wallen, 1996).

However, the results do not say which variables affect the other. The correlational studies do not establish a cause and effect (Fraenkel & Wallen, 1996). It says only whether the relationships between the variables significant or not. On the other hand, the used statistical method (Structural Equation Modeling) and software obtained relationships can show cause and effect relationship. In recent years, there has been considerable interest in extending and applying structural equation models to situations where there are non-linear relationships involving latent variables, in particular to models with interaction effects. The difference between SEM and these other techniques is in the flexibility with which causal models can be built. In ANOVA models, causality is inferred because one variable is systematically manipulated to see the effect on another. Likewise, in SEM, causality can be inferred, but only from the model originally constructed (and not from the statistical test of that model). The benefit of SEM over other approaches such as ANOVA or regression is simply the flexibility with which models can be built (Field, 2000). Due to that reason, the obtained results can be used to built cause and effect relationship in the present study.

3.2 Sampling

In TIMSS-R, representative and efficient samples in all countries were crucial to the success of the Project. The quality of the samples depends on the sampling information available at the design stage and particularly on the sampling procedures. There are three populations presented in the TIMSS-R. The first group is the third and fourth grade students (Population 1), the second group is seventh and eighth grade students (Population 2), and the final group is the students who were in their final year of high school (in most of the participated countries this population defines the students at eighth grade).

The present study is dealing with Population 2 which includes eighth grade students in Turkey. The basic sample design for TIMSS 1999 is generally referred to as a two-stage stratified cluster sample design. The first stage consisted of a sample of school, the second stage consisted of a single mathematics classroom selected at random from the target grade in sampled schools (TIMSS Technical Report, 1999).

3.2.1 Stratification and Sampling of Schools

First sampling stage is the school selection. The sample-selection method was used for the first-stage of sampling in TIMSS-R. First of all available school were determined in Turkey and then first school was sampled by choosing a random number in the range between one and the sampling interval. By adding the sampling interval to that first random number, a second school was identified. This process of consistently adding the sampling interval to the previous selection number is continued to the completion of schools selection.

Stratification is the grouping and sampling units (e.g., schools) in the sampling frame according to some attribute that includes geography, school type and level of urbanization or variable prior to drawing the sample.

3.2.2 Sampling of Students and Teachers

The first-stage of sampling was the school selection and the second-stage was the selection of classrooms within sampled schools. As a rule, one classroom per school was sampled.

The students who were in sampled classroom and the science and mathematics teachers who taught the sampled classroom were selected automatically as a student and teacher samples. Turkey participated in TIMSS-R at the eighth grade level. Actually total numbers in the students and teacher samples for Turkey are 7841 and 204 in Population 2 respectively. But in the data cleaning process some of the teachers and students did not complete the questionnaires due to that reason and to get the meaningful and true results listwise deletion method was used in the statistical analysis and teachers who did not complete questionnaire were not included in statistical analysis.. Thus the teacher sample was dropped to 177 and missing value corresponds to 12.7% of the original sample. In educational studies cutoff criteria for the missing value is 10 % of the original sample. The reason of this problem is data collection was independent from this study and the researcher has no control on sampling procedure and effective sample size. Gender and age of the teacher sample for Turkey were presented in the following two tables.

Table 3.1 Sex of Science Teacher For Turkey

Sex	**Frequency**	**Percent (%)**
Female	79	38.7
Male	124	61.3
Total	203	100

Table 3.2 Age of Science Teacher For Turkey

Age	Frequency	Percent (%)
Under 25	10	4.9
25-29	40	19.7
30-39	58	28.6
40-49	86	42.4
50-59	9	4.4
Total	203	100

3.3 Instruments

In the present study two instrument results were used. First one is the achievement test and second one is the science teacher background questionnaire. In this section the properties and content of these two instruments were explained.

3.3.1 Achievement Test

International Association for the Evaluation of Educational Achievement (IEA) studies have the central aim of measuring student achievement in school subjects with a view to learning more about the nature and extent of achievement and the context in which it occurs. The designers of TIMSS choose to focus on curriculum as a broad explanatory factor underlying student achievement. From that perspective curriculum was considered to be a three-strand model; what society would like to see taught (intended curriculum), what is actually taught (implemented curriculum), and what the students learn (attained curriculum) (Gonzales&Miles, 2000).

TIMSS curriculum framework underlying mathematics and science tests was developed by groups of mathematics and science educators with input from the TIMSS National Research Coordinators (NRCs) and their curriculum advisors from the participated countries. The framework contains three dimensions or aspects which are content, performance expectation and perspectives. The Table 3.3 shows content which one of the three aspects of the TIMSS 1999 Science Test Items (Gonzales&Miles, 2000).

Table 3.3 Content of TIMSS 1999 Science Achievement Test

	Content Areas
Science	Earth Science
	Life Science
	Physical Science
	History of Science and Technology
	Environmental and Resource Issues
	Nature of Science
	Science and Other Disciplines

Table 3.4 describes the performance expectations which were included in TIMSS 1999 Science Achievement Test (SAT)

Table 3.4 Performance Expectations of TIMSS 1999 SAT

	Performance Expectations
Science	Understanding
	Theorizing, Analyzing, Solving Problems
	Using Tools, Routine Procedures and Science Processes
	Investigating the Natural World
	Communicating

Perspectives is the third aspect of TIMSS 1999 SAT applied to the students and the Table 3.3 shows which topics were covered under this section.

Table 3.5 Perspectives of TIMSS 1999 SAT

	Perspectives
Science	Attitudes
	Careers
	Increasing Interest
	Safety
	Habits of Minds

In the science domain earth science, life science, physics, chemistry, environmental and resource issues, scientific inquiry and the nature of science were tested. The subject domain and the corresponding number of questions are shown in Table 3.6.

Table 3.6 Number of Items and Score Points in TIMSS 1999 SAT

Science	**Number of Items**	**Score Points**	**Percentages**
Earth Science	22	23	15.1%
Life Science	40	42	27.4%
Physics	39	38	26.7%
Chemistry	20	22	13.7%
Environmental and Resource Issues	13	14	8.9%
Nature of Science and Scientific Inquiry	12	13	8.2%
Total	146	153	100%

The achievement test includes different types of item format to test the content mentioned above. In the test multiple choice, short answer, and extended response type items were used to measure student science achievement. Scoring and number of questions in the sub-science domains was presented in Table 3.7.

Table 3.7 Score Points by Type and Category

Reporting Category	Item Type Multiple Choice	Short Answer	Extended Response	Number of Items	Score Points
Earth Science	17	4	1	22	23
Life Science	28	7	5	40	42
Physics	28	11	-	39	39
Chemistry	15	2	3	20	22
Env. Issues	7	2	4	13	14
Scientific Inquiry	9	2	1	12	13
Total	104	28	14	146	153

The present study used student science achievement scores to find out working model.

3.3.2 Science Teacher Background Questionnaire

In TIMSS-R four background questionnaires were used to gather information at various level of educational system; curriculum questionnaire addressed issues of curriculum design and emphasis in mathematics and science; a school questionnaire asked school principal to provide information about school staffing and facilities, as well as curriculum and instructional arrangements, teacher questionnaire asked mathematics and science teachers about their backgrounds, attitudes and teaching activities and approaches and a questionnaire for students sought information about their home background, attitudes and their expectations in mathematics and science classes (TIMSS 1999 Technical Report).

The main interest of the present study is about teacher questionnaires. Teacher questionnaires were carefully constructed to elicit information on variables taught to be associated with student achievement and some of important research questions addressed by the teacher questionnaires were:

- What are the characteristics of mathematics and science teachers?
- What are teachers' perceptions about mathematics and science?

- How do teachers spend their school-related time?
- How are mathematics and science classes organized?
- How much homework are students assigned?
- What assessment and evaluation procedures do teachers use?

The teacher questionnaire includes two sections. First section of the questionnaires deals with teacher background, experience, attitudes and teaching load. The second section of the questionnaire deal with teaching mathematics or science to the class sampled for TIMSS 1999 testing. The content of teacher questionnaire was presented in the Table 3.8.

Table 3.8 Content of Teacher Questionnaires

Question No	**Item Content**	**Description**
		Section A
1-2	Age and Sex	İdentifies teacher's sex and age range.
3	Teaching Experience	Describes teaching experience
4-5	Ins. Time	Number of hours per week the teacher devotes to teaching science
6	Adm. Tasks	Number of hours per week spent on administrative tasks
7	Teaching-Related Activities	The amount of time teachers are involved in various Professional outside the formally-scheduled school day.
8	Teaching Activities	Describes the total number of hours per week spent on teaching activities.
9	Meet with Other Teachers	Describes the frequency with which teachers collaborate and consult with their colleagues.
10	Teacher's Influence	Describes the amount of influence that teachers perceive they have on various instructional decisions.
11	Being Good at Science	Describes teacher's beliefs about what skills are necessary for students to be good at mathematics / science.
12	Ideas about Science	Describes teacher's beliefs about the nature of mathematics / science and how the subject should be taught.
13	Document Familiarity	Describes teacher's knowledge of curriculum guides, teaching guides, and examination prescriptions (country-specific options.

Table 3.8 (continued)

Question No	Item Content	Description
14	Science Topics Prepared to Teach	Provides an indication of teacher's perceptions of their own preparedness to teach the TIMSS 1999 in-depth topic areas in mathematics or science.
15-18	Teacher Training	Describes the highest level of formal education completed by the teacher, the number of years of teacher training completed, and the teacher's major area of study.
		Section B
1	Target Class	Identifies the number of students in the TIMSS 1999 tested class, by gender.
2	Instructional Emphasis	Identifies the subject matter emphasized most in the target mathematics / science class.
3	Instructional Time	Identifies the number of minutes per week the class is taught.
4	Textbook Use	Identifies whether textbook is used in mathematics / science class as well as the approximate percentage of weekly instructional time that is based on the textbook.
5-7	Calculators	Describes the availability of calculators and how they are used in the target class.
8	Computers	Describes the availability of computers and whether they are used to access the internet.
9	Planning Lessons	Identifies the extent to which a teacher relies on various sources for planning lessons (e.g., curriculum guides, textbooks, exam specifications).
10	Student Tasks	Describes the frequency with which teachers ask students various types of questions and ask students to perform various mathematics / science activities during lessons.
11	Students' Work	Describes how often students work in various group arrangements.
12	Time Allocation	Describes the percentage of time spent on each of several activities associated with teaching (e.g., homework review, tests).
13	Science Topic Coverage	Indicates the extent of teacher's coverage in target class of mathematics / science topics included in the assessment.
14	Classroom Factors	Identifies the extent to which teachers perceive that various factors limit classroom instructional activities.
15-16	Amount of Homework	Describes the frequency and amount of homework assigned to the target class.
17-18	Type and Use of Homework	Describes the homework assignments and how the homework is used by the teacher.
19-20	Assessment	Describes the kind and use of various forms of student assessment in the target class.

In the following figure sample item type from the Science Teacher Questionnaire was presented.

TIMSS-R Ref.No. 98-0038

14. In your view to what extent do the following limit how you teach your science class?

*Check **one** box in each row.*

		Not at all	*A little*	*Quite a lot*	*A great deal*
a)	students with different academic abilities	☐	☐	☐	☐
b)	students who come from a wide range of backgrounds, (e.g., economic, language)	☐	☐	☐	☐
c)	students with special needs, (e.g., hearing, vision, speech impairment, physical disabilities, mental or emotional/psychological impairment)	☐	☐	☐	☐
d)	uninterested students	☐	☐	☐	☐
e)	disruptive students	☐	☐	☐	☐
f)	parents interested in their children's learning and progress	☐	☐	☐	☐
g)	parents uninterested in their children's learning and progress	☐	☐	☐	☐
h)	shortage of computer hardware	☐	☐	☐	☐
i)	shortage of computer software	☐	☐	☐	☐
j)	shortage of other instructional equipment for students' use	☐	☐	☐	☐
k)	shortage of equipment for your use in demonstrations and other exercises	☐	☐	☐	☐
l)	inadequate physical facilities	☐	☐	☐	☐
m)	high student/teacher ratio	☐	☐	☐	☐
n)	low morale among fellow teachers/administrators	☐	☐	☐	☐
o)	low morale among students	☐	☐	☐	☐
p)	threat(s) to personal safety or the safety of students	☐	☐	☐	☐

Figure 3.1 Sample Item from TIMSS STBQ

The statistical analysis was based on these two instruments results and structural equation modeling analysis was run according to result.

3.4 Statistical Analysis

The present study used advanced statistical analysis. In the first part of the statistical analysis principal component factor analysis were run by concerning the data from TIMSS Teacher Background Questionnaires. On the light of the factor analysis, by using LISREL Package program structural equation modeling (SEM) technique constructed the second part of the statistical progress used in this study.

3.4.1 Principal Component Factor Analysis

Factor analysis is a statistical procedure to determine whether many variables can be described by a few meaningful factors (Fraenkel&Wallen, 1996). One purpose of factor analysis is to determine the number of factors required to account for the pattern of correlations between all pairs of tests in a set of tests. A common factor or unobservable variable which is correlated with scores on two or more tests (Fraenkel&Wallen, 1996).

A second purpose of the factor analysis is to determine the nature of the common factors that account for the test inter correlations (Craker&Algina, 1986). The present study used principal component factor analysis in the first purpose of the analysis to get meaningful groups can be named as latent variables using the data of TIMSS-R Teacher Background Questionnaires.

3.4.2 Structural Equation Modeling

Structural equation modeling (SEM) has become a standard tool in many scientific disciplines for investigating the plausibility of theoretical models that might explain the inter correlations among a set of variables. A structural equation model represents a series of hypotheses about how two variables in the analysis are generated and related (Hu & Bentler, 1999).

SEM is a process starting with specification of a model to be estimated and ending with the assessment of goodness of fit and the estimation of parameters of the hypothesized models (Hu & Bentler, 1999). The process of SEM (Boomsma, 2000) can be defined with the following diagram;

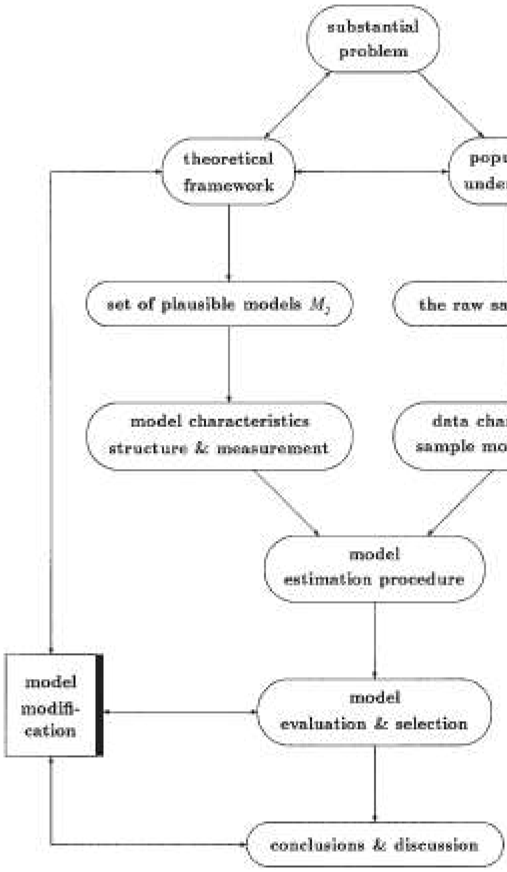

Figure 3.2 Flow Diagram of the SEM process

Often some basic model, for the structural relations is postulated (i.e., only one model is considered) which implies a strict confirmatory statistical analysis is being made (Boomsma, 2000). As mentioned above SEM is starting with specification of a model and gets a path diagram at the end of statistical analysis of SEM. This path diagram contains observed variables and latent variables. SEM analysis gives a path diagram with the path coefficient which is a standardized multiple regression coefficient (Kelloway, 1998) between the variables.

Identification is the second step which includes determination of whether the model identified or over identified of SEM process. To continue analysis the results must show that the model identified which means there are a number of solutions and finding the model which best fit to data.

The third step of SEM procedure is estimation and testing fit of the data. In the estimation of the model, imply that which estimates used to explain the nature of the proposed model. It is not feasible or necessary to present all estimation indices as obtained with a SEM. Given the model under study and the specific research questions posed, often different aspects of estimation results need to be emphasized (Boomsma, 2000).

There are several number of fit indices exist in the process of SEM. It is time to make decision about which fit indices must be presented about , what is the cutoff criteria for the estimates. The two most popular ways of evaluating model fit one those that involve the χ^2 goodness-of-fit statistics and fit indices. The χ^2 goodness-of-fit statistics assesses the magnitude of discrepancy between the sample and fitted covariance matrices (Hu & Bentler, 2001). Another popular ways of evaluating model fit is the so-called fit indices that have been offered to supply the χ^2 test. Fit indices can be classified into absolute and incremental fit indices. Examples of absolute fit indices include the Goodness-of-fit Index (GFI), Adjusted Goodness-of-fit Index (AGFI), a Standardized version of Jöreskog and Sörbom's Root Mean Square Residiual (S-RMR) and the Root Mean Square Error of Approximation (RMSEA). Examples of incremental fit indices include Normed Fit Index (NFI), Comparative Fit Index (CFI) (Hu & Bentler, 2001).

As noted Bentler and Bonett (1980), fit indices were designed to avoid some of the problems of sample size and distributional misspecification associated with the conventional overall test of fit (the χ^2 statistic) in the evaluation of a model. In the present study RMSEA, S-RMR, GFI, AGFI, CFI and NFI were used. For these fit indices cutoff criteria can be explained as; rules for the fit indices S-RMR and RMSEA should be smaller than 0.05, for the fit indices GFI, AGFI, CFI, and NFI should be bigger than 0.90. The cutoff criteria was summarized in Table 3.9.

Table 3.9 Cutoff Criteria for the Fit Indices

Fit Index	Cutoff Criteria
GFI	> 0.90
AGFI	> 0.90
S-RMR	< 0.05
RMSEA	< 0.05
CFI	> 0.90

And the final step of SEM progress is modification of model if needed. In a process of model modification, subsequent changes are preferably made one at a time. If after a number of model modifications a decision is made to stick to a "final" model, it is the researcher's responsibility to answer questions about validity of that model (Boomsma, 2000).

3.5 Procedure

In this section of the thesis, procedure followed during the preparation of this study was presented. The procedure section includes getting data, cleaning and preparing data to factor analysis, describing latent variables included in the model, proposing a model and the evaluating model fit. In the following part of this section these step were explained in details.

3.5.1 Data Collection

In the present study data collection did not take place because it used prepared data for the TIMSS. For the essence of the procedure data collection was explained briefly. Each participating country was responsible for carrying out all aspects of the data collection, using standardized procedures developed for the study. Training manuals were created for School Coordinators and Test Administrators that explained procedures for receipt and distribution of materials as well as for the activities related to the testing sessions. Each country also responsible for conducting quality control procedures and describing this effort in the NRCs' report documenting procedures used in the study.

In addition, the International Study Center (ISC) considered it essential to monitor compliance with standardized procedures NRCs were asked to nominate one or more persons unconnected with their national center, such as retired school teachers, to serve as quality control monitors for their countries (Gonzales & Miles, 2000).

After explaining data collection procedure, the second step was the cleaning and preparing data for the principal component factor analysis. The used data was downloaded from the http://isc.bc.edu which is the official web site of TIMSS. In this web site there is a huge database that contains all of the data collected in the TIMSS of participated countries. For the present study the Turkey's data was downloaded. To open downloaded data codebooks and programs were needed. The other programs and codebooks also were downloaded from the same web site.

After completion of data files the data was converted to editable format by using codebook and programs in SPSS 10.0 package program. After these step editable SPSS data file was obtained. In the present study three data files were used to gather information to carry out statistical analysis. Students' Achievement Data file, Science Teacher Background Data file, and the Teacher-Student Link file were used. By using students' achievement data file and teacher-student link file teacher student link were established. According to teacher id students average science achievement scores (five plausible scores) were calculated. As a last step missing values were checked in the data file of TIMSS Science Teacher Background Questionnaire (STBQ).

3.5.2 Principle Component Factor Analysis

By considering science teacher questionnaire 87 observed variables were taken into principle component factor analysis. These observed variables were selected by considering importance according to researcher and the related literature. From the original data of STBQ these selected 87 observed variables were taken to form new data file to run principal component factor analysis. In the factor analysis varimax rotation technique was used to get the result. To handle the missing data and get the correct results in the factor analysis listwise deletion method was preferred. After the principle component factor analysis nine factors were obtained. The factors and items that constructed the corresponding factor and factor loadings were presented in Table 3.1

Table 3.10 Factor Analysis Results

Items	F 1	F2	F3	F4	F5	F6	F7	F8	F9
SMALL GROUP PROJECTS	**.786**								
FIND USES OF CONTENT	**.724**								
PREPARE ORAL REPORTS	**.648**								
INDIVIDUAL PROJECTS	**.629**								
LOW MORAL AMONG STAFF		**.831**							
THREATS TO PERS. OR STUD. SFTY		**.745**							
LOW MORAL AMONG STUDENTS		**.742**							
HIGH STUDENT TEACHER RATIO		**.623**							
SPECIAL NEEDS		**.467**							
SHORTGE OF INSTR EQUIPMENT			**.787**						
SHORTGE OF COMPUTR HARDWARE			**.777**						
SHORTGE OF COMPUTR SOFTWARE			**.740**						
SHORTGE OF DEMNSTR EQUIPMNT			**.723**						
MEET PARENTS				**.735**					
UPDATE STUDENT RECORDS				**.625**					
MEET STUDENTS				**.623**					
PROFESSIONAL READING				**.558**					
ADMINISTRATVE TASKS				**.528**					
IMPORTANCE OF SEQNTAL DIRECTIONS					**.797**				
PRACTICAL AND STRUCTURED GUIDE					**.794**				
FORMAL REPRESENTATION OF WORLD					**.603**				
MULTIPLE CHOICE						**.891**			
STANDARD TESTS						**.555**			
REASONING TESTS						**.532**			
OBSERVATION							**.711**		
RESPONSES IN CLASS							**.686**		
PROJECT PERFORMANCE							**.677**		
WORK ON PROBLEMS								**.722**	
ANALYZE RELATIONSHIPS								**.623**	
HOW USED IN REAL WORLD								**-.440**	
EXPLAIN REASONING								**.428**	
DISRUPTIVE STUDENTS									**.732**
UNINTERESTED STUDENTS									**.674**
PARENTS UNINTRESTED IN PROGRESS									**.465**

Eigenvalues of these nine factors also presented in the following Table 3.11.

Table 3.11 Eigenvalues of the Corresponding Factors

Factors	**Eigenvalues**
Factor 1	9.108
Factor 2	5.925
Factor 3	3.815
Factor 4	3.693
Factor 5	2.919
Factor 6	2.893
Factor 7	2.816
Factor 8	2.516
Factor 9	2.312

Total variance explained by these nine factors and cumulative percent explained by these factors were presented in table 3.12.

Table 3.12 Cumulative Percent Explained by Nine Factors

Factors	Eigenvalues	% of Variance	Cumulative %
Factor 1	4.925	5.661	5.661
Factor 2	4.198	4.826	10.487
Factor 3	3.829	4.401	14.888
Factor 4	2.987	3.433	18.321
Factor 5	2.962	3.404	21.726
Factor 6	2.811	3.231	24.957
Factor 7	2.666	3.064	28.021
Factor 8	2.485	2.856	30.877
Factor 9	2.313	2.659	33.436

To form latent variables the factor analysis results were used. In the factor analysis some of the factors were formed only first 4 or five of the extracted items because to keep model simple. If all of the factors were taken into structural equation modeling the results may be distrubed. After organization of factor analysis results the latent variables used in the SEM were formed. According to results, homework type (HMWR), limitations to teach science (LMTS), physical classroom utilities (CLUT), activities outside of the school (OUTS), teachers' perception of science

(PRC1), written type of assessment (exams, tests) weight preferred in the classroom (ASW1), performance-based assessment weight preferred in the classroom (ASW2), learning tasks in the classroom (TSKS). The latent variables and observed variables that formed latent variables were presented in Table 3.13.

Table 3.13 Latent and Observed Variables

Questions	Items	Observed Var.	Latent Variables
If you assign homework, how often do you assign each of the following kinds of tasks?	SMALL GROUP PROJECTS	smpr	HMWR
	FIND USES OF CONTENT	fndu	
	PREPARE ORAL REPORTS	pror	
	INDIVIDUAL PROJECTS	inpr	
In your view to what extent do the following limit how you teach your science class?	LOW MORAL AMONG STAFF	lmas	LMTS
	THREATS TO PERS. OR STUD. SFTY	thrt	
	LOW MORAL AMONG STUDENTS	loas	
	HIGH STUDENT TEACHER RATIO	hstr	
	SPECIAL NEEDS	spnd	
In your view to what extent do the following limit how you teach your science class?	SHORTGE OF INSTR EQUIPMENT	shie	CLUT
	SHORTGE OF COMPUTR HARDWARE	shch	
	SHORTGE OF COMPUTR SOFTWARE	shcs	
	SHORTGE OF DEMNSTR EQUIPMNT	shde	
	ADMINISTRATVE TASKS	adtk	

Table 3.13 (continued)

Questions	Items	Observed Var.	Latent Variables
Approximately how many hours per week do you normally spend on each of the following activities outside the formal school day?	MEET PARENTS	mepa	OUTS
	UPDATE STUDENT RECORDS	updr	
	MEET STUDENTS	mest	
	PROFESSIONAL READING	prof	
	ADMINISTRATVE TASKS	adtk	
To what extent do you agree or disagree with each of the following statements?	IMPORTANCE OF SEQNTAL DIRECTIONS	imsd	PRC1
	PRACTICAL AND STRUCTURED GUIDE	psgu	
	FORMAL REPRESENTATION OF WORLD	frow	
In assessing the work of the students in your science class, how much weight do you give each of the following types of assessment?	MULTIPLE CHOICE	mcts	ASW1
	STANDARD TESTS	sdts	
	REASONING TESTS	rsts	
In assessing the work of the students in your science class, how much weight do you give each of the following types of assessment?	OBSERVATION	obse	ASW2
	RESPONSES IN CLASS	rpic	
	PROJECT PERFORMANCE	prpf	
In your science lessons, how often do you usually ask students to do the following?	WORK ON PROBLEMS	worp	TSKS
	ANALYZE RELATIONSHIPS	arel	
	HOW USED IN REAL WORLD	howu	
	EXPLAIN REASONING	expr	
In your view to what extent do the following limit how you teach your science class?	DISRUPTIVE STUDENTS	disr	LMT2
	UNINTERESTED STUDENTS	unis	
	PARENTS UNINTRESTED IN PROGRESS	prun	

In addition to these latent variables that were formed by using the results of STBQ factor analysis, student science achievement was taken as another latent variable in the name of ACHV which was constructed using students' five different science scores (plasuible values). The following step is the proposing a model for the data.

3.5.3 Proposing a Model

After obtaining the latent variables the next step was the proposing a LISREL model. When the tested model was determined LISREL syntax was written to carry out SEM analysis by LISREL. The LISREL syntax file contains correlation matrix which shows the relations within latent variables. The constructed SPSS file was used to obtain this correlation matrix. The correlation matrix was obtained by using both SPPS and LISREL programs. In the syntax the correlation matrix can be put in the correlation matrix itself or it can be put in the form of .cov data file and the path address of this file should be written in the syntax. The following figure shows the model tested in the present study.

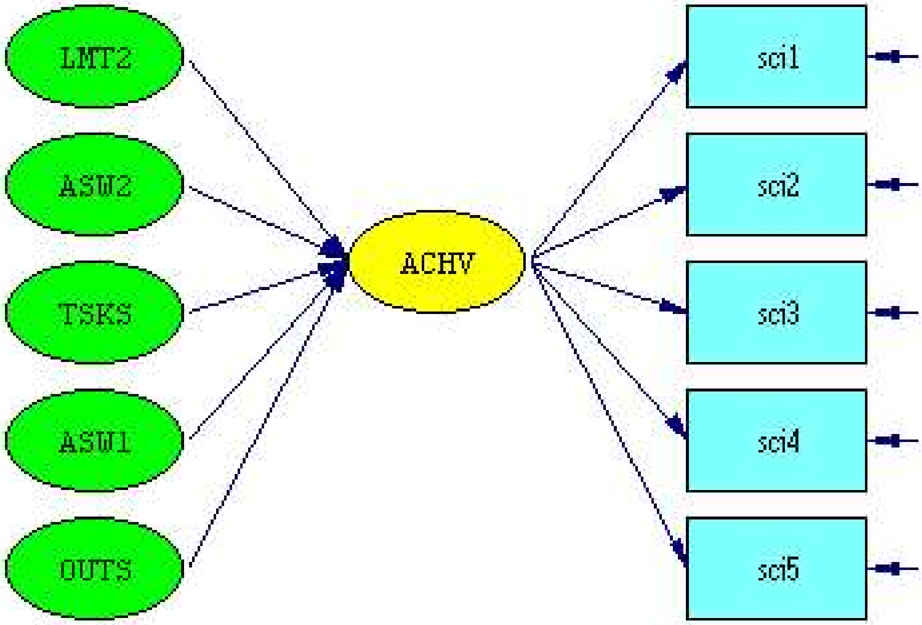

Figure 3.3 Proposed and Tested Path Diagram

When the proposing a model step was finished the LISREL program was run and the results were obtained. The next step was the evaluation of fit of the proposed model.

In the SEM analysis the main proposed model was also analyzed according to subtests of science achievement test. As mentioned before science achievement test which was applied to the sampled students of TIMSS-R consists of six subtests. Earth Science, Life Science, Chemistry, Physics, Environmental and Resource Issues, and Nature of Science and Scientific Inquiry subtests were used to measure students' science achievement in TIMSS-R. The main model was tested considering the each six subtests and results also were discussed in the next chapter of this thesis.

3.5.4 Evaluating the Fit of The Proposed Model

In this step of the study fit indices which were obtained after SEM analysis were evaluated. In the present study, RMSEA, S-RMR, GFI, AGFI, and CFI were used to evaluate the fit of the model. The cutoff criteria for the fit indices were given in Table 3.9 before and these fit indices should in the range of acceptable area.

In the present study the proposed main model is the best model can be achieved by using only STBQ data of TIMSS-R. To get the final best model researcher tried lots of different models by using the latent variables given in Table 3.13. Also some modifications were made to get the resultant model and these modifications were presented at the LISREL syntax at Appendix C.

3.6 Internal Validity and Reliability

In this section the validity of the proposed model results were discussed. To get the internal validity evidence for the proposed model confirmatory factor analysis were run within the latent variables. For the reliability of the model Cronbach-alphas were calculated for the latent variables.

3.6.1 Internal Validity

Internal validity means that any relationship observed between two or more variables should be unambiguous as to what it means rather than being due to "something else" (Fraenkel & Wallen, 1996). There are several threats to internal validity. Some of the threats are subject characteristics, mortality, location, instrumentation, testing and maturation. Maturation is not the main interest of the present study because all of the data used in the study was collected in a session. For the mortality, in the present study list wise deletion was used to control this effect and get the true and dependable results. Threats due to instrumentation and testing some precautions were taken before the data collection in TIMSS. TIMSS tried to minimize testing and implementation effects on the study and data collection by developing a standardized data collection and testing procedure. And also to eliminate the errors due to collectors all of the staff was given two day seminars about instrumentation and testing.

Also to collect internal validity evidence for the proposed model, by using LISREL package program confirmatory factor analysis was run to determine whether the constructed latent variables were valid and meaningful. To carry out confirmatory factor analysis, line that shows relationships between the dependent and independent variables was deleted from the LISREL syntax file and program was run again. The results of confirmatory factor analysis of latent variables were presented at Appendix E.

3.6.2 Reliability

TIMSS also provides reliability standards in the student achievement test scores for the extended and free-response items. To ensure reliable scoring procedures based on the TIMSS rubrics, the International Study Center prepared detailed guides containing the rubrics and explanations of how to use them, together with example student responses for each rubric. These guides, along with training packets containing extensive examples of student responses for practice in applying the rubrics, served as a basis for intensive training in scoring the free response items. The training sessions were designed to help representatives of national centers who would then be responsible for training personnel in their countries to apply the two digit codes reliably (TIMSS Technical Report, 2000).

In the present study also Cronbach-alpha coefficient were calculated for the latent variables and the results were shown in Table 3.14.

Table 3.14 Cronbach-alpha Coefficient for the Latent Variables

Latent Variables	**Cronbach-alphas**
HMWR	0.7697
LMTS	0.7617
CLUT	0.8189
PRC1	0.6934
OUTS	0.6006
ASW1	0.5618
ASW2	0.6385
TSKS	0.6128
LMT2	0.6763

According to Fraenkel and Wallen (1996), for research purposes a useful rule of thumb is that reliability should be at least 0.70 and preferably higher. By considering this criteria, the obtained Cronbach-alphas were around 0.70 and they can be acceptable for this study.

CHAPTER 4

RESULTS

In this section of the present study results obtained from Structural Equation Modeling and path diagram were discussed. Fit of the proposed model was evaluated according to fit indices criteria given in Table 3.9.

4.1 Proposed Model (Main Model)

In structural equation modeling (SEM) analysis a proposed model which consisted of LMT2, ASW2, TSKS, ASW1, OUTS, and ACHV latent variables was tested. The latent variables LMT2, ASW2, TSKS, ASW1 and OUTS were used to explain students' science achievement (ACHV). In the analysis of the SEM two different versions of the path diagram were used to explain the variance of ACHV. First version of the path diagram shows the relationships between the variables with correlation coefficient and the other version of the path diagram shows the relationships with t-values. Moreover, in all the analyses 0.05 level of significance is used.

The path diagram contains standardized solutions of the proposed model was presented in Figure 4.1. Also significance of the relationships for the tested model in the study was shown in Figure 4.2 with t-values. In the proposed model all of the relationships were not significant. ASW1 and OUTS' relations were not found significant due to that reason in the version of the proposed model with t-values links between the ACHV and the latent variables ASW1 and OUTS were not presented.

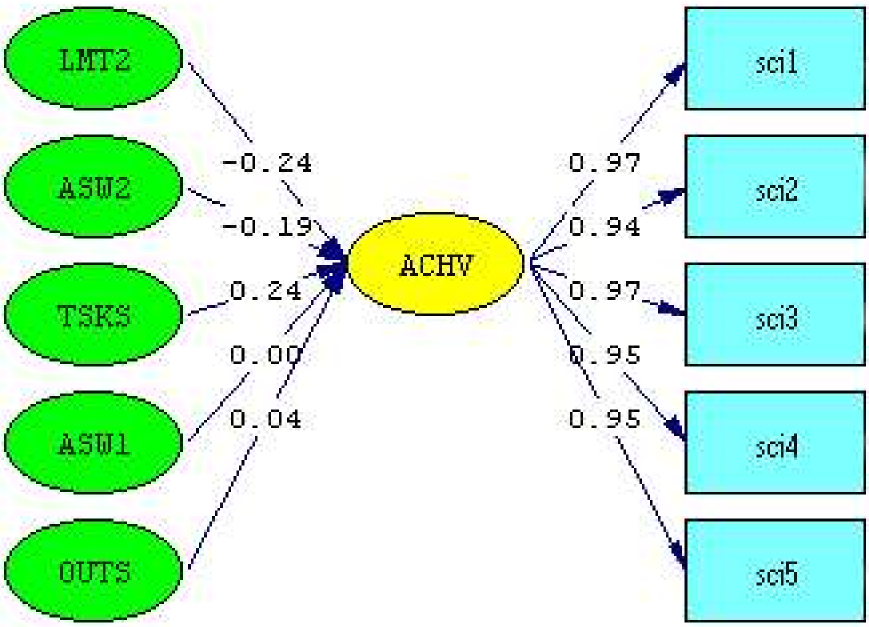

Figure 4.1 Proposed Path Diagram

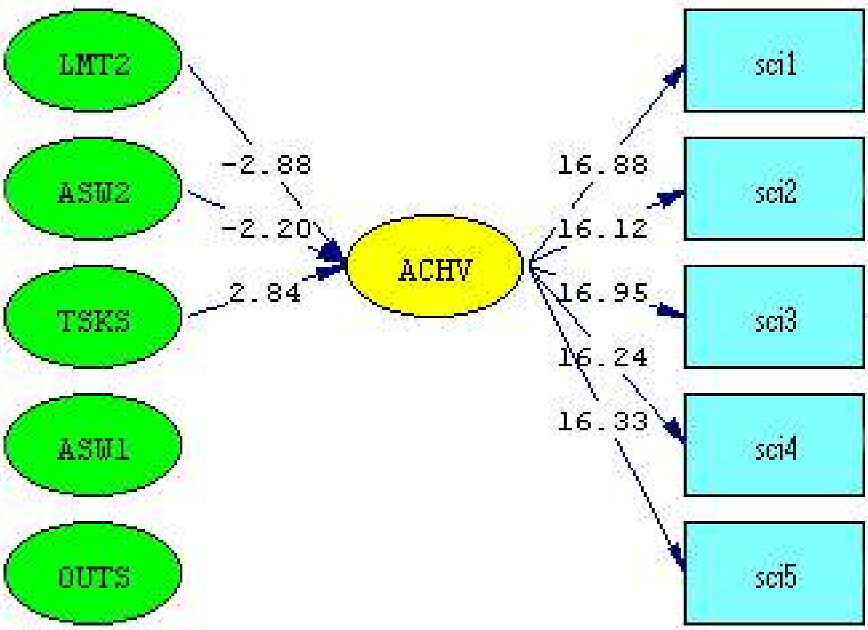

Figure 4.2 Significance of the Relationships with t-values

In Appendix D the whole model which means not only the relationships between latent variables but also relationship between the observed variables and corresponding latent variables were presented in two forms (standardized solution and t-values) can be found.

In the model one of the significant relationship links was between the latent variable LMT2 and the ACHV. The path coefficient of this relationship is – 0.24 and the t-value of this relationship is – 2.88. This means that according to teachers when the limitations in the classroom increase students' science achievement decreases in TIMSS. Students who scored low from TIMSS science achievement test were the ones in the class of teachers who think the uninterested students and parents, and disruptive students in the class negatively affect achievement. This link also corresponds to highest relationship in the proposed model.

Another negative relationship in the model exists between the ASW2 and ACHV. The path coefficient of this link is – 0.19 and the t-value is – 2.20. The ASW2 contains assessment types that the teacher prefer in the classroom to evaluate students work based mainly on students performance. According to this results, when the teachers prefer assessment types that require students' performances, students' science achievement level decreases. This relation is the lowest significant relationship in the model. This is a contradictory result with the current literature in the field of education. The reasons of this contradiction will be discussed in the discussion part of this thesis.

TSKS and ACHV link was the other significant relationship. The path coefficient of this relationship is 0.24 and the t-value is 2.84. This implies that if the teacher prefers tasks which include work on problem, analyze relationship, how used in real world and explain reasoning, students' achievement in science increases. ASW1-ACHV and OUTS-ACHV path links did not produce significant relationships in the model.

4.2 Subtests Examination of Proposed Main Model

In this part of the thesis subtests of science achievement test were examined as sub models of the proposed model. The path coefficients and the obtained t-values for the sub models of Earth Science, Life Science, Chemistry, Physics, and Nature of Science and Scientific Inquiry were presented. Also path diagrams of these five sub models were given.

4.2.1 Earth Science Sub model

The sub models of the proposed model were constructed by using students' science scores which were obtained at the end of application of science achievement test. Left side of the main proposed model was kept as the same and only right side of the model was changed. For the total science score of the students sub-science scores of the students were used in the model development. Path diagrams of the Earth Science Model were presented Figures 4.3 and 4.4.

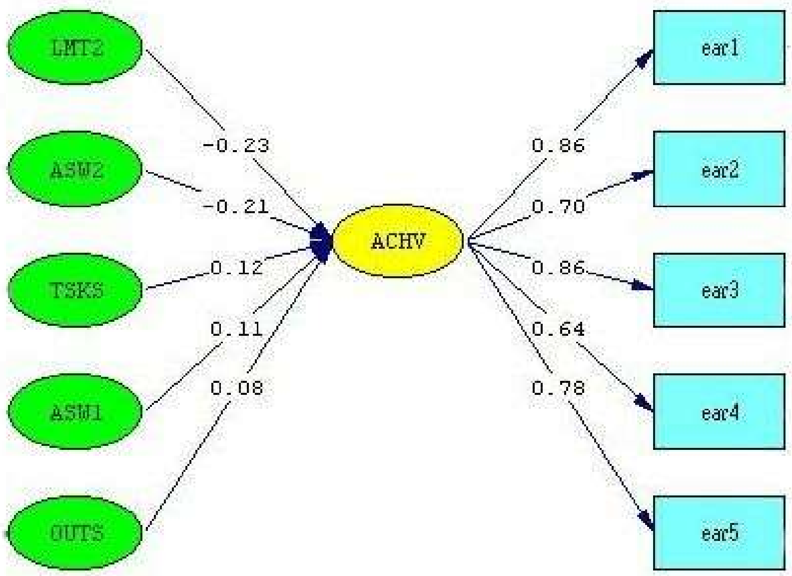

Figure 4.3 Standardized Solutions of Earth Science Sub model

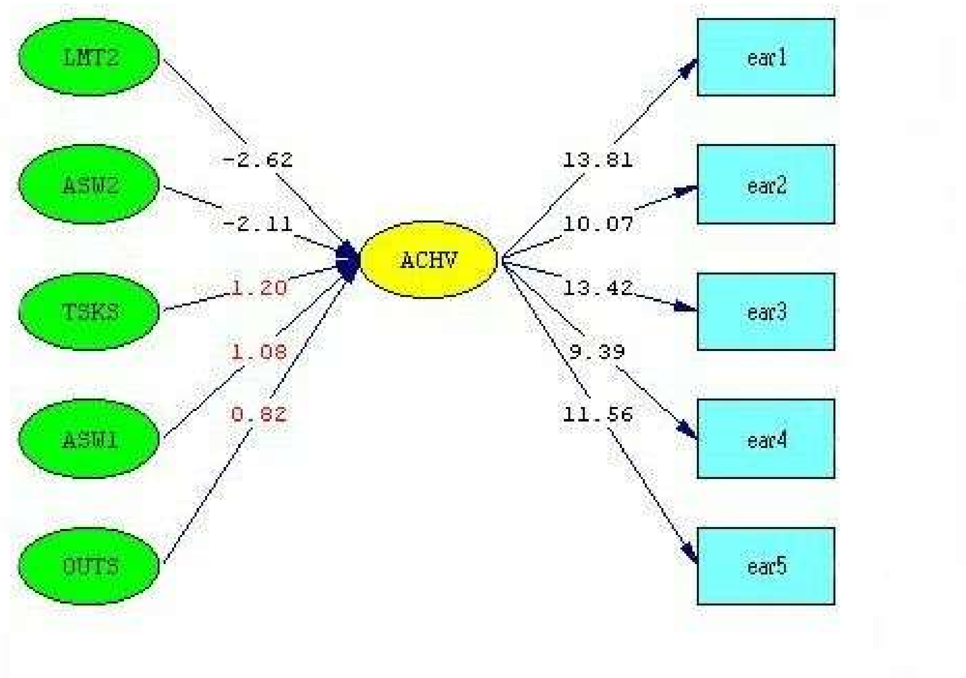

Figure 4.4 Significance of the Relationships with t-values of Earth Science Sub model

In the Earth Science Sub model LMT2-ACHV, and ASW2-ACHV links give significant but negative relationships. TSKS, ASW1, and OUTS do not give significant relationship with the latent variable of ACHV.

4.2.2 Life Science Sub model

Another sub model of the science achievement test is the Life Science Subtest. Path coefficient and t-values of the Life Science Sub model were presented below.

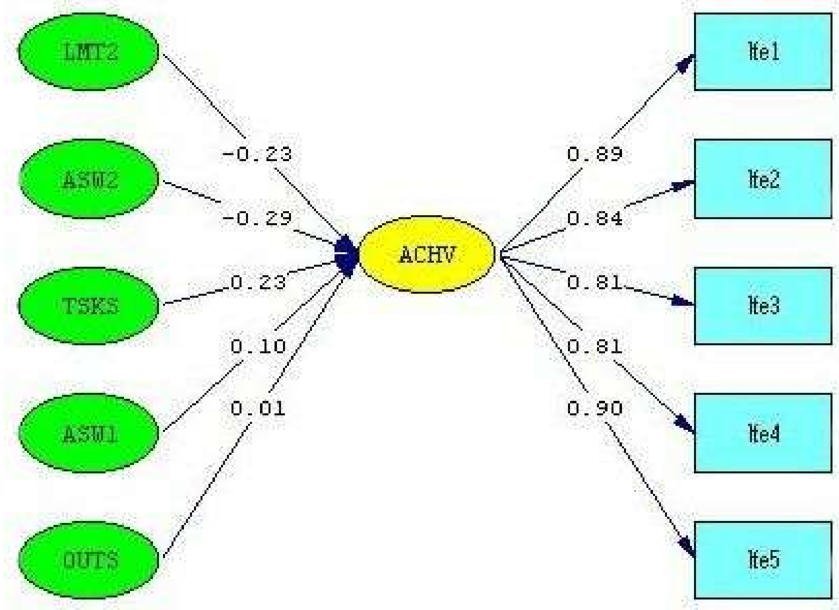

Figure 4.5 Standardized Solutions of Life Science Sub model

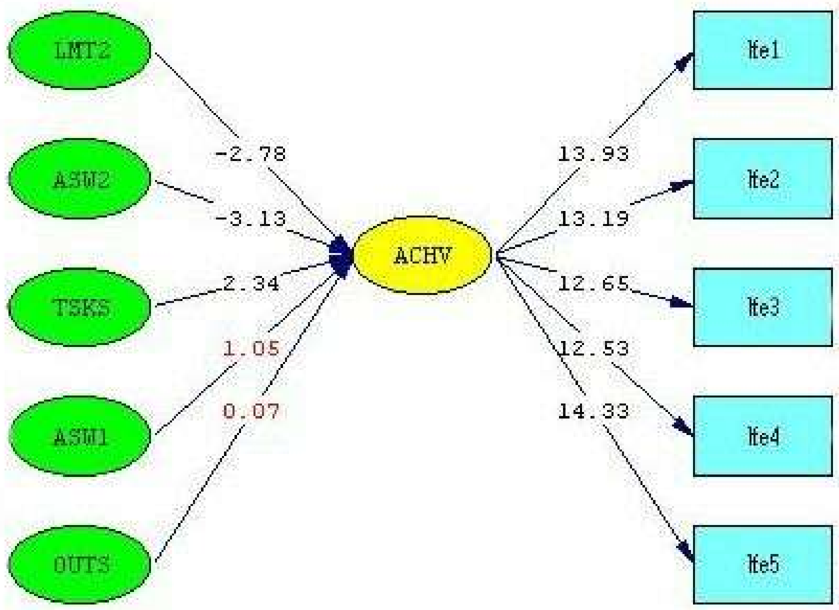

Figure 4.6 Significance of the Relationships with t-values of Life Science Sub model

In the Life Science sub model LMT2, ASW2, and TSKS variables produce significant relationships with the latent variable ACHV. Life Science Sub model has similar pattern with the main proposed model in the study.

4.2.3 Physics Science Sub model

Physics Sub model has similar pattern with the Earth Science Sub models. The significant relationship links were the same in both models. Path diagrams of the Physics Science Sub models were given below.

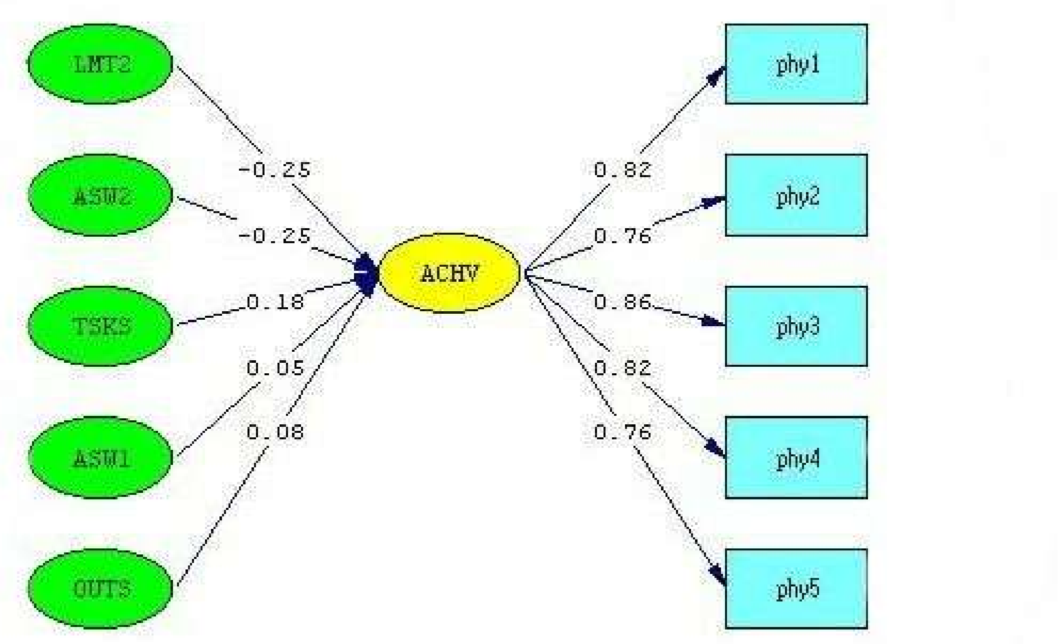

Figure 4.7 Standardized Solutions of Physics Science Sub model

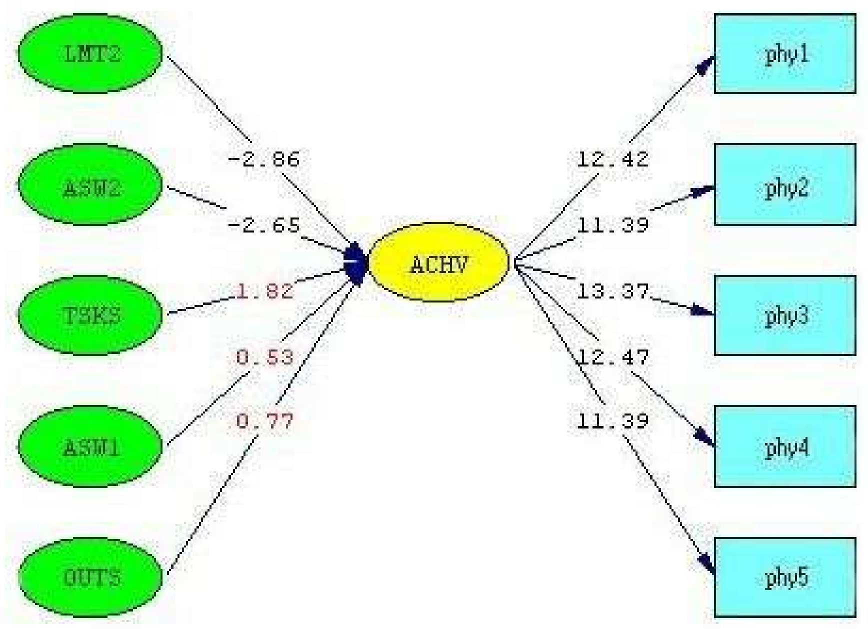

Figure 4.8 Significance of the Relationships with t-values of Physics Science Sub model

4.2.4 Chemistry Science Sub model

Chemistry Science Sub model is one of the similar models with the main proposed model. The same significant relationship links were obtained from the Chemistry Science Sub model. Path diagrams with standardized solution and t-values were shown in Figure 4.9 and 4.10.

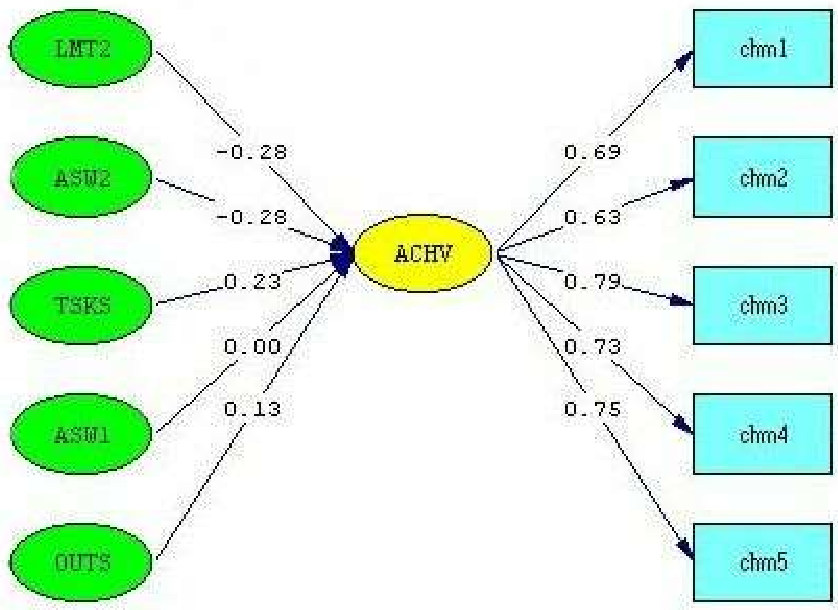

Figure 4.9 Standardized Solutions of Chemistry Science Sub model

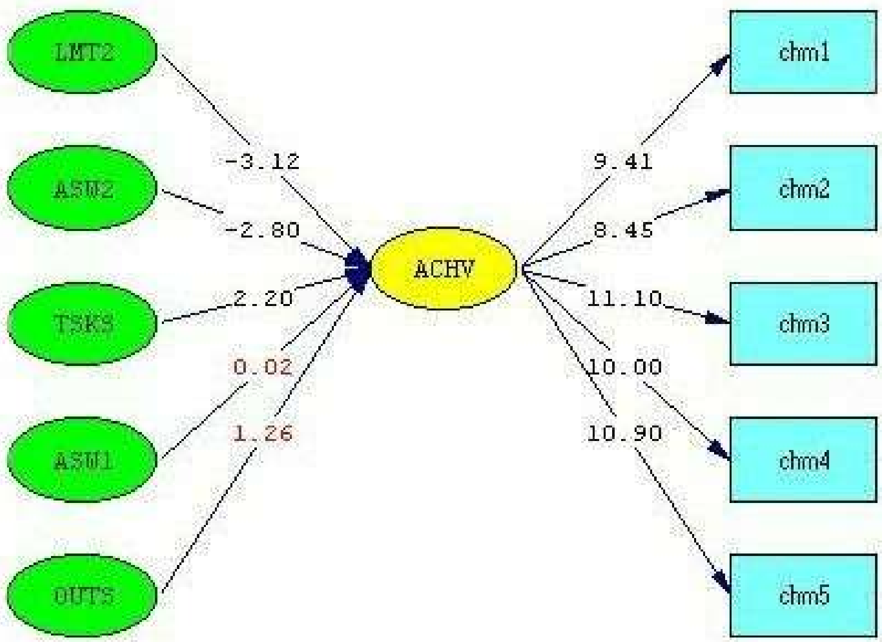

Figure 4.10 T-values of Chemistry Science Sub model

4.2.5 Nature of Science and Scientific Inquiry Sub model

As a last sub model, Nature of Science and Scientific Inquiry Sub model was examined. Again as in the case of Chemistry and Earth Science Sub models, Nature of Science Sub model has a similar significance pattern with the main proposed model of the present study. Similarly, path diagrams of the Nature of Science Sub model were presented below.

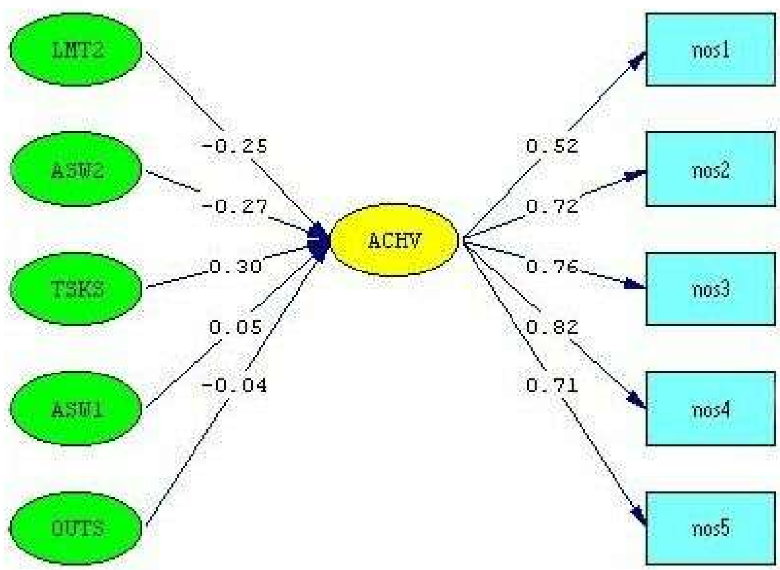

Figure 4.11 Standardized Solutions of Nature of Science Sub model

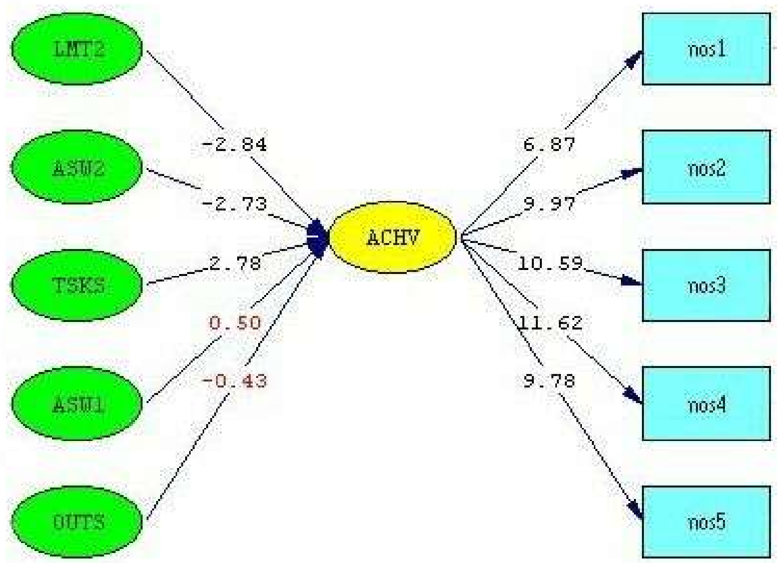

Figure 4.12 Significance of the Relationships with t-values of Nature of Science Sub model

In the sub models of Chemistry, Earth and Nature of Science similar results were obtained. Path coefficients and the t-values of the sub models were nearly equal to each other. Moreover, the direction of the relationship links was the same. In these sub models the relationship links between the LMT2, ASW2, and TSKS and ACHV latent variable can be accepted in the same perspectives. As in the main model ASW1 and OUTS latent variables do not yield significant correlations with the ACHV. On the other hand the sub models Physics and Life Science have slightly different pattern with the main model. In addition to ASW1 and OUTS latent variables TSKS latent variable does not yield a significant relationship contrary to the other sub models. Results of the sub models were summarized in the following table.

Table 4.1 Cutoff Criteria Values of Subtests Models

Sub models	X^2	df	RMSEA	S-RMR	GFI	AGFI	CFI
Earth Science	263,06	206	0,040	0,057	0,89	0,85	0,93
Life Science	298,06	208	0,049	0,058	0,87	0,83	0,91
Physics	257,08	201	0,040	0,058	0,89	0,87	0,93
Chemistry	258,03	203	0,039	0,059	0,89	0,85	0,94
Nature of Science	304,26	209	0,060	0,050	0,87	0,83	0,88

When the Table 4.1 carefully examined in all of the sub models χ^2 and df values were comparable with each other as in the case of the main proposed model of this study. As mentioned in Chapter 3, a model can be accepted as a working model RMSEA value of the model should be smaller than 0.050. This criteria is satisfied by all models except Nature of Science Submodel which has a RMSEA value of 0.060. Another important evidence of working model is GFI values. For the submodels the GFI values are very close to cutoff value which is 0.090. Generally, all submodels tend to show similar patterns with the main model. Small distortions in the cutoff values of the proposed submodels are derived from the sample size of the study. With larger samples the better results will be obtained.

Best represantative submodel of the main proposed model is Chemistry Science Submodel. The LISREL syntax of the submodels are presented in Appendix C.

4.3 Evaluation of Goodness-of-Fit of the Main Model

In this section of the thesis, goodness-of-fit indices of the proposed model were evaluated. As mentioned before, for a good and working model some cutoff criteria should be satisfied by the model. This criteria and fit indices were presented in Table 3.9. For the evaluation of fit of the model first of all chi-square and degrees of freedom (df) should be comparable (Kelloway, 1998). For the present study χ^2 is

277.45 and df is 208. When the numbers were examined that the df and χ^2 values are comparable and for the model this can be acceptable and supportive result.

The second dimension of the evaluation of the goodness-of-fit of the model is checking whether the fit indices in the expected range or not. In this study GFI, AGFI, RMSEA, S-RMR, and CFI were used to evaluate fit of the model. The Table 4.2 shows the fit indices results for the proposed model and the expected range. As a third dimension of evaluating the model fit is the explained variance or The Coeffient of Determination (R^2). The coefficient of Determination can be defined as the square of the correlation between a predictor and a criterion variable (Fraenkel & Wallen, 1996).

Table 4.2 Fit Indices for the Proposed Model

Fit Index	**Value**	**Cutoff Criteria**	**Satisfaction**
RMSEA	0.043	< 0.05	Satisfied
S-RMR	0.050	< 0.05	Satisfied
GFI	0.900	> 0.90	Satisfied
AGFI	0.860	> 0.90	Unsatisfied
CFI	0.960	> 0.90	Satisfied

A cutoff value 0.05 was used for S-RMR and RMSEA that values less than 0.05 be considered as indicative of close fit. Also values between 0.05 and 0.08 considered as fair fit (Hu & Bentler, 1999). For the proposed model The Root-Mean-Square Error of Approximation (RMSEA) is 0.043 and this is in the range of acceptable conditions in evaluation of the fit of the data. RMSEA criteria is satisfied by the model and this mean that the data good fits to data.

The Standardized Root-Mean-Square Residual and the Goodness-of-Fit Index are the other criteria indices for the evaluation of model. For the present study S-RMR is 0.05. This value is on the edge of cutoff point but it can be acceptable value because there was not big difference between the acceptable conditions and the actual condition. The same thing can be in question. For the proposed model the Goodness-of-Fit Index (GFI) is 0.90 that can also be accepted as a satisfaction index for the model.

According to cutoff criteria (> 0.90) of AGFI is not satisfied by the model. AGFI is 0.86 for the current study. This means model satisfy a fair fit of the data. Another index is CFI for the model evaluation. The CFI of the proposed model in the study is 0.96 and according to cutoff criteria (>0.90) model satisfies a good fit of the data.

Some of the fit indices may seem to be problematic such as AGFI and S-RMR in the evaluation of the model. But the reason can be the sample size of the study. The sample size of the study was 178 science teachers, but for the SEM studies sometimes several hundred subjects were needed to get intended result (Boomsma, 2000).

As mentioned before explained variance by the model is the third dimension of the model evaluation. The coefficient of determination for the relationships in the proposed model, the variance explained by the latent variables was presented in Table 4.3. Also Table 4.3 shows the total explained variance of ACHV is presented.

Table 4.3 The Coefficient of Determination (R^2) for the Latent Variables

Latent Variables	**R^2**
LMT2	0.058
ASW2	0.040
TSKS	0.058
Total	0.156

The latent variable LMT2 is explained the 5.8% of the variance of ACHV. ASW2 is the lowest explained variance. It explains only 4% of the variance of ACHV variable. TSKS variable is the latent variable explains the highest variance with the LMT2 in the model. Totally the model is explained the 15.6% of the variance.

This means that the proposed model explains the 15.6% of the students' science achievement by considering the only teacher-related variables.

4.4 Proposed Model 2

Another model was tested in the present study as a second proposed model. The model constructed by using the same factors obtained from principle component factor analysis and tested by using SEM analysis. In the model HMWR, LMTS, CLUT, PRC1, and LMT2 were used to form the model. HMWR latent variable consist of which types of homework were assigned to students by teachers. Small group projects, find uses of content, prepare oral reports, and individual projects formed the HMWR latent variable. Low moral among staff, threats to personality and student safety, low moral among student, high student teacher ratio, and special needs constructed the latent variable of LMTS. LMTS means limitations that limit teachers when they try to teach science. Another limitation latent variable is CLUT which means classroom utilities. CLUT includes shortage of instructional equipment for student use, shortage of computer hardware, shortage of computer software, and shortage of demonstration equipment observed variables. Teachers perceptions about science formed another latent variable which is PRC1. Importance of giving direction to students when they are doing experiments, science is a practical and structured guide for addressing real situations, and science is a formal way of representing the real world are the components of PRC1 latent variable. As a last latent variable LMT2 was taken into consideration. Disruptive students, uninterested students, and parents uninterested in progress formed the latent variable of LMT2.

Path diagrams consisting t-values and standardized solutions were presented below. Figure 4.13 and 4.14 shows the standardized solutions and t-values of the proposed model 2 respectively.

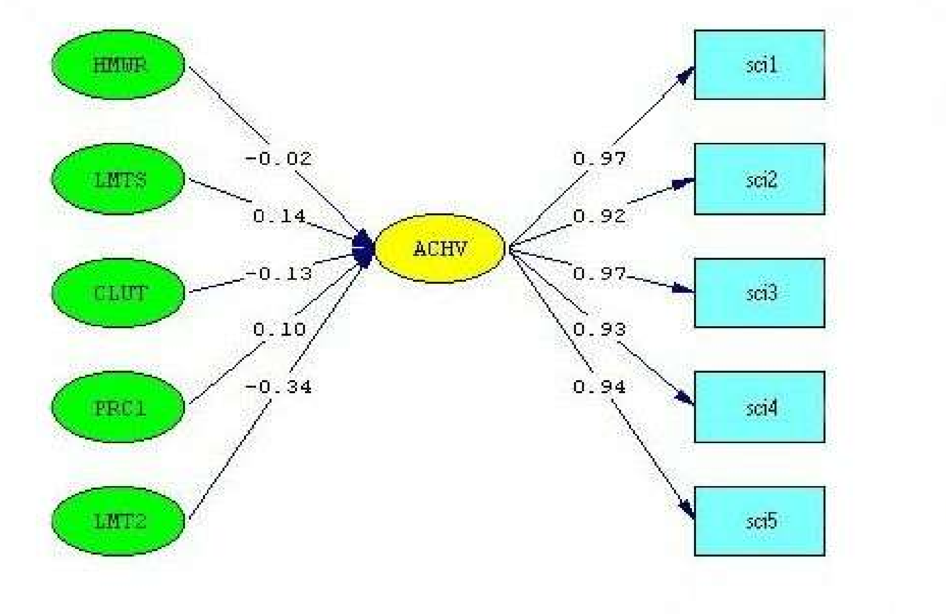

Figure 4.13 Standardized Solutions of Proposed Model 2

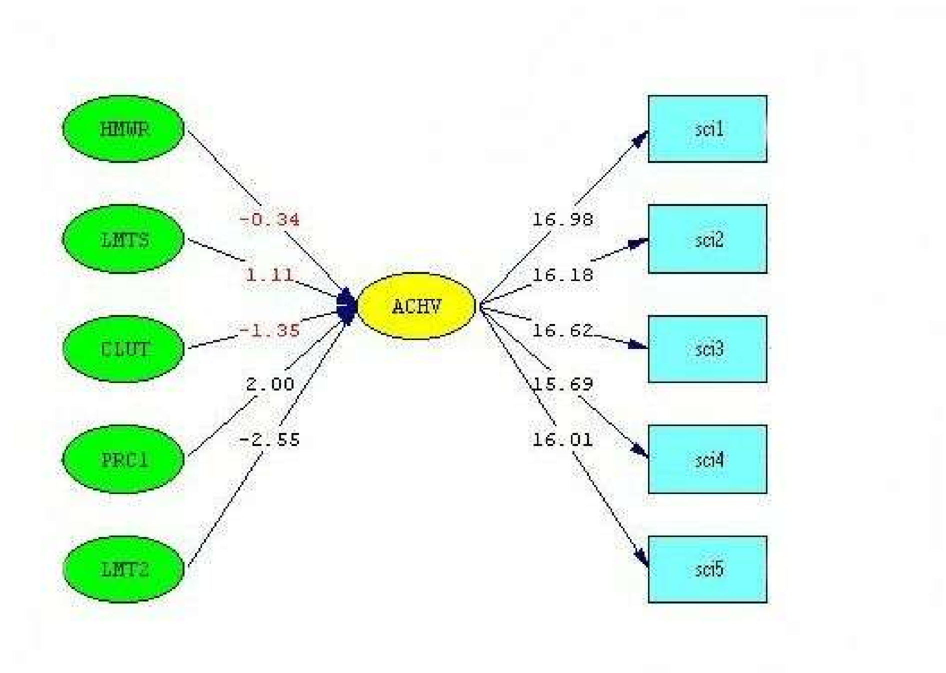

Figure 4.14 Significance of the Relationships with t-values Proposed Model 2

HMWR, LMTS, and CLUT latent variables do not produce significant relationships with the latent variable of ACHV. On the other hand, PRC1, and LMT2 have significant relationship links with the ACHV.

In the proposed model one of the non-significant relationship links was between the latent variable HMWR and the ACHV. The path coefficient of this relationship is – 0.02 and the t-value of this relationship is – 0.34. This means that the model do not put an evidence for the significance of homework type in the perspective of student science achievement.

Another non-significant link was between the LMTS and ACHV. The path coefficient of this relationship is 0.14 and the t-value of this relationship is 1.11. Last non-significant link in the proposed model 2 was between the CLUT and ACHV. The path coefficient of this relationship is – 0.13 and the t-value of this relationship is – 1.35. In this study the relationship between the CLUT and the ACHV was non-significant but this link should be carefully examined. Because, t-values can be found larger when the sample size is larger than this study. This link is important because it shows us that when the shortage of instructional equipment, computer hardware, software and demonstration equipment increases, the students' science achievement decreases. In other words when the physical utilities in the classroom and schools are improved, the students' science achievement will increase. The ratio of technological facilities of a school determines the ratio of students' success in science.

One of the significant relationships in the proposed model 2 was between the PRC1 and ACHV. The path coefficient of this relationship is 0.10 and the t-value of this relationship is 2.00. The science teachers' perceptions of science positively affect students' science achievement. When the science teachers see science as a formal way of representing the real world and a practical and structured guide for addressing real situations the student science achievement will increase.

The strongest relation in the proposed model 2 was between the LMT2 and ACHV. The path coefficient of this relationship is -0.34 and the t-value of this relationship is -2.55. This means that when the number of disruptive and uninterested students and uninterested parents increases, students' science achievement level decreases. In other words, classroom climate is important for science achievement and tidy classes more suitable for science lectures for Turkish educational system.

4.5 Evaluation of Goodness-of-Fit of the Proposed Model 2

In the evaluation of goodness of fit of any proposed model some cutoff values should be satisfied by the model. As mentioned before cutoff criteria for the models for the present study was explained in Table 4.2. For the proposed model 2 obtained values are given in Table 4.4.

Table 4.4 Fit Indices for the Proposed Model 2

Fit Index	**Value**
RMSEA	0.050
S-RMR	0.066
GFI	0.087
AGFI	0.081
CFI	0.096

Fit indices for the proposed model 2 have some trouble. S-RMR value is larger than 0.050 and AGFI also is smaller than 0.090. This values arises due to sample size of the study and make the model weak. On the other hand GFI and CFI values are in the acceptable range. Although, the proposed model 2 carry some problems in the perspective of cutoff values it can be accepted as working model. Because when the explained variance of science achievement by the proposed model 2 was examined it is easy to see the value of explained variance is not smaller than the main proposed model. The explained variance by the latent variables and the total variance explained by the model were presented in Table 4.5.

Table 4.5 The Coefficient of Determination (R^2) for the Latent Variables

Latent Variables	**R^2**
HMWR	0.0004
LMTS	0.0196
CLUT	0.0169
PRC1	0.0100
LMT2	0.1156
Total	0.1625

The model explained 16.25% of the variance of students' science achievement in TIMSS-R.

CHAPTER 5

DISCUSSION

The present study was carried out to explain the variance in the eighth grade student science achievement in Turkey by considering the teacher-related variables. The data used in the present study was the collected data for TIMSS-R. Student achievement scores and the science teacher background questionnaire data were used to explain the relationships between the variables in the proposed models.

5.1 Discussion of the SEM Results of Main Model

The present study is carried out to deeply understand the results and outcomes of TIMSS for our educational system. TIMSS gave a chance to participating countries to compare their educational system on the world stage and considering the outcomes to make some modifications in their educational frameworks. In other words TIMSS is a feedback mechanism for the participating countries. Educators and ministry of education departments of participating countries should carefully analyze the outputs of the TIMSS and try to understand what the TIMSS says. By this way, extensive educational reforms can be carried out with the reliable and valid evidences.

This study reveals the fact that teacher and teacher preparation are important. According to results of structural equation modeling analysis, all evidences direct us to teacher preparation. Moreover, the present study shows that our teachers are not well qualified for the effective teaching. After examination of the results of the present study the scene is more cleared.

In the study different theoretical models were proposed and tested. In the SEM analyses, latent variables which were obtained from the principal component factor analysis of the data of STBQ were used (The teachers' answers to the STBQ are presented in Appendix A). In the proposed main model one of the negative significant relationships was the LMT2-ACHV link. In the background questionnaire, one of the items that the teachers answered was “what extent do the following limit how you teach your science class?” .The latent variable LMT2 which includes observed variables of disruptive students, uninterested students and uninterested parents in progress, was formed with the results of that question. Students who scored low from TIMSS science achievement test were the ones in the class of teachers who think the uninterested students and parents, and disruptive students in the class negatively affect achievement. These are expected results for the Turkish educational system as the class sizes in our country are not suitable for the effective learning for the students. The mean class size in TIMSS study for Turkey data was 47 students per class. This number is very high for effective learning. With this number of student performing learning tasks is very difficult for teachers. Moreover, teachers may spend some part of their class time to control the class.

Another negative relationship in the main model was between the ASW2 and ACHV latent variables. ASW2 is the latent variable which implies how much weight does teacher gives to types of assessment. ASW2 includes observation, response in class and project performance assessment types. When we look at the observed variables in the ASW2 latent variable we can put these observed variables under the category of student-centered activities. Students who scored low from TIMSS science achievement test were the ones in the class of teachers who answered the question about preferred teaching method as student-centered. Then this result is a contradictory result with the literature in the field of education. In addition to that similar results were found in Özdemir’s study. He found that science achievement had a negative relationship with the classroom activities considered as student-centered. Where is the problem, what are the reasons of this contradiction. The main reason of this contradictory result is that our teachers are not well qualified. There may be two reasons for this contradictory result. First, teachers may use the easy way because of their inadequacy and leave all activities to students to do. For example, teachers divide the topic into pieces and tell students to explain the studied topic. The only thing that the teacher does in this process is dividing and assigning the content. But the same teacher answers the question about their preferred teaching method as student-centered. This is the main reason why student-centered activities or student-centered evaluation affect student science achievement negatively.

Here this is time to make decision about whether our teachers are well-qualified but they do not use their potentials and prefer easy way or our teachers are not well qualified and they do not know how they can apply teaching methods which they were taught in the undergraduate programs. With the same approach and conditions, result of the computer-assisted instruction in science negatively affect student achievement can be reached. In most cases, teacher take students to computer laboratory for the science lecture and leave students free and within this time students use computer for gaming or other activities other than science or teacher use computer as page turner and when they were asked they said that we use computer-assisted instruction. Thus the statement "computer-assisted instruction" negatively effect student science achievement" stands in front of us as inevitable result. Because of such situations, we should be careful when we evaluate the results of the present study. Although the results of the present study seem to be contradictive with the current literature in the field of education, for Turkey data the results seem to be dependable and reliable.

When the teacher candidates finish their undergraduate programs and start their careers in schools they are inexperienced teachers. They do not receive any support from the ministry of education about implementation of curriculum, classroom management, etc. On the other hand, extensive reforms are carried out and teachers are not informed about changes. For example, ministry of education took a decision such as they upgrade the education style to student-centered education. This is a good and realistic approach but none of the teachers are informed about the procedure. The ministry of education only takes decisions and tells to teachers to give the education in this way. Every step is left to teachers. Teachers can not survive in this process. When there is a modification in educational system teachers must be educated or trained with pre and in-service education, then we can get reliable and compatible results with the current literature.

In the main model there is a positive and significant relationship between TSKS and ACHV variables. Students who scored high from science achievement test in

TIMSS were the ones of teachers who prefer learning tasks which requires explain reasoning, analyze relationship, and work on problems for the collected data. TSKS latent variable contains work on problem, analyze relationship, how used in real world, and explain reasoning observed variables. These elements are requirements for effective learning. Analyzing relationship, explain reasoning behind a fact or situation produce a complete learning process in science. If we educate our teachers as educators who follow application of modern education methods such as cooperative learning, group studies, project studies, etc. then we can say that we reach the world standard in the teacher perspective.

Teachers' spend time outside of the school is not significantly related with the student science achievement in TIMSS. When evaluating the results of the present study the fact of TIMSS framework should be kept in mind. This is an international study and it is difficult to get complete consensus about the content of the achievement tests. As a matter of fact, the conflict between the content of the applied science achievement test in TIMSS and the countries curriculum were discussed and pointed out (Ramseier, 1999; Bracey, 1998). Also the questions may not totally reflect the nature of content and translation may play an important role. Turkey's score (433) of TIMSS in science domain is significantly lower than the international average (488). The content disagreement may be one of the factors of this failure or unexpected result. The results of TIMSS should be deeply discussed and the reasons of this result should be searched. This study tries to give small aid in this perspective.

5.2 Discussion of the SEM Results of Proposed Model 2

According to results of proposed model 2, technological investments should be increased to answer the necessities of our schools. By doing this not only bring our school to modern and quality school level but also increase our students science achievement. Moreover when the students interact with technological facilities they can educate and prepare themselves for the technological era developing with speed of light.

Also teacher preparation is also an important factor. Teacher who can combine science and real world situations or see science is a formal way of representing the real world should be preferred to reach achievement. Turkish students' science achievement level is not good in TIMSS-R. The reason of this may arises from the content of science achievement test. Our educational system direct students to memorize and also assessment instruments that the teachers use do not measure higher cognitive skills. The content of TIMSS science achievement test highly depends on daily life experiences. We should connect the science with the daily life. Again we come to the same point as discussed above. As in the main model, in model 2 the importance of teacher perception of science is obvious. If we have well-qualified and well educated educators than we will bring up successful generations that is formed by individuals who are searcher and argumentative. This not only needed for successful and effective education but also for reaching world standards in every field of life.

In the proposed model 2 the strongest relationship link was between the LMT2-ACHV. The latent variable LMT2 includes disruptive students, uninterested students and uninterested parents in progress observed variables. This means that disruptive and uninterested students in the class negatively affect the student science achievement in TIMSS. In other words, when the number of problem students increases the level of science achievement decreases in TIMSS. This is expected result for the Turkish educational system. The class sizes in our country are not suitable for the effective learning for the students. The mean class size in TIMSS study for Turkey data was 47 students per class. This number is very high for effective learning. With this number of student performing learning tasks is very difficult for teachers. Moreover, teachers may spend some part of their class time to control the class. Also teachers think that uninterested, disruptive students and uninterested parents limit quite a lot the how the teacher teaches his science class.

If the results of the present study are examined carefully, importance of teacher preparation is obvious. All of the effort made is to explain 16% of the science achievement variance. At the end, the most striking results of the study is importance of teacher preparation. Extensive reforms should be performed in the programs of the education faculties to get the well-qualified teachers as outputs. The results of this study support the findings of Druva & Anderson (1983); Supovitz & Turner (2000); Mitman, (1985). They found that student outcomes are positively associated with the preparation of the teacher especially science training, but also preparation in education and academic work generally. The importance of the teacher preparation is expressed in the present study.

Another similar result with the reviewed literature is about parents' interest with the progress. When parents express high (but not unrealistic) expectations for their children's achievement and future careers, parents become involved in their children's education at the school and in the community (San Diego County of Education, 1997). This means that parents' interest with the progress is important for students' achievement.

As mentioned before in the literature review one of the findings' of Miller' study was that effective teaching begins with effective teacher preparation programs should be based on strong content expertise and research-based instructional strategies (Miller, 2003).

Last but not least, the most concrete and obvious results of this study is that whatever the instructional method used in the school and embedded into the curriculums this does not change the fact of "Teachers form the backbone of our educational system."

5.3 Implications

Some of the implications were explained and discussed in the following lines;

- One of the most important results of this study is that classroom climate affect student science achievement significantly. If the students in the class are disruptive or uninterested the achievement level in science decreases. Of course it is not possible to eliminate this factor completely in Turkey with classes of forty-eighth students mean. When the size of the class increases, the number of problematic students also increases. To get effective teaching and learning standards the class sizes must be minimized. Thus, when the number of students in class is small, also the number of disruptive student decreases and this may result with increase in science achievement for the Turkish students. Also mechanism of teacher-student-family interaction should be checked. Schools may organize activities that support powerful school-parents interaction. When this interaction is established between the school and parents, this affect student science achievement positively. The role can be undertaken by the school-family unities in the schools.

- Another important result of the present study is that assessment types that require students to show their performances decrease student science achievement in TIMSS. In our educational system; students are familiar to paper and pencil exams and also teachers prefer written exams to evaluate students' achievement in class. Because of this, students can not adopt themselves to this type of assessment such as project performance and assessment by observation. To overcome this weakness our teachers should use performance-based assessment techniques time to time. By this way, students become familiar to performance evaluation and also develop higher order thinking skills and teachers get more objective profile of their teaching progress and outcomes. Moreover, teachers can assess not only the students' written performances but also assess project and production performances. Finally, to install the system which supports student-centered activities in science education laboratory activities can form some percent of the students' science grades.
- The nature of science includes explaining an idea behind the scientific facts or any event. The learning tasks such as work on problems, analyze relationships between the ideas or facts, explain reasoning affect science achievement in TIMSS positively. In Turkey, educational system is based on teacher-centered education. Teachers convey all the theoretical knowledge in an organized way to students who are passive receivers. TIMSS says that in our country students who were taught in a teacher-centered setting are more

successful in TIMSS. The results of the present study also support this finding in Turkish setting and data. Moreover, Özdemir (2003) also found similar results in his study with the data of TIMSS. Deliberate crossing should be carried out from teacher-centered education to student-centered education. To perform this, of course the class sizes must be reduced firstly. But we should monitor trends in education on the world stage. Our curriculums should be reviewed. Last reforms close science curriculum to daily-life experiences and realistic content, but the application and transfer of content is questionable. What percent of science curriculum conveyed to the students by the teachers. The resource of problem must be defined and found whether the problem arises due to teacher or available resources. Of course, the answers of these questions are beyond the present study.

- Computer technologies also play an important role in science achievement. All school should be checked whether there is enough computer hardware and software or not. Also instructional materials such as over head projector, laboratory accessories and other instructional materials should be supported for effective learning environment. Moreover, about technological instruments in-service training programs can be given to teachers.

5.4 Recommendations for Further Researchers

- The researchers can carry out research on modeling on factors affecting student achievement by considering the TIMSS data, because the database gives us a chance to make extractions for our educational outputs.
- The researchers can carry out research by using the database of TIMSS by using the data of other countries to compare their results with our outcomes.
- The researchers can carry out cross-cultural studies by using the database.

- In the perspective of the present study, teacher factor can be studied by considering the data of developed countries.
- Teacher-centered education and supportive activities should be studied with different samples and settings.
- Effects of evaluation types should be deeply studied. The selection should be made whether the assessment type that requires only paper performances or assessment type that requires both paper and project or alive performance in a learning task.
- Finally, more studies should be carried out about TIMSS to understand the meaning of results and also not to miss a chance of making modification and reforms.

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APPENDIX A

FREQUENCY OF TEACHER RESPONSES TO THE STBQ

Table A.1. Assessing the work of the students in your science class (mcts)

Choices	Frequencies	Percent
none	22	10.8
little	95	46.6
quite a lot	75	36.8
a great deal	8	3.9
missing	4	2.0
total	204	100

Table A.2. Assessing the work of the students in your science class (sdts)

Choices	Frequencies	Percent
none	47	23.0
little	112	54.9
quite a lot	39	19.1
a great deal	4	2.0
missing	2	1.0
total	204	100

Table A.3. Assessing the work of the students in your science class (rsts)

Choices	Frequencies	Percent
none	12	5.9
little	67	32.8
quite a lot	97	47.5
a great deal	26	12.7
missing	2	1.0
total	204	100

Table A.4. Assessing the work of the students in your science class (obse)

Choices	Frequencies	Percent
none	13	6.4
little	66	32.4
quite a lot	107	52.5
a great deal	16	7.8
missing	2	1.0
total	204	100

Table A.5. Assessing the work of the students in your science class (rpic)

Choices	Frequencies	Percent
none	2	1.0
little	14	6.9
quite a lot	98	48.0
a great deal	89	43.6
missing	1	0.5
total	204	100

Table A.6. Assessing the work of the students in your science class (prpf)

Choices	Frequencies	Percent
none	28	13.7
little	79	38.7
quite a lot	81	39.7
a great deal	15	7.4
missing	1	0.5
total	204	100

TableA.7. How often do you usually ask students to do the following? (worp)

Choices	Frequencies	Percent
never	51	25.0
some lessons	117	57.4
most lessons	26	12.7
every lessons	7	3.4
missing	3	1.5
total	204	100

TableA.8. How often do you usually ask students to do the following? (arel)

Choices	Frequencies	Percent
never	3	1.5
some lessons	81	39.7
most lessons	78	38.2
every lessons	40	19.6
missing	2	1.0
total	204	100

TableA.9.How often do you usually ask students to do the following? (expr)

Choices	Frequencies	Percent
never	4	2.0
some lessons	56	27.5
most lessons	89	43.6
every lessons	54	26.5
missing	1	0.5
total	204	100

TableA.10. What extent do the following limit how you teach your science class? (disr)

Choices	Frequencies	Percent
not at all	16	7.8
a little	97	47.5
quite a lot	55	27.0
a great deal	34	16.7
missing	2	1.0
total	204	100

TableA.11. What extent do the following limit how you teach your science class? (unis)

Choices	Frequencies	Percent
not at all	7	3.4
a little	50	24.5
quite a lot	87	42.6
a great deal	58	28.4
missing	2	1.0
total	204	100

TableA.12. What extent do the following limit how you teach your science class? (prun)

Choices	Frequencies	Percent
not at all	18	8.8
a little	53	26.0
quite a lot	77	37.7
a great deal	54	26.5
missing	2	1.0
total	204	100

TableA.13. Approximately how many hours per week do you normally spend on each of the following activities outside the formal school day?(mest)

Choices	Frequencies	Percent
never	18	8.8
rarely	75	36.8
sometimes	86	42.2
Always	21	10.3
missing	4	2.0
total	204	100

TableA.14. Approximately how many hours per week do you normally spend on each of the following activities outside the formal school day?(updr)

Choices	Frequencies	Percent
never	87	42.6
rarely	82	40.2
sometimes	27	13.2
Always	1	0.5
missing	7	3.4
total	204	100

TableA.15. Approximately how many hours per week do you normally spend on each of the following activities outside the formal school day?(mepa)

Choices	Frequencies	Percent
never	33	16.2
rarely	109	53.4
sometimes	45	22.1
Always	9	4.4
missing	8	4.0
total	204	100

TableA.16. Approximately how many hours per week do you normally spend on each of the following activities outside the formal school day?(prof)

Choices	Frequencies	Percent
never	83	40.7
rarely	65	31.9
sometimes	36	17.6
Always	8	3.8
missing	12	6.0
total	204	100

TableA.17. Approximately how many hours per week do you normally spend on each of the following activities outside the formal school day?(adtk)

Choices	Frequencies	Percent
never	51	25.6
rarely	95	47.7
sometimes	47	23.0
Always	4	2.0
missing	7	3.5
total	204	100

APPENDIX B

RESULTS OF FACTOR ANALYSIS FOR STBQ (FACTOR LOADINGS)

Table B.1. HMWR

Items	Factor Loadings
SMALL GROUP PROJECTS	0,786
FIND USES OF CONTENT	0,724
PREPARE ORAL REPORTS	0,648
INDIVIDUAL PROJECTS	0,629
KEEP ASSIGNMENTS	0,562
ASSIGN DIFFERNT TRACKS	0,533
BASIS FOR DISCUSSION	0,439
PROVIDE FEEDBACK	0,329

Table B.2. LMTS

Items	Factor Loadings
LOW MORAL AMONG STAFF	0,831
THREATS 2 PERS OR STDT SFTY	0,745
LOW MORAL AMONG STUDENTS	0,742
HIGH STUDENT TEACHER RATIO	0,623
SPECIAL NEEDS	0,467
PREPARE TEST	-0,362

Table B.3. CLUT

Items	Factor Loadings
SHORTGE OF INSTR EQUIPMENT	0,787
SHORTGE OF COMPUTR HARDWARE	0,777
SHORTGE OF COMPUTR SOFTWARE	0,740
SHORTGE OF DEMNSTR EQUIPMNT	0,723
INADEQUATE PHYSICL FACILITS	0,376

Table B.4. OUTS

Items	Factor Loadings
MEET PARENTS	0,735
UPDATE STUD RECORDS	0,625
MEET STUDENTS	0,623
PROFESSIONL READING	0,558
ADMINISTRATVE TASKS	0,528

Table B.5. PRC1

Items	Factor Loadings
IMPORTANCE OF SEQNTAL DIRECTIONS	0,797
PRACTICAL AND STRUCTURED GUIDE	0,794
FORMAL REPRESENTATION OF WORLD	0,603

Table B.6. ASW1

Items	Factor Loadings
MULTIPLE CHOICE	0,891
STANDARD TESTS	0,555
REASONING TESTS	0,532

Table B.7. ASW2

Items	Factor Loadings
OBSERVATION	0,711
RESPONSES IN CLASS	0,686
PROJECT PERFORMNCE	0,677

Table B.8. TSKS

Items	Factor Loadings
ORGANIZE EVENTS OF OBJECTS	0,737
WRITE EXPLANATIONS	0,481
SMALL INVESTIGATIONS	0,457
RETURN ASSIGNMENTS	0,382

Table B.9. LMT2

Items	Factor Loadings
DISRUPTIVE STUDENTS	0,732
UNINTERESTED STUDENTS	0,674
PARENTS UNINTRESTD IN PROGR	0,465

APPENDIX C

LISREL SYNTAX OF MAIN PROPOSED MODEL

```
TIMSS
Observed Variables
disr unis prun obse rpic prpf worp arel howu
expr mcts sdts rsts mepa updr mest prof adtk
sci1 sci2 sci3 sci4 sci5
Correlation Matrix from File cor.cov
Sample Size 178
Latent Variables
LMT2 ASW2 TSKS ASW1 OUTS ACHV

Relationships
disr unis prun = LMT2
obse rpic prpf expr howu = ASW2
worp arel howu expr = TSKS
mcts sdts rsts mepa= ASW1
mepa updr mest prof adtk = OUTS
sci1 sci2 sci3 sci4 sci5 = ACHV
ACHV = LMT2 ASW2 TSKS ASW1 OUTS

Set Error Covariance of obse and unis Free
Set Error Covariance of mest and mepa Free
Set Error Covariance of prof and mcts Free
Set Error Covariance of sdts and unis Free

Admissibility Check = 1000
Iterations = 5000

Path Diagram
End of Problem
```

LISREL SYNTAX OF EARTH SCIENCE SUBMODEL

```
TIMSS
Observed Variables
disr unis prun obse rpic prpf worp arel howu
expr mcts sdts rsts mepa updr mest prof adtk
ear1 ear2 ear3 ear4 ear5
Correlation Matrix from File cor1.cov
Sample Size 178
Latent Variables
LMT2 ASW2 TSKS ASW1 OUTS ACHV

Relationships
disr unis prun = LMT2
obse rpic prpf expr howu = ASW2
worp arel howu expr = TSKS
mcts sdts rsts mepa= ASW1
mepa updr mest prof adtk = OUTS
ear1 ear2 ear3 ear4 ear5 = ACHV
ACHV = LMT2 ASW2 TSKS ASW1 OUTS

Set Error Covariance of obse and unis Free
Set Error Covariance of howu and ear4 Free
Set Error Covariance of adtk and mcts Free
Set Error Covariance of mest and mepa Free
Set Error Covariance of prof and howu Free
Set Error Covariance of obse and ear1 Free

Admissibility Check = 1000
Iterations = 5000

Path Diagram
End of Problem
```

LISREL SYNTAX OF LIFE SCIENCE SUBMODEL

```
TIMSS
Observed Variables
disr unis prun obse rpic prpf worp arel howu
expr mcts sdts rsts mepa updr mest prof adtk
lfe1 lfe2 lfe3 lfe4 lfe5
Correlation Matrix from File cor2.cov
Sample Size 179
Latent Variables
LMT2 ASW2 TSKS ASW1 OUTS ACHV

Relationships
disr unis prun = LMT2
obse rpic prpf expr howu = ASW2
worp arel howu expr = TSKS
mcts sdts rsts mepa= ASW1
mepa updr mest prof adtk = OUTS
lfe1 lfe2 lfe3 lfe4 lfe5 = ACHV
ACHV = LMT2 ASW2 TSKS ASW1 OUTS

Set Error Covariance of lfe5 and lfe1 Free
Set Error Covariance of obse and unis Free
Set Error Covariance of adtk and mcts Free
Set Error Covariance of mest and mepa Free


Admissibility Check = 1000
Iterations = 5000

Path Diagram
End of Problem
```

LISREL SYNTAX OF PHYSICS SCIENCE SUBMODEL

```
TIMSS
Observed Variables
disr unis prun obse rpic prpf worp arel howu
expr mcts sdts rsts mepa updr mest prof adtk
phy1 phy2 phy3 phy4 phy5
Correlation Matrix from File cor3.cov
Sample Size 179
Latent Variables
LMT2 ASW2 TSKS ASW1 OUTS ACHV

Relationships
disr unis prun = LMT2
obse rpic prpf expr howu = ASW2
worp arel howu expr = TSKS
mcts sdts rsts mepa= ASW1
mepa updr mest prof adtk = OUTS
phy1 phy2 phy3 phy4 phy5 = ACHV
ACHV = LMT2 ASW2 TSKS ASW1 OUTS


Set Error Covariance of phy5 and phy2 Free
Set Error Covariance of obse and unis Free
Set Error Covariance of rpic and phy5 Free
Set Error Covariance of mest and mepa Free
Set Error Covariance of worp and phy2 Free
Set Error Covariance of adtk and mcts Free
Set Error Covariance of rsts and phy2 Free
Set Error Covariance of adtk and phy2 Free
Set Error Covariance of updr and mcts Free
Set Error Covariance of mcts and rpic Free
Set Error Covariance of mcts and arel Free

Admissibility Check = 1000
Iterations = 5000

Path Diagram
End of Problem
```

LISREL SYNTAX OF CHEMISTRY SCIENCE SUBMODEL

```
TIMSS
Observed Variables
disr unis prun obse rpic prpf worp arel howu
expr mcts sdts rsts mepa updr mest prof adtk
chm1 chm2 chm3 chm4 chm5
Correlation Matrix from File cor6.cov
Sample Size 179
Latent Variables
LMT2 ASW2 TSKS ASW1 OUTS ACHV

Relationships
disr unis prun = LMT2
obse rpic prpf expr howu = ASW2
worp arel howu expr = TSKS
mcts sdts rsts mepa= ASW1
mepa updr mest prof adtk = OUTS
chm1 chm2 chm3 chm4 chm5 = ACHV
ACHV = LMT2 ASW2 TSKS ASW1 OUTS


Set Error Covariance of obse and unis Free
Set Error Covariance of mest and chm5 Free
Set Error Covariance of prpf and chm5 Free
Set Error Covariance of mest and mepa Free
Set Error Covariance of adtk and mcts Free
Set Error Covariance of worp and chm4 Free
Set Error Covariance of updr and mcts Free
Set Error Covariance of mcts and arel Free
Set Error Covariance of mcts and rpic Free

Admissibility Check = 1000
Iterations = 5000

Path Diagram
End of Problem
```

LISREL SYNTAX OF NATURE OF SCIENCE SUBMODEL

```
TIMSS
Observed Variables
disr unis prun obse rpic prpf worp arel howu
expr mcts sdts rsts mepa updr mest prof adtk
nos1 nos2 nos3 nos4 nos5
Correlation Matrix from File cor5.cov
Sample Size 179
Latent Variables
LMT2 ASW2 TSKS ASW1 OUTS ACHV

Relationships
disr unis prun = LMT2
obse rpic prpf expr howu = ASW2
worp arel howu expr = TSKS
mcts sdts rsts mepa= ASW1
mepa updr mest prof adtk = OUTS
nos1 nos2 nos3 nos4 nos5 = ACHV
ACHV = LMT2 ASW2 TSKS ASW1 OUTS


Set Error Covariance of obse and unis Free
Set Error Covariance of adtk and mcts Free
Set Error Covariance of mest and mepa Free

Admissibility Check = 1000
Iterations = 5000

Path Diagram
End of Problem
```

APPENDIX D

TESTED MAIN MODEL (LISREL PATH DIAGRAMS)

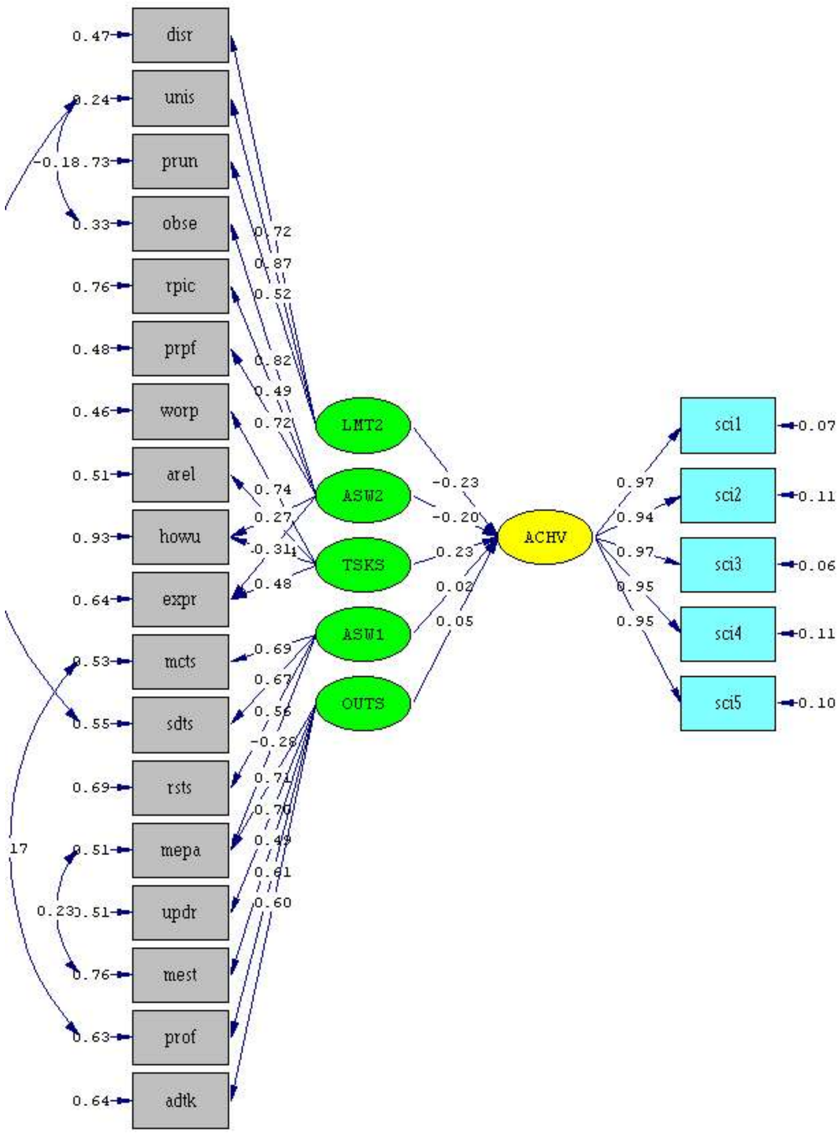

Figure D.1. Proposed Main Model (Standardized Solutions)

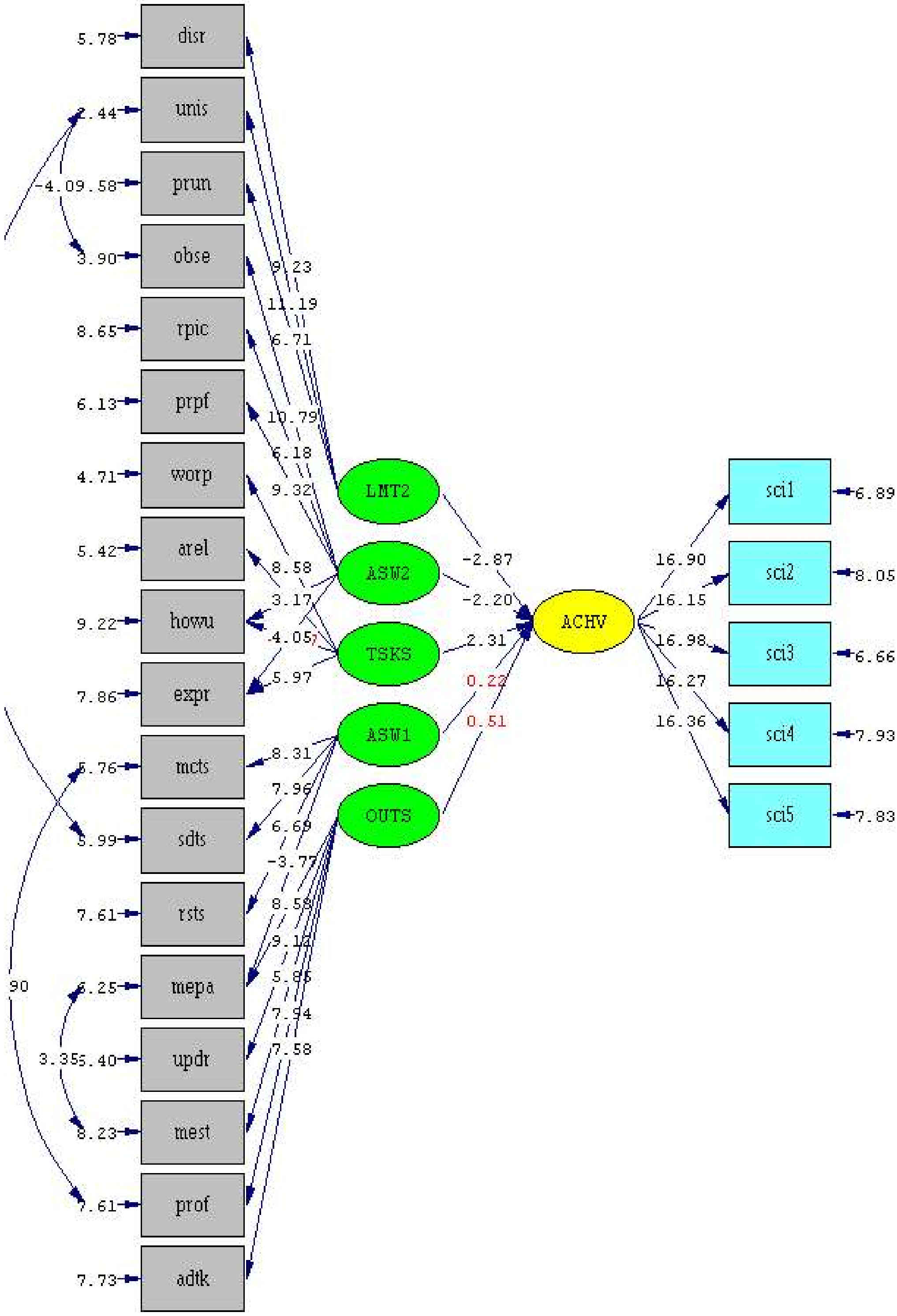

Figure D. 2. Proposed Main Model (t-values)

APPENDIX E

CONFIRMATORY FACTOR ANALYSIS RESULTS OF LATENT VARIABLES OF MAIN MODEL

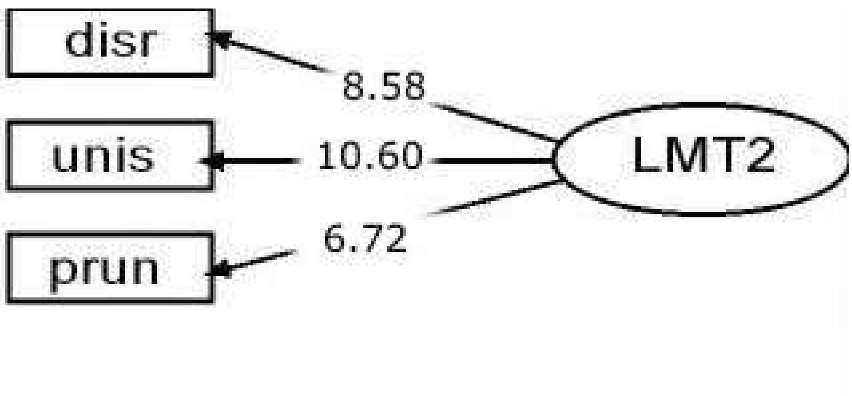

Figure E. 1. Confirmatory Factor Analysis Results for LMT2 (t-values)

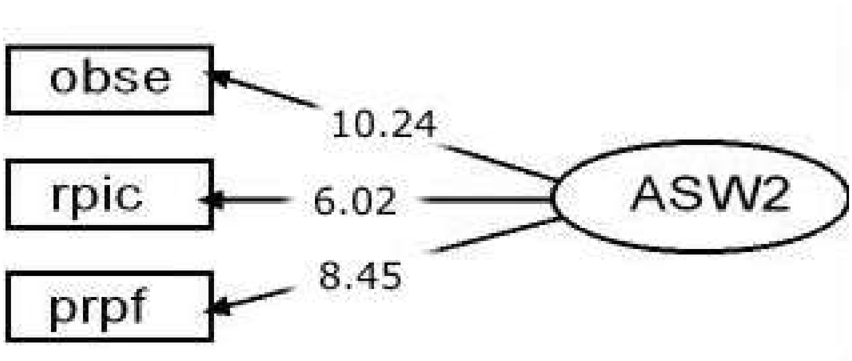

Figure E. 2. Confirmatory Factor Analysis Results for ASW2 (t-values)

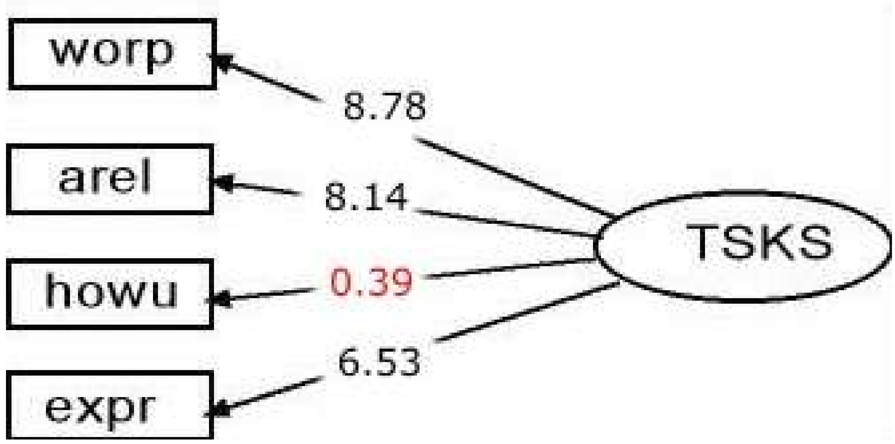

Figure E. 3. Confirmatory Factor Analysis Results for TSKS (t-values)

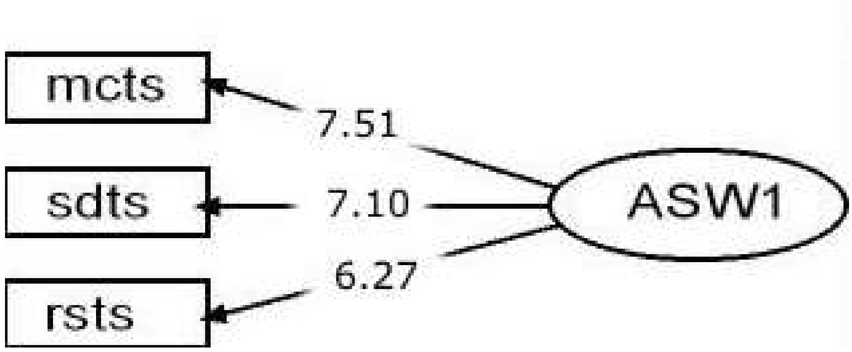

Figure E. 4. Confirmatory Factor Analysis Results for ASW1 (t-values)

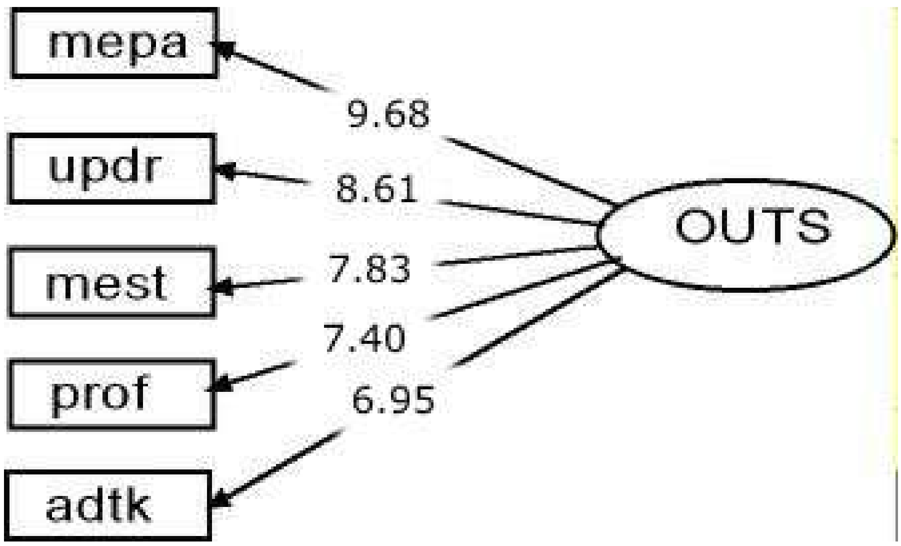

Figure E. 5. Confirmatory Factor Analysis Results for OUTS (t-values)

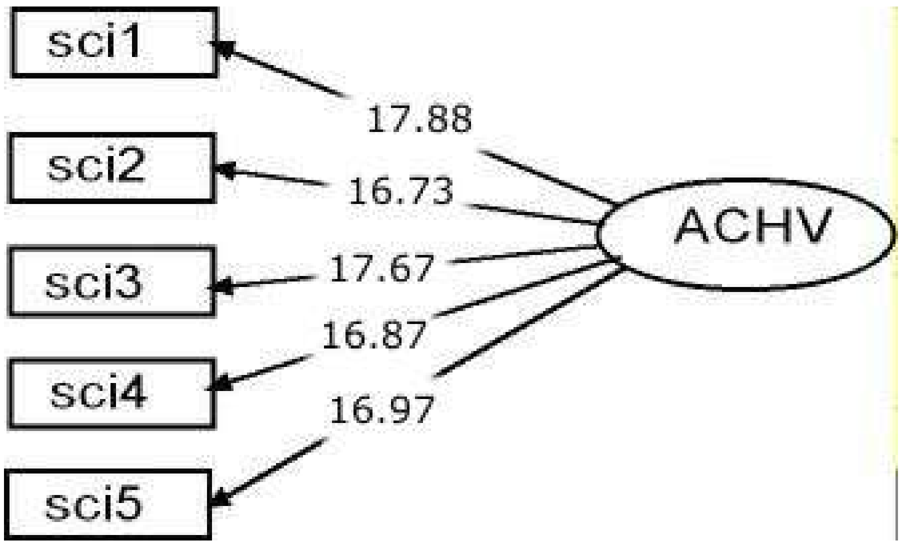

Figure E. 6. Confirmatory Factor Analysis Results for ACHV (t-values)

APPENDIX F

Identification Label	
School ID :	
Stratum ID:	
Teacher ID:	Link:
Name:	
Class ID:	
Name of Class:	
Subject:	Grade:

IEA Third International Mathematics and Science Study - Repeat

Science Teacher Questionnaire
Main Survey

Your school has agreed to participate in the Third International Mathematics and Science Study - Repeat (TIMSS-R), an educational research project sponsored by the International Association for the Evaluation of Educational Achievement (IEA). TIMSS-R is investigating mathematics and science achievement in about forty countries around the world. It is designed to measure and interpret differences in national education systems in order to help improve the teaching and learning of mathematics and science worldwide.

This questionnaire is addressed to teachers of science, who are asked to supply information about their academic and professional backgrounds, instructional practices, and attitudes towards teaching science. Since your class has been selected as part of a nationwide sample, your responses are very important in helping to describe science classes in <country>.

Some of the questions in this questionnaire ask about **your science class**. This is the class which is identified at the top of this page, and which will be tested as part of TIMSS-R in your school.

It is important that you answer each question carefully so that the information provided reflects your situation as accurately as possible. It is estimated that it will require approximately 60 minutes to complete this questionnaire.

Your cooperation in completing this questionnaire is greatly appreciated.

TIMSS Study Center
Boston College
Chestnut Hill, MA 02467
USA

(Institute Address)

TIMSS-R Ref.No. 98-0038

THERE ARE NO QUESTIONS ON THIS PAGE

Section A

1. How old are you?

*Check **one** box only.*

- under 25 ☐
- 25-29 ☐
- 30-39 ☐
- 40-49 ☐
- 50-59 ☐
- 60 or more ☐

2. Are you female or male?

*Check **one** box only.*

- female ☐
- male ☐

3. By the end of this school year, how many years will you have been teaching altogether?

Please round to the nearest whole number. ______

4. In one typical calendar week from Monday to Sunday, for how many single <hours/periods> are you formally <scheduled/time-tabled> in one school week altogether?

Write in number .... ______ *<hours/periods>*

5. In one typical calendar week from Monday to Sunday, for how many single <hours/periods> are you formally <scheduled/time-tabled> to teach each of the following subjects?

NRC Note: <List only the generic science courses appropriate for your country.>

Count a double <hour/period> as two single <hours/periods>. Write zero if none.

	Number of single <hours/periods>
a) mathematics	______
b) <GENERAL/INTEGRATED SCIENCE>	______
c) <PHYSICAL SCIENCE>	______
d) <EARTH SCIENCE>	______
e) <LIFE SCIENCE>	______
f) <BIOLOGY>	______
g) <CHEMISTRY>	______
h) <PHYSICS>	______
i) other subjects	______

6. In one typical calendar week from Monday to Sunday, for how many single <hours/periods> are you formally <scheduled/time-tabled> to perform each of the following tasks?

Count a double <hour/period> as two single <hours/periods>. Write zero if none.

	Number of single <hours/periods>
a) student supervision (other than teaching)	______
b) student counselling/appraisal	______
c) administrative duties	______
d) individual curriculum planning	______
e) cooperative curriculum planning	______
f) other non-student contact time (i.e., use not specified)	______
g) other	______

7. APPROXIMATELY how many hours per week do you normally spend on each of the following activities outside the formal school day? Do not include time already accounted for in Question # 6.

*Check **one** box in each row.*

		None	*Less than 1 hour*	*1 - 2 hours*	*3 - 4 hours*	*More than 4 hours*
a)	preparing or grading student tests or exams	☐	☐	☐	☐	☐
b)	reading and grading other student work	☐	☐	☐	☐	☐
c)	planning lessons by yourself	☐	☐	☐	☐	☐
d)	meeting with students outside of classroom time (e.g., tutoring, guidance)	☐	☐	☐	☐	☐
e)	meeting with parents	☐	☐	☐	☐	☐
f)	professional reading and development activity (e.g., seminars, conferences, etc.)	☐	☐	☐	☐	☐
g)	keeping students' records up to date	☐	☐	☐	☐	☐
h)	administrative tasks including staff meetings (e.g. photocopying, displaying students' work)..	☐	☐	☐	☐	☐
i)	other	☐	☐	☐	☐	☐

8. APPROXIMATELY how many hours per week do you normally spend on your teaching activities altogether (include time spent in and out of school)?

Please round to the nearest whole hour. .... _____

9. About how often do you have meetings with other teachers in your subject area to discuss and plan curriculum or teaching approaches?

Check one box only.

never	☐
once or twice a year	☐
every other month	☐
once a month	☐
once a week	☐
two or three times a week	☐
almost every day	☐

10. How much influence do you have on each of the following...

Check one box in each row.

	None	*Little*	*Some*	*A lot*
a) subject matter to be taught	☐	☐	☐	☐
b) specific textbooks to be used	☐	☐	☐	☐
c) the amount of money to be spent on supplies	☐	☐	☐	☐
d) what supplies are purchased	☐	☐	☐	☐

11. To be good at science at school, how important do you think it is for students to...

Check one box in each row.

	Not important	*Somewhat important*	*Very important*
a) remember formulas and procedures	☐	☐	☐
b) think in a sequential and procedural manner	☐	☐	☐
c) understand science concepts, principles, and strategies	☐	☐	☐
d) be able to think creatively	☐	☐	☐
e) understand how science is used in the real world	☐	☐	☐
f) be able to provide reasons to support their conclusions	☐	☐	☐

12. To what extent do you agree or disagree with each of the following statements?

Check one box in each row.

		Strongly disagree	Disagree	Agree	Strongly agree
a)	Science is primarily an abstract subject.	☐	☐	☐	☐
b)	Science is primarily a formal way of representing the real world.	☐	☐	☐	☐
c)	Science is primarily a practical and structured guide for addressing real situations.	☐	☐	☐	☐
d)	Some students have a natural talent for science and others do not.	☐	☐	☐	☐
e)	It is important for teachers to give students prescriptive and sequential directions for doing science experiments.	☐	☐	☐	☐
f)	Focusing on rules is a bad idea. It gives students the impression that the sciences (physics, chemistry, biology, and earth science) are a set of procedures to be memorized.	☐	☐	☐	☐
g)	If students get into debates in class about ideas or procedures covering the sciences, it can harm their learning.	☐	☐	☐	☐
h)	Students see a science task as the same task when it is represented in two different ways (picture, concrete material, symbol set, etc.).	☐	☐	☐	☐
i)	A liking for and understanding of students are essential for teaching science.	☐	☐	☐	☐

13. Indicate your familiarity with each of the following documents:

NRC Note: <Include country-specific appropriate options only.>

*Check **one** box in each row.*

		No such document	*Not familiar*	*Fairly familiar*	*Very familiar*
a)	<THE NATIONAL CURRICULUM GUIDE FOR SCIENCE>	☐	☐	☐	☐
b)	<THE REGIONAL CURRICULUM GUIDE(S) FOR SCIENCE>	☐	☐	☐	☐
c)	<THE SCHOOL CURRICULUM GUIDE>	☐	☐	☐	☐
d)	<THE NATIONAL EXAMINATION SPECIFICATIONS>	☐	☐	☐	☐
e)	<THE REGIONAL EXAMINATION SPECIFICATIONS>	☐	☐	☐	☐
f)	<THE NATIONAL PEDAGOGY GUIDE FOR SCIENCE>	☐	☐	☐	☐
g)	<THE REGIONAL PEDAGOGY GUIDE FOR SCIENCE>	☐	☐	☐	☐

14. How well prepared do you feel you are to teach...

*Check **one** box in each row.*

		I do not teach these topics	*Not well prepared*	*Somewhat prepared*	*Very well prepared*
a)	earth science – earth's features and physical processes?	☐	☐	☐	☐
b)	earth science – the solar system and the universe?	☐	☐	☐	☐
c)	biology – structure and function of human systems?	☐	☐	☐	☐
d)	biology – diversity, structure, and processes of plant and animal life?	☐	☐	☐	☐
e)	chemistry – classification and structure of matter?	☐	☐	☐	☐
f)	chemistry – chemical reactivity and transformations?	☐	☐	☐	☐
g)	physics – types of energy, sources of energy, conversion between energy types?	☐	☐	☐	☐
h)	physics – light?	☐	☐	☐	☐
i)	environmental and resource issues?	☐	☐	☐	☐
j)	scientific methods and inquiry skills?	☐	☐	☐	☐

15. What is the highest level of formal education you have completed?

*Check **one** box only*

<DID NOT COMPLETE SECONDARY SCHOOL> .... ☐

<SECONDARY ONLY> .... ☐

<BA OR EQUIVALENT> .... ☐

<MA/PHD> .... ☐

16a. Do you have a <teacher training certificate>?

*Check **one** box only.* .... *Yes* ☐ *No* ☐

16b. How many years of <pre-service teacher training> have you had?

Please round to the nearest whole number. .... ______
(Write in 0 (zero), if you have not had any teacher training.)

16c. If you have had <pre-service teacher training>, did you begin this training in secondary school?

*Check **one** box only.* .... *Yes* ☐ *No* ☐

17. While studying to obtain your <BA or equivalent or teacher training certificate>, what was your major or main area of study?

I do not have a <BA or equivalent or teacher training certificate.> .... ☐
(Check the box and skip to the next question.)

*Check **one** box in each row.*

	Yes	*No*
a) Mathematics	☐	☐
b) Biology	☐	☐
c) Physics	☐	☐
d) Chemistry	☐	☐
e) Education	☐	☐
f) Mathematics Education	☐	☐
g) Science Education	☐	☐
h) Other	☐	☐

18. If you have a master's degree, what was your major or main area of study?

I do not have a master's degree. .... ☐
(Check the box and skip to the next question.)

*Check **one** box in each row.*

	Yes	*No*
a) Mathematics	☐	☐
b) Biology	☐	☐
c) Physics	☐	☐
d) Chemistry	☐	☐
e) Education	☐	☐
f) Mathematics Education	☐	☐
g) Science Education	☐	☐
h) Other	☐	☐

International Option

19. Was teaching your first choice as a career when beginning university or teacher education college?

*Check only **one** box* .... *Yes* ☐ *No* ☐

20. Would you change to another career if you had the opportunity?

*Check only **one** box* .... *Yes* ☐ *No* ☐

21. Do you think that society appreciates your work?

*Check only **one** box* .... *Yes* ☐ *No* ☐

22. Do you think your students appreciate your work?

*Check only **one** box* .... *Yes* ☐ *No* ☐

23. Approximately how many books are in your home?

(Do not count magazines or newspapers.)

*Check **one** box only.*

none or very few (0-10) .... ☐

enough to fill a shelf (11-25) .... ☐

enough to fill a bookcase (26-100) .... ☐

enough to fill two bookcases (101-200) .... ☐

enough to fill three or more bookcases (more than 200) .... ☐

THERE ARE NO QUESTIONS ON THIS PAGE

Section B

In this section, many of the questions refer to **your science class**. Please remember that this is the class which is identified on the cover of this questionnaire, and which will be tested as part of TIMSS-R in your school.

1. How many students are in your science class?

Write in a number for each. Write 0 (zero) if there are none.

boys ______ girls ______

2. What subject matter do you emphasize <u>most</u> in your science class?

*Check **one** box only.*

- General/integrated science .... ☐
- Earth science .... ☐
- Biology .... ☐
- Chemistry .... ☐
- Physics .... ☐
- Physical science (chemistry/physics) .... ☐
- Other, please specify ______________________ .... ☐

3. How many minutes per week do you teach science to your science class?

Minutes: ______

4a. Do you use a textbook in teaching science to your class?

*Check **one** box.*

Yes ☐ *No* ☐

4b. If yes, approximately what percentage of your weekly science teaching time is based on your science textbook?

*Check **one** box.*

- 0-25% .... ☐
- 26-50% .... ☐
- 51-75% .... ☐
- 76-100% .... ☐

5. Do the students in your science class have calculators available to use during science lessons?

*Check **one** box only.*

Yes ☐ *No* ☐

6. To what extent are the students in your science class permitted to use calculators in science lessons?

*Check **one** box only.*

unrestricted use	☐
restricted use	☐
calculators are not permitted	☐

7. How often do students in your science class use calculators for the following activities?

*Check **one** box in each row.*

	Almost every class	*Once or twice a week*	*Once or twice a month*	*Never, or hardly ever*
a) Checking answers	☐	☐	☐	☐
b) Tests and exams	☐	☐	☐	☐
c) Routine computation	☐	☐	☐	☐
d) Solving complex problems	☐	☐	☐	☐
e) Exploring number concepts	☐	☐	☐	☐

8. Do the students in your science class have computers available to use during science lessons?

*Check **one** box in each row.*

	Never or almost never	*Some lessons*	*Most lessons*	*Every lesson*
a) in the classroom	☐	☐	☐	☐
b) in other instructional rooms (computer labs, science lab, reading lab, library, etc.)	☐	☐	☐	☐

If computers are available,

	Yes	*No*
c) do any of the computers have access to the Internet?	☐	☐
d) do you use the Internet for instructional/educational purposes?	☐	☐

9. In planning science lessons, what is your main source of written information when...

NRC Note: <List only country-specific appropriate options.>

Check one box in each row.

	Other Resource Books	*Student Edition of Textbook*	*Teacher Edition of Textbook*	*<School Curriculum Guide>*	*<National or Regional Curriculum Guide>*	*<National or Regional Examination Specifications>*
a) deciding which topics to teach (goals)	☐	☐	☐	☐	☐	☐
b) deciding how to present a topic	☐	☐	☐	☐	☐	☐
c) selecting problems and exercises for work in class and homework	☐	☐	☐	☐	☐	☐
d) selecting problems and applications for assessment and evaluation	☐	☐	☐	☐	☐	☐

10. In your science lessons, how often do you usually ask students to do the following?

Check one box in each row.

	Never or almost never	*Some lessons*	*Most lessons*	*Every lesson*
a) explain the reasoning behind an idea	☐	☐	☐	☐
b) represent and analyze relationships using tables, charts, or graphs	☐	☐	☐	☐
c) work on problems for which there is no immediately obvious method of solution	☐	☐	☐	☐
d) use computers to solve exercises or problems	☐	☐	☐	☐
e) write explanations about what was observed and why it happened	☐	☐	☐	☐
f) put events or objects in order and give a reason for the organization	☐	☐	☐	☐
g) use graphing calculators to solve exercises or problems	☐	☐	☐	☐

11. In science lessons, how often do students...

*Check **one** box in each row.*

	Never or almost never	*Some lessons*	*Most lessons*	*Every lesson*
a) work individually without assistance from the teacher	☐	☐	☐	☐
b) work individually with assistance from the teacher	☐	☐	☐	☐
c) work together as a class with the teacher teaching the whole class	☐	☐	☐	☐
d) work together as a class with students responding to one another	☐	☐	☐	☐
e) work in pairs or small groups without assistance from the teacher	☐	☐	☐	☐
f) work in pairs or small groups with assistance from the teacher	☐	☐	☐	☐

12. In a typical month of lessons in your science class, what percentage of time is spent on each of the following activities?

Write in a percentage for each activity.

The total should add to 100%.

a) adminstrative tasks (not related to lesson's content/purpose) ______%

b) homework review ______%

c) lecture-style presentation by teacher ______%

d) teacher-guided student practice ______%

e) re-teaching and clarification of content/procedures ______%

f) student independent practice ______%

g) tests and quizzes ______%

h) teacher demonstrations of experiments ______%

i) students conducting experiments ______%

j) other ______%

13. The following list includes the main topics addressed by the TIMSS science test. Check the response that describes when students in your class have been taught each topic.

*If a topic has been taught before this year and also in the current year, check the two boxes that apply. Otherwise, check **one** box in each row.*

	Taught before this year	*Taught 1-5 periods this year*	*Taught more than 5 periods this year*	*Not yet taught*	*I do not know*
a) Earth Science					
1) Earth's physical features (layers, landforms, bodies of water, rocks, soil)	☐	☐	☐	☐	☐
2) Earth's atmosphere (layers, composition, temperature, pressure)	☐	☐	☐	☐	☐
3) Earth processes and history (weather and climate, physical cycles, plate tectonics, fossils)	☐	☐	☐	☐	☐
4) Earth in the solar system and the universe (interactions between Earth, sun, and moon; relationship to planets and stars)	☐	☐	☐	☐	☐
b) Biology					
5) Human body - structure and function of organs and systems	☐	☐	☐	☐	☐
6) Human bodily processes (metabolism, respiration, digestion)	☐	☐	☐	☐	☐
7) Human nutrition, health, and disease	☐	☐	☐	☐	☐
8) Biology of plant and animal life (diversity, structure, life processes, life cycles)	☐	☐	☐	☐	☐
9) Interactions of living things (biomes and ecosystems, interdependence)	☐	☐	☐	☐	☐
10) Reproduction, genetics, evolution, and speciation	☐	☐	☐	☐	☐
c) Chemistry					
11) Classification of matter (elements, compounds, solutions, mixtures)	☐	☐	☐	☐	☐
12) Structure of matter (atoms, ions, molecules, crystals)	☐	☐	☐	☐	☐
13) Chemical reactivity and transformations (definition of chemical change, oxidation, combustion)	☐	☐	☐	☐	☐
14) Energy and chemical change (exothermic and endothermic reactions, reaction rates)	☐	☐	☐	☐	☐

*If a topic has been taught before this year and also in the current year, check the two boxes that apply. Otherwise, check **one** box in each row.*

d) Physics	*Taught before this year*	*Taught 1-5 periods this year*	*Taught more than 5 periods this year*	*Not yet taught*	*I do not know*
15) Physical properties and physical changes of matter (weight, mass, states of matter, boiling, freezing)	☐	☐	☐	☐	☐
16) Subatomic particles (protons, electrons, neutrons)	☐	☐	☐	☐	☐
17) Energy types, sources, and conversions (chemical, kinetic, electric, light energy; work and efficiency)	☐	☐	☐	☐	☐
18) Heat and temperature	☐	☐	☐	☐	☐
19) Wave phenomena, sound, and vibration	☐	☐	☐	☐	☐
20) Light	☐	☐	☐	☐	☐
21) Electricity and magnetism	☐	☐	☐	☐	☐
22) Forces and motion (types of forces, balanced/unbalanced forces, fluid behavior, speed, acceleration)	☐	☐	☐	☐	☐
e) Environmental and Resource Issues					
23) Pollution (acid rain, global warming, ozone layer, water pollution)	☐	☐	☐	☐	☐
24) Conservation of natural resources (land, water, forests, energy sources)	☐	☐	☐	☐	☐
25) Food supply and production, population, and environmental effects of natural and man-made events	☐	☐	☐	☐	☐
f) Nature of Science and Scientific Inquiry Skills					
26) Scientific method (formulating hypotheses, making observations, drawing conclusions, generalizing)	☐	☐	☐	☐	☐
27) Experimental design (experimental control, materials, and procedures)	☐	☐	☐	☐	☐
28) Scientific measurements (reliability, replication, experimental error, accuracy, scales)	☐	☐	☐	☐	☐
29) Using scientific apparatus and conducting routine experimental operations	☐	☐	☐	☐	☐
30) Gathering, organizing, and representing data (units, tables, charts, graphs)	☐	☐	☐	☐	☐
31) Describing and interpreting data	☐	☐	☐	☐	☐

14. In your view to what extent do the following limit how you teach your science class?

Check one box in each row.

		Not at all	*A little*	*Quite a lot*	*A great deal*
a)	students with different academic abilities	☐	☐	☐	☐
b)	students who come from a wide range of backgrounds, (e.g., economic, language)	☐	☐	☐	☐
c)	students with special needs, (e.g., hearing, vision, speech impairment, physical disabilities, mental or emotional/psychological impairment)	☐	☐	☐	☐
d)	uninterested students	☐	☐	☐	☐
e)	disruptive students	☐	☐	☐	☐
f)	parents interested in their children's learning and progress	☐	☐	☐	☐
g)	parents uninterested in their children's learning and progress	☐	☐	☐	☐
h)	shortage of computer hardware	☐	☐	☐	☐
i)	shortage of computer software	☐	☐	☐	☐
j)	shortage of other instructional equipment for students' use	☐	☐	☐	☐
k)	shortage of equipment for your use in demonstrations and other exercises	☐	☐	☐	☐
l)	inadequate physical facilities	☐	☐	☐	☐
m)	high student/teacher ratio	☐	☐	☐	☐
n)	low morale among fellow teachers/administrators	☐	☐	☐	☐
o)	low morale among students	☐	☐	☐	☐
p)	threat(s) to personal safety or the safety of students	☐	☐	☐	☐

15. How often do you usually assign science homework?

Check one box.

- never ☐
- less than once a week ☐
- once or twice a week ☐
- 3 or 4 times a week ☐
- every day ☐

If "never," please skip ahead to Question 19.

16. If you assign science homework, how many minutes of science homework do you usually assign your students?

(Consider the time it would take an average student in your class.)

Check one box.

- less than 15 minutes ☐
- 15-30 minutes ☐
- 31-60 minutes ☐
- 61-90 minutes ☐
- more than 90 minutes ☐

17. If you assign science homework, how often do you assign each of the following kinds of tasks?

*Check **one** box in each row.*

		Never	*Rarely*	*Sometimes*	*Always*
a)	worksheets or workbook	☐	☐	☐	☐
b)	problem/question sets in textbook	☐	☐	☐	☐
c)	reading in a textbook or supplementary materials	☐	☐	☐	☐
d)	writing definitions or other short writing assignment	☐	☐	☐	☐
e)	small investigation(s) or gathering data	☐	☐	☐	☐
f)	working individually on long term projects or experiments	☐	☐	☐	☐
g)	working as a small group on long term projects or experiments	☐	☐	☐	☐
h)	finding one or more uses of the content covered	☐	☐	☐	☐
i)	preparing oral reports either individually or as a small group	☐	☐	☐	☐
j)	keeping a journal	☐	☐	☐	☐

18. If students are assigned written science homework, how often do you do the following?

I do not assign written homework. .... ☐
(Check the box and skip to the next question.)

Check one box in each row.

	Never	Rarely	Sometimes	Always
a) record whether or not the homework was completed	☐	☐	☐	☐
b) collect, correct and keep assignments	☐	☐	☐	☐
c) collect, correct assignments and then return to students	☐	☐	☐	☐
d) give feedback on homework to whole class	☐	☐	☐	☐
e) have students correct their own assignments in class	☐	☐	☐	☐
f) have students exchange assignments and correct them in class	☐	☐	☐	☐
g) use it as a basis for class discussion	☐	☐	☐	☐
h) use it to contribute towards students' grades or marks	☐	☐	☐	☐

19. In assessing the work of the students in your science class, how much weight do you give each of the following types of assessment?

Check one box in each row.

	None	Little	Quite a lot	A great deal
a) standardized tests produced outside the school	☐	☐	☐	☐
b) teacher-made short answer or essay tests that require students to describe or explain their reasoning	☐	☐	☐	☐
c) teacher made multiple choice, true-false and matching tests	☐	☐	☐	☐
d) how well students do on homework assignments	☐	☐	☐	☐
e) how well students do on projects or practical/laboratory exercises	☐	☐	☐	☐
f) observations of students	☐	☐	☐	☐
g) responses of students in class	☐	☐	☐	☐

20. How often do you use the assessment information you gather from students to...

*Check **one** box in each row.*

	None	*Little*	*Quite a lot*	*A great deal*
a) provide students' grades or marks?	☐	☐	☐	☐
b) provide feedback to students?	☐	☐	☐	☐
c) diagnose students' learning problems?	☐	☐	☐	☐
d) report to parents?	☐	☐	☐	☐
e) assign students to different programs or tracks?	☐	☐	☐	☐
f) plan for future lessons?	☐	☐	☐	☐

THANK YOU for the thought, time, and effort you have put into completing this questionnaire.