A CROSS-CULTURAL COMPARISON OF MATHEMATICS ACHIEVEMENT IN THE THIRD INTERNATIONAL MATHEMATICS AND SCIENCE STUDY-REPEAT (TIMSS-R)

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ABSTRACT

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The purpose of this study has two phases. In the first phase, a model that explains students' mathematics achievement in TIMSS-R will be proposed. In the second phase, the proposed model will be evaluated to interpret the similarities and differences across three culturally and linguistically different countries; Turkey, the Netherlands, and Italy. This study will basically combine students' answers on TIMSS-R Students Questionnaire items with their mathematics achievement scores obtained from TIMSS-R Mathematics Achievement Test. In order to achieve this, items in the student questionnaire will be grouped under latent variables and then the related models will be established.

Thirty-seven items selected from the TIMSS-R Student Questionnaire were analyzed using principle component factor analysis for each country. The results indicated seven interpretable dimensions. Based on the results' of factor analysis of Turkey, the latent variables were generated by selecting the observed variables with highest loadings. These latent variables were; out-of-school activities, socioeconomic status, importance given to math, math classroom climate, perception of failure, teacher-centered and student-centered activities. The proposed mathematics achievement model was tested by structural equation modeling for each country separately with the sample of 4772, 2728, and 2781 eighth grade students in Turkey, the Netherlands, and Italy, respectively.

In all of the countries perception of failure was the strongest factor explaining the mathematics achievement of the eighth grade students. The other two important factors explaining mathematics achievement were socioeconomic status and student-centered activities for Turkey and Italy; out-of-school activities and importance given to math for the Netherlands.

The results indicated that Turkey and Italy have more similar results when compared with the Netherlands. Different than the other countries in Turkey instructional activities formed two separate dimensions such as; teacher-centered and student-centered instructional activities. Since this finding emphasized the important role of teacher in the Turkish education system, it was suggested that more importance should be given to the teacher education.

Keywords: Factors Effecting Mathematics Achievement, Structural Equation Modeling, TIMSS-R, Cross-Cultural Comparison of Mathematics Achievement.

ÖZ

ÜÇÜNCÜ ULUSLARARASI MATEMATİK VE FEN ÇALIŞMASI-TEKRAR (TIMSS-R) DAKİ MATEMATİK BAŞARISININ KÜLTÜRLER ARASI KARŞILAŞTIRMASI

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Yüksek Lisans, Orta Öğretim Fen ve Matematik Alanları Eğitimi Bölümü
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Bu çalışmanın amacının iki evresi vardır. İlk evrede, TIMSS-daki öğrencilerin matematik başarısını açıklayan bir model öne sürülecek. İkinci evrede, öne sürülen bu model farklı kültürleri ve dilleri olan üç ülkedeki; Türkiye, Hollanda ve İtalya, benzerlikleri ve farklılıkları yorumlamak için değerlendirilecektir. Bu çalışma temelde öğrencilerin TIMSS-R Öğrenci anketine verdikleri cevaplar ile TIMSS-R Matematik başarı testinden aldıları puanları birleştirecektir. Bunu başarmak için öğrenci anketindeki sorular örtük değişkenler altında gruplanacak ve daha sonra ilgili modeller kurulacaktır.

Öğrenci anketinden seçilen otuzyedi soru temel bileşenler faktor çözümlemesi kullanılarak her bir ülke için analiz edildi. Sonuçlar yedi yorumlanabilir boyut gösterdi. Türkiye'nin faktör analizi sonuçları baz alınarak en yüksek yüklü gözlenen değişkenler seçilerek örtük değişkenler oluşturuldu. Bu örtük degişkenler şunlardır; okul dışı aktiviteler, matematiğe verilen önem, matematik sınıf iklimi, başarısızlık algısı, öğretmen merkezli ve öğrenci merkezli aktiviteler. Öne sürülen model Doğrusal Yapısal Modelleme yöntemi ile her bir ülke için ayrı ayrı, Türkiye, Hollanda ve İtalya için sırasıyla, 4772, 2728 ve 2781 kişilik sekizinci sınıf öğrenci örneklemi ile test edildi.

Tüm ülkelerde başarısızlık algısı, sekizinci sınıf öğrencilerinin matematik başarısını açıklayan en güçlü faktördü. Matematik başarısını açıklayan diğer önemli iki faktör Türkiye ve İtalya için sosyoekonomik statü ve öğrenci merkezli aktiviteler; Hollanda için ise okul dışı aktiviteler ve matematiğe verilen önemdi.

Sonuçlar şunu göstermiştir ki; Hollanda ile karşılaştırıldığında Türkiye ve İtalya'nın sonuçları daha benzerdir. Diğer ülkelerden farklı olarak Türkiye'de sınıf içi aktiviteler öğretmen merkezli ve öğrenci merkezli olmak üzere iki farklı boyut oluşturmuştur. Bu bulgu Türk eğitim sisteminde öğretmenin önemli rolünü vurguladığından, öğretmen eğitimine önem verilmesi önerilmiştir.

Anahtar Kelimeler: Matematik Başarısını Etkileyen Faktörler, Doğrusal Yapısal Modelleme Yöntemi, TIMSS-R, Matematik Başarısının Kültürler Arası Karşılaştırılması.

To My Parents

Günay and Kemal YAYAN

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OUTOFSCH:	Out-of-school activities
SES:	Socioeconomic status
IMPT:	Importanve given to math (mother-friends-self)
PERFAIL:	Perception of failure
CLIMATE:	Math classroom climate
TEACACT:	Teacher-centered activities
STUACT:	Student-centered activities
ACHV:	Mathematics achievement
ML:	Maximum Likelihood
GOF:	Goodness-of-Fit
AGFI:	Adjusted goodness-of-fit
SRMR:	Standardized root mean squared residual
RMSEA:	Root-mean-square error of approximation

CHAPTER 1

INTRODUCTION

"Originally conducted in 1994-1995, the Third International Mathematics and Science Study (TIMSS) was the largest and most comprehensive comparative international study of education ever undertaken" (Mullis, et al., 2000, p.13). It was designed to provide a base from which policy makers, curriculum specialists, and researchers could better understand the performance of their educational systems. TIMSS compared the mathematics and science achievement of students in 42 countries at five grade levels using questionnaires, videotapes, and, analyses of curriculum materials. Information was collected about educational systems, curriculum, teacher and school characteristics, and instructional practices to obtain rich source of valuable insights into mathematics teaching and learning (Mullis, et al., 2000).

TIMSS was the first step for further assessments in mathematics and science planned for 1999, 2003, and beyond. TIMSS 1999, also known as TIMSS-Repeat or TIMSS-R was a replication of TIMSS at the eighth grade in most countries (Mullis, et al., 2000).

The original TIMSS and TIMSS 1999 were conducted by the International Association for the Evaluation of Educational Achievement (IEA). The IEA having a permanent secretariat in the Netherlands, is an independent international cooperative of national research institutions and governmental research agencies. Its main purpose is to carry out large-scale comparative studies of educational achievement to obtain a deeper understanding of the effects of policies and practices within and across systems of education (Mullis, et al., 2000).

In TIMSS and TIMSS 1999, 42 and 38 countries were participated respectively. A national center and a National Research Coordinator (NRC) were identified for each participating country to conduct the activities of the study and to implement it in accordance with international procedures (Mullis, et al., 2000). In Turkey, The Ministry of Education conducted the TIMSS project. Turkey didn't participate the TIMSS that was conducted in 1995 and the TIMSS 1999 was conducted in May 1999 in Turkey.

TIMSS 1999 not only measured students' achievement in mathematics and science but also used background questionnaires to gather information at various levels of the educational system. These background questionnaires were curriculum questionnaires, school questionnaire, the teacher questionnaire and a student questionnaire. Student questionnaire asked students about their home backgrounds and attitudes, and their experiences in mathematics and science classes. Since home and the school within which education takes place can play important roles in how students learn mathematics, TIMSS collected extensive information about these background factors (Mullis, et al., 2000). Also in TIMSS 1995 a mathematics and science literacy study (MLS) and Performance Assessment were conducted with 21 countries that were participated in TIMSS 1995 (Gonzales & Miles). Common goal of this test and assessment was to measure students' abilities in science and mathematics differently from abilities that were measured in the classical achievement tests (Harmon, 1999; Kuiper, Bos, & Plomp, 2001).

Reports released at that time and subsequently have also provided information about the broad content areas in which some countries are ahead and some are behind the international average. When we looked at the TIMSS 1999 results that were released via Internet in June 2001, we saw that Turkish eighth grade students underperformed in mathematics in comparison to students in most of other nations that participated. According to the results, in 38 countries Turkey was ranked only 32nd in mathematics achievement falling behind most countries and below the international average.

Since 1959 the (IEA) has conducted more than 16 international comparative studies providing information for policymakers, educators, and researchers about educational achievement in a range of subjects and contexts in which learning takes place around the world (Wagemaker, 2002; Webster & Fisher, 2000). In international comparative studies like TIMSS data analysis is focused at differences and similarities among education systems of countries (Bos & Kuiper, 1999). Such studies afford policy makers and educators from different countries the opportunity to learn from each other. It offers countries the ability to determine what seems to be working elsewhere (in terms of curriculum, standards, instruction, etc.) and whether what works in one country can be adopted or adapted to their own country (Shen & Pedulla, 2000). TIMSS provides unprecedented opportunities for cross-cultural analyses of educational systems throughout the world. TIMSS project, allows us to see the value of cross-cultural comparative studies. In a world of rapid globalization with tougher and tougher competition, educators, as well as parents and policy makers, should consider their educational standards and pedagogical practice in an international context so that the expectations of students are not just confined within a local city, district or country. Teaching and learning are cultural activities and the TIMSS encompasses countries with very different cultural contexts, as well as different social, economic and historical background (Shen, 2002). TIMSS does provide some rich information in terms of comparative education (Wang, 2001).

After the results were released many secondary analyses that compare the countries especially the high- versus low-performing countries were conducted in both descriptive and inferential level such as comparing education systems, quality of schooling and cost of education systems, modeling factors affecting achievement (Lassibille & Navarro, 2000).

However it is believed that there are many benefits of cross-cultural studies, there are also many debates about the fairness, validity and reliability issues of cross-cultural studies such as; cross-cultural studies compare “apples and oranges” since schooling differs across countries; international samples are unfair comparison of average national achievement since proportions of an age group attending school can vary across countries; international assessment test can not be fair across so many languages, cultures and educational systems and so on (Baker, 1997). Similarly, Wang (1998) mentioned about the empirical findings which were confusing and conflicting interpretations, together with technical issues such as; free-response items, conducting curriculum analysis, and evaluating videotape findings of TIMSS. Additionally, Wang (2001) discussed the TIMSS findings in terms of some technical concerns such as; five different plausible values, inconsistencies between format of test items and goals of education reforms, different structures of the booklets, and grade-level and content differences among countries. As a result he suggested that TIMSS findings should be interpreted carefully before making important decisions based on the results of TIMSS. Similarly, Haertel (1997) discussed the pitfalls and challenges in learning from TIMSS and, suggested some possible ways to use the TIMSS data productively. Schmidt and McKnight (1998) mentioned about the publicity and criticism that TIMSS received and whether TIMSS results could be used to improve educational policies. They summarize some of the TIMSS results and claimed that many of the TIMSS results were robust.

Apart from the critics of TIMSS, countries carefully interpret the findings, and necessary revision in the educational systems is being carried out by the education policy makers. With the bulk of information obtained across different countries, TIMSS may provide feedback for the educational system of any country that might be interpreted together with the findings of other research studies. Being below the international average in mathematics achievement, Turkey is one of the participating countries in the TIMSS-R. This may provide some valuable feedback to revise and renovate the problematic issues of its' educational system. Low achievement level of Turkish students in various subject matter areas is a well-known and determined fact for many years. For instance, a very recent publication of Ministry of National Education of Turkey (MONE) indicates that, in science and mathematics achievement, students can achieve no more than 50 % of the curricular objectives (Eğitimi Araştıma Geliştirme Dairesi Başkanlığı [EARGED], 2002).

Similarly Dikenoğlu (1992) noticed that with the impact of structural formation and problems peculiar to this era, our education system is affected naturally and extensively by cultural and political developments. He noticed that the most distinctive outcome of this interaction between the new developments and our education system is a serious of educational problems requiring deep-rooted precautions. Moreover, he stated that plans carried by policies and researches showed that our education system is not in accord with the increase in population and political, social, and economical developments. He emphasized that new improvements should be made based on scientific researches in preparing and conducting educational programs that reflect the reality of our country to solve the existing problems. Similarly, Onur (1994) investigated characteristics of Turkish Education System in the perspective of experts, textbooks used in classes, and news published in newspapers, and he pointed that educational philosophy, policies, and applications should be made up-to-date as soon a possible. Additionally, Ataünal (1994) criticized the basic problems in higher education in Turkey and suggested some remedies to these problems.

The most important aspect of the TIMSS is, undoubtedly the fact that the participating nations are able to use the study data for their diverse purposes. With the increase in the availability of cross-cultural data, it is of importance to carry out secondary analyses to find out why some countries perform better than other countries on the same international achievement test and to learn from each other. Thus, originating from the main goal of international studies, the present study aims to determine the factors effecting mathematics achievement of students in TIMSS-R, and compare these factors across three different countries with different levels of success in the TIMSS-R study. The Netherlands is the 7th country and Italy is the 23rd country in TIMSS-R with respect to mathematics achievement rankings. The Netherlands is the most successful European country ranking after Belgium (Flemish), however according to the TIMSS 1999 International Mathematics Report (Mullis, et al., 2000) there is no statistically significant difference between them. Additionally, Italy ranks above the international average but there is no statistically difference between international average and Italian eighth graders' mathematics performance (Mullis, et al., 2000). Even it is a well-known fact that some variables are very influential on achievement such as socio economics status, cross lingual and cultural comparisons of a model may help to understand the important variables that are influential on achievement and whether these variables hold the same importance in a cross-cultural data. Thus, being among the successful, average and unsuccessful levels, comparisons among Netherlands, Italy and Turkey, will shed some lights on possible factors that may be influential on students mathematical achievement levels, in a cross-cultural fashion. This study will be a first step in investigating these different performances occurred among these three countries in mathematics achievement. Also, results of the study will be helpful in explaining the poor performance of Turkish eighth graders. Eventually, some solid suggestions could be provided to enhance students' achievement in mathematics in the Turkish educational system.

1.1 Problem of the Study

The problem of this research study has two phases. In the first phase, a model that explains students' achievement in TIMSS will be proposed. In the second phase this model will be evaluated across three culturally and linguistically different countries to interpret similarities and differences. Thus; "What linear structural model explains the determiners of students' achievement levels in the mathematics subtest of the TIMSS study?" and "Does the proposed model explain the achievement levels of students in the same manner across three countries with different levels of average mathematics achievement in the TIMSS data?" are the problems investigated in this research study.

This study will basically combine students' answers on student questionnaire items with their mathematics achievement scores. In order to achieve this, firstly the items in the student questionnaire must be grouped under latent variables, and then the related models are established. Thus, the study starts analysis with an exploratory fashion to group the items of the student questionnaire. Then, various models are tested if they give the best explanations of the determiners of the student mathematics achievement within each country.

Conceptually, items in the student questionnaire have, out-of-school activities, socio economic status, importance given to math, teacher-centered activities, student-centered activities, math classroom climate, and perception of academic failure dimensions. Thus, the model proposed and tested is given below;

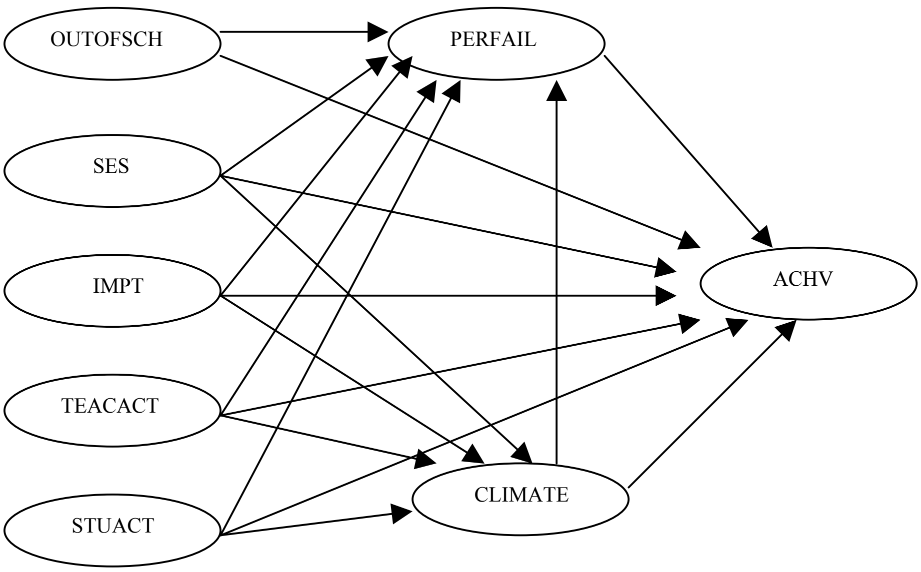

Figure 1.1 Hypothesized Mathematics Achievement Model

1.2 Definition of the Important Terms

The descriptions of latent variables included in the hypothesized model and the basic terminology of the statistical method are given as follows;

1. Out-of-school activities (OUTOFSCH): Students can do a lot of out-of-school activities like watching tv or videos, playing with friends, and playing sports. A high score on this construct means the student spends a lot of time on these activities.

2. Socioeconomic status (SES): White (1982) indicated that most frequently used indicators of socioeconomic status are income, education, or occupation of parents. In this study socioeconomic status is restricted to home educational background items such as, the highest education level of parents and the number of books in the student's home. A high score means that the student's parents are well educated and there are many books in the student's home.
3. Importance to given math (IMPT): This latent variable measures the student's perceptions of the degree of importance his/her mother and peers, and the student himself/herself place on to do well in mathematics. A high score on importance given to math means the student thinks to do well in mathematics is important as well as his/her mother and peers think so.
4. Perception of academic failure (PERFAIL): Perception of academic failure can be regarded as student's perception of the difficulty level of mathematics and his/her performance in mathematics achievement. Five observed variables reflect this latent variable: "I would like to mathematics much more if it were not so difficult"; "Although I do my best, mathematics is more difficult for me than for many of my classmates"; "Nobody can be good in every subject, and I am just not talented in mathematics"; "Sometimes, when I do not understand a new topic in mathematics initially, I know that I will never really understand it"; and "Mathematics is not one of my strengths". A high score of perception of failure means the student thinks he/she cannot understand mathematics and has no talent to do well in mathematics. There are different alternatives for naming the observed variables included in the latent variable of perception of academic perception. Also this variable can be defined as self-concept of ability. As Marsh (1986) indicated it is a cognitive representation of students' perceptions of their own competencies and can initiate and influence motivational processes. Additionally this construct is related with math anxiety as Meece,

Wigfield, and Eccles (1990) indicated math anxiety is most directly related to students' math ability perceptions, performance expectations, and value perceptions.

5. Math classroom climate (CLIMATE): Mathematics classroom climate is a perceptual measure. Students were asked for their perceptions of the climate during mathematics lessons. Three observed variables reflect this construct: "Students often neglect their schoolwork" (scores were inverted to mean that students did not neglect schoolwork but took it seriously); "Students are orderly and quiet"; and "Students do exactly as the teacher said". A high score means the students perceived an orderly and quiet atmosphere during mathematics lessons.
6. Teacher-centered activities (TEACACT): This latent variable is defined by using three observed variables that reflect students' perceptions of a more teacher oriented instructional activities used in mathematics classroom. These variables are: teacher shows how to do problems, we copy notes from the board, and teacher explains the rules and definitions. A high score on teacher-centered activities means teacher-centered activities are used frequently in mathematics classroom.
7. Student-centered activities (STUACT): This latent variable is defined by using three observed variables that reflect students' perceptions of a more student oriented instructional activities used in mathematics classroom. These variables are: we work on math projects, we work in pairs or small groups, when we begin a new topic in mathematics, we discuss practical problem; we work in small groups: teacher ask what students know. A high score on student-centered activities means student-centered activities are used frequently in mathematics classroom.
8. Mathematics achievement (ACHV): TIMSS generated not one but five plausible values for each student for each of the content area in mathematics as well as for overall scores in mathematics. Since, it was suggested to use at least two plausible values in the secondary analyses, all of the five overall mathematics plausible values are as observed variables

to represent mathematics achievement in the present study (Gonzales & Miles).

9. Observed, indicator or manifest variables: Observed variables are directly observable or measured variables (Schumacher & Lomax, 1996, p. 77).
10. Latent variables: Latent variables are not directly observable or measured. They must be observed or measured indirectly (Schumacher & Lomax, 1996, p. 77).
11. Latent dependent or endogenous variable: Latent dependent variable is influenced by some other latent variable in the model. The latent dependent variables are measured on the basis of the observed dependent variables (Schumacker & Lomax, 1996, p 78).
12. Latent independent or exogenous variable: Latent independent variable is not influenced by any other latent variable in the model. The latent independent variables are measured on the basis of the observed independent variables (Schumacker & Lomax, 1996, p.78).
13. Measurement model: Confirmatory factor analysis methods reflect measurement models in which observed variables determine constructs or latent variables. How well the observed variables measure each latent variable is identified in the measurement model. The measurement model involves specifying which observed variables determined a construct and reflects the extent to which the observed variables are assessing in terms of reliability and validity. Measurement models are defined for both independent and dependent latent variables (Schumacker & Lomax, 1996, p.64).
14. The structural model: After latent variables defined with the measurement model the relationships of the latent variables were examined in a structural model. The structural model is specified by allowing for certain relationships among the latent variables depicted by directed lines or arrows. A theoretical basis should be established for the latent variable relationships (Schumacker & Lomax, 1996, p.73, 83).

15. Structural equation model: The structural equation model is consists of two parts: the measurement model and the structural model. The structural equation model specifies the direct and indirect relationships among the latent variables and is used to describe the amount of explained and unexplained variance (Schumacker & Lomax, 1996, p.50).
16. λ_y (lowercase lambda sub y) and λ_x (lowercase lambda sub x): These values refer to coefficients between the latent variables and observed variables. They provide us with information about the extent to which a given observed variable is able to measure the latent variable. These values serve as a validity coefficient and are typically referred as factor loadings (Schumacker & Lomax, 1996, p. 81,225).
17. Measurement errors: Measurement errors refers to proportion of an observed variable that is measuring something other than what the observed variable is hypothesized to measure. The measurement errors are symbolized as ε (lowercase epsilon) and δ (lowercase delta) for Ys and Xs, respectively. They serve as a reliability coefficient (Schumacker & Lomax, 1996, p. 81,225).
18. The β (lowercase beta): This structure coefficient refers the strength (weak or strong) and direction (positive or negative) of the relationship among the latent dependent variables (Schumacker & Lomax, 1996, p. 225).
19. The γ (lowercase gamma): This structure coefficient refers the strength and direction of the relationship among latent dependent variables and latent independent variables (Schumacker & Lomax, 1996, p. 225).
20. Direct effect: Direct effect is defined as the effect between two latent variables when a single directed line or arrow connects them. It is measured by a structure coefficient (Schumacker & Lomax, 1996, p. 90).
21. Indirect effect: Indirect effect is defined as the effect between two latent variables when no single straight line or arrow directly connects them but when the first latent variable may be reached from the second latent variable through one or more other latent variables via their paths (Schumacker & Lomax, 1996, p. 90).

1.3 The Hypothesized Mathematics Achievement Model

The proposed model in Figure 1.1 was developed based on the previously developed models (Bos & Kuiper, 1999; Papanastasiou, 2000). In the proposed model a set of direct and indirect relationships between latent variables was proposed. First of all, ACHV that is an endogenous variable is supposed to be influenced directly by exogenous variables; OUTOFSCH, SES, IMPT, CLIMATE, PERFAIL, TEACACT, and STUACT. Furthermore, as it can be seen from Figure 1.1, PERFAIL and CLIMATE, which are also endogenous variables, are supposed to be influenced by a number of exogenous latent variables. OUTOFSCH, SES, IMPT, CLIMATE, TEACACT, and STUACT are directly linked to PERFAIL. SES IMPT, TEACACT, and STUACT are directly linked to CLIMATE. Finally, OUTOFSCH, SES, IMPT, CLIMATE, TEACACT, and STUACT are supposed to influence ACHV indirectly through PERFAIL while SES, IMPT, TEACACT, and STUACT are supposed to influence ACHV indirectly through CLIMATE.

1.4 Significance of the Study

This study may provide a comprehensive data that may help to overview and rethink of educational practices. Especially for Turkey it gives a general overview of determiners of students' success in mathematics. The findings could be used to revise and organize the national mathematics curriculum. It also gives an overview of the Turkish educational system with respect to European countries on the way to European Union (EU) attempts of Turkey.

It is important to determine where the place of education system of Turkey is when compared with European countries, in terms of integration with EU, since nowadays Turkey is in a great effort to be included in the EU. For this goal eight-year compulsory education has been carried out and studies to increase this period to twelve years have been started. The results of TIMSS 1999 showed that Turkish eighth graders underperformed in both mathematics and science in comparison to students in all of other European countries that participated.

However, these results should be interpreted cautiously since it was the first time that Turkey has participated in such an international study.

To increase the performance of Turkey in such international studies, some remedies should be developed in the education system of Turkey. Gaining positive results from these remedies mostly depends on determining the place of Turkey's education system among the other European countries' education systems. In this process education systems of European countries should be as criterion. So, the Netherlands an overperforming European country and Italy an average performing European country in TIMSS 1999 were selected to compare the mathematics achievement models of three countries developed using TIMSS 1999 results. Since Italy is a typically Mediterranean country having many similarities with Turkey, it is expected to see similarities both in the factor structure and the models of these two countries. However, because of the different characteristics of the Netherlands and Turkey, it is expected to see differences in the results of the both factor analysis and the model testing.

Differences that we expect to find can be originated from the cultural differences, as well as curriculum, ratio of schooling, teacher education, educational policies, and so on.

On the other hand, in Turkey, up to now no research has been conducted comparing Turkey with other countries inferentially in educational area, especially in mathematics. Such studies were only in descriptive manner. For instance, Oktay and Ramazan (1992) discussed the elementary education applications in various countries in terms of the period and the beginning age of compulsory elementary education, the content of the elementary education, and administration of the educational policies. Şen and Özgün-Koca (2002) investigated the place of Turkish students in TIMSS 1999 with respect to organization of mathematics and science instructions, mathematics and science curricula, and attitudes of students towards mathematics and science descriptively.

TIMSS has provided a good database for describing the variation found across the countries in many of the variables that have been shown to be related to mathematics achievement. We may learn much from the TIMSS data, but only by asking the right questions and pursuing the answers using appropriate analytical methods. Although many more analyses of the Turkey data are waiting to be performed, some clear messages for mathematics education and educators in our country have already emerged with this study.

CHAPTER 2

LITERATURE REVIEW

After the results of TIMSS 1995 and TIMSS 1999 were released many secondary analyses that compare the countries especially the high- versus low-performing countries were conducted in both descriptive and inferential level such as comparing education systems, quality of schooling and cost of education systems, modeling factors affecting achievement (Lassibille & Navarro, 2000). TIMSS data were made available for secondary analysis by researchers and some of the TIMSS items will also released to public, allowing secondary analyses (Haertel, 1997).

Up to now many theorists and researchers have consistently tried to determine the determinants of achievement and to comprehend how these determinants affect achievement. Researchers have studied academic achievement using large samples and applying various statistical models to assess multiple factors of academic achievement (Baker & Stevenson, 1986). Since mathematics opens the doors of careers and provides knowledge to compete in a technological economy, it should be given the appropriate importance to mathematics to participate fully in the world of the future (National Research Council [NRC], 1989, p.1). There are lots of factors influencing mathematics achievement directly or indirectly. Students' characteristics, attitudes, and prior knowledge, teachers' characteristics and experiences, instructional activities, parent's characteristics and education level, school principals, government, curriculum and so on. They are all important and each factor completes the other ones.

This chapter introduces studies conducted using TIMSS 1995 and TIMSS 1999 data, models developed related with factors affecting mathematics achievement and studies that investigated the factors used in the present study.

2.1 Models Developed Using TIMSS Data

After the results of TIMSS 1995 and TIMSS 1999 released many secondary analyses, comparing the countries especially the high- versus low-performing countries (Papanastasiou, 2000; Bos & Kuiper, 1999), developing path model (Lokan & Greenwood), testing previously developed models (Köller, Baumert, Clausen, & Hosenfeld, 1999), testing the dimensionality of socioeconomic status (Yang, 2003), using multilevel and hierarchical linear modeling to examine student, teacher, and school level characteristics (Webster & Fisher, 2000; Schiller, Khmelkov, & Wang, 2002; Schreiber, 2002).

Papanastasiou (2000) examined the predictors of attitudes and beliefs related to school and family and examined predictors of mathematics outcomes focusing on attitudes and beliefs in order to advance a conceptual model based on the literature and tested this model empirically using data collected within the TIMSS project. He used the Cyprus model, which evolved from TIMSS 1995 data, on US and Japanese data in order to see whether the model fits and to examine the strength of attitudes and beliefs as predictors of mathematics outcomes. The final samples were 1026, 4980, and 5249 eighth graders for Cyprus, Japan, and US, respectively. Data gathered from the TIMSS 1995 student questionnaire. The student variables included in the model were determined on the basis of factor analysis. The 35 questions used in this study were grouped into separate categories, related to the following:

1. student views and attitudes on mathematics, and mother's and friends' opinions on the importance of mathematics;
2. the socioeconomic status and educational background of the family;
3. teacher-initiated activities in the mathematics class, especially those implemented at the beginning of a new topic; and
4. school- the general climate of the school.

The educational background of the family measures included the highest level of parents' education and the size of the family home library except student textbooks. Whether the students' mother, friends and the student him- or herself think that to be a high-achieving student in the class is important is related reinforcement measures. The teaching measures included questions on activities related to the mathematics lesson such as; do they work on math projects, do they use events from everyday life in solving mathematics projects, do they check and discuss homework, do teachers begin the lesson discussing a practical problem, and do they ask questions related to new topics. The SES measures involved items that students have at home, such as calculators, dictionaries, and video recorders. The climate measures involved questions related to the school environment such as did the students think that student might hurt them, were friends ever hurt by other students, did some of their friends skip classes, was something ever stolen from school. Whether students like mathematics, and if do they enjoy mathematics, do they find it boring and think it is an easy subject were the questions related to attitudes measures. Lastly, the beliefs regarding success in mathematics involved questions on the need for naturally ability/talent, hard work, studying at home and memorization of textbooks and notes. Although the prediction that attitudes and beliefs about success in mathematics would have significant effect on mathematics outcomes, this was not proven in all three structural models. In the model of Cyprus, the paths from educational background to SES, to beliefs, and to climate were significant. The paths from reinforcement to attitudes, and to beliefs about success in mathematics were also significant as were the paths from climate to teaching, the path from teaching to attitudes, the paths from beliefs to teaching and to attitudes. Beside, in the US model, the paths from educational background to SES and climate were significant, but the path from educational background to beliefs was not significant unlike the model of Cyprus. The paths from reinforcement to attitudes and to beliefs about success in mathematics were also significant, as were the paths from beliefs to teaching, from teaching to attitudes, from SES to climate, and from SES to attitudes. Unlike, the paths from climate to teaching and from beliefs to attitudes were not significant. Finally, in the model of Japan, the paths from reinforcement to attitudes and to beliefs about success in mathematics were significant as were the path from beliefs to teaching and the path from teaching to attitudes same with the models of Cyprus and US. Also the path form beliefs to attitudes was not significant unlike the model of Cyprus. The results of the study indicated that two factors – the educational background of the family and student reinforcement – define a second-order factor structure which includes the endogenous predictors, the socioeconomic status of the family, the student attitudes toward mathematics, the beliefs regarding success in mathematics, the type of teaching, and the school climate. Consequently, these results indicate that the phenomenon of mathematics achievement is multidimensional.

Similarly, Bos and Kuiper (1999) conducted a secondary analysis using TIMSS 1995 data to find relationship between achievement in mathematics and constructs at student and teacher levels. Their research question was "What can be learned about mathematics of grade 8 students, and the factors at student and classroom levels that may be associated with that achievement across 10 education systems?" Figure 2.1 displays the conceptual student/teacher path model. The ten European education systems were, Belgium-Flemish, Belgium-French, Czech Republic, Denmark, England, Germany, Lithuania, Norway, Sweden, and the Netherlands. A principle component analysis was carried out to form latent variables. The latent variables were homework (from textbook, application), teaching style (student and teacher oriented), school climate (safety), student gender, maternal expectation, friends' expectations, success attribution mathematics (talent, luck, hard working, memorize), instructional formats (co-operative learning), mathematics class climate (neglect schoolwork, quiet in lessons, do as teacher says), attitude towards mathematics (like, importance), home educational background, class size, effective learning time (total number of minutes mathematics per week), assessment (evaluation, feedback, and corrective instruction), out-of-school activities (job, leisure). As a limitation of this study, the reliability coefficients of most of the latent variables for most of the education systems were not higher than .50. Then on the TIMSS data the Partial Least

Squares path analysis technique had been applied. First of all, the percentage of variance in students' mathematics scores explained by the latent variables of the

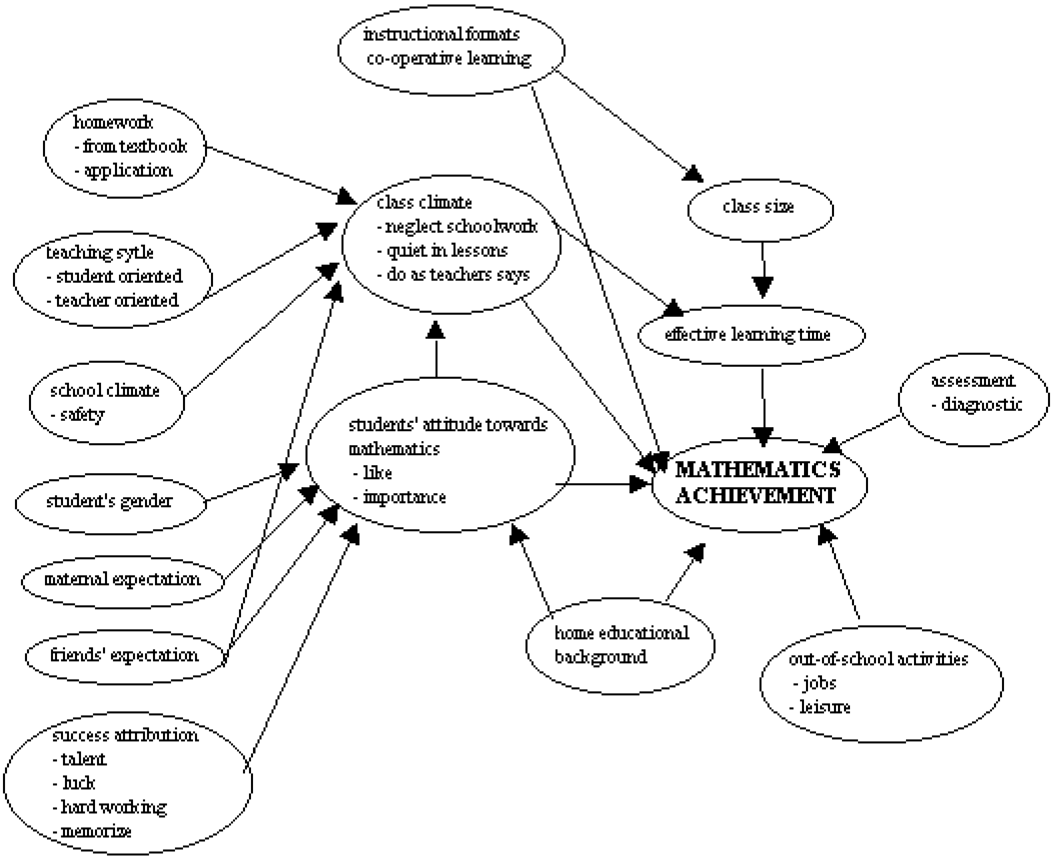

Figure 2.1 General student/teacher Path Model

path model is not higher than 19% (in England). Home educational background, out-of-school activities and attitude towards mathematics have significant influence on achievement in most of the 10 systems. Home educational background shows the highest (positive) path coefficients in most of the systems together with out-of-school activities. The path coefficient of out-of-school activities is negative, which means that the more time a student spends on jobs and watching television and playing games the less his or her achievement in mathematics is. Class climate as perceived by the students, assessment usage, instructional formats, and effective learning time do not show significant path coefficients in the majority of the education systems. In all 10 systems home educational background has no direct link to attitude. But in the majority of the educations systems, gender, maternal expectation, friends' expectation, and success attribution have a positive link to attitude.

Differently from the previously mentioned studies Lokan and Greenwood (2000) firstly examined and interpreted some important parameters of TIMSS 1995 in Australia in terms of such as; Australia's education systems and schools, test date, sample, response rate and adequacy of data, relative performance, areas of strength and weakness, and implications of TIMSS 1995 in terms of mathematics instruction. Then by using correlations they examined the relationships between selected student level; school and class-level characteristics and mathematics achievement. Among these correlations, parents' occupational status and education level, books in the home and family size were found to be significantly correlated with mathematics achievement. Moreover whether the students liked mathematics was associated with achievement but the association was not strong. Additionally, "Self-efficacy" or believing that one is doing well in the subject had the highest correlation with the achievement. With regards to school and class level characteristics, "students-centered emphasis", "teacher-centered emphasis", and "class discipline" variables that were derived from classroom practices, had only low or negligible correlations with achievement. Interestingly it was found that the use of student-centered teaching strategies was negatively related to achievement. In terms of student-level factors, time spent out-of-school in on academic activities was correlated negatively with mathematics achievement while importance of mathematics to life, liking for mathematics, mother's, own, and friends' valuing of academic study were positively correlated with mathematics achievement. Finally, Lokan and Greenwood (2000) developed a path model for the Australian TIMSS 1995 data by using the results of previously conducted factor analyses. The dominating factors in relation to achievement were self-efficacy, own educational aspiration, and external attribution for success. Moreover, the students' liking for mathematics contributed achievement through its relationship with self-efficacy. They pointed that the importance of positive attitudes towards mathematics and a belief that one has ability to do well in mathematics is reinforced by these results. Also they emphasized that it is important for students to be encouraged to believe that their own actions can influence their success at school, since believing that success is due to luck rather than to one's own efforts was shown to be to be negative predictor of achievement in this study. As a result they concluded that it would be worthwhile that teachers can play a role in influencing students' attitudes, self-perceptions and beliefs.

In another analysis conducted with German data of First International Mathematics Study (FIMS), Second International Mathematics Study (SIMSS), and TIMSS 1995, Köller, et al. (1999) tested model of educational productivity provided by Walberg and colleagues in 1981 (cited in Köller at al., 1999). They believed that ability, motivation, developmental stage, mass media, home environment, and peers are variables affecting achievement at student level, while quality and quantity of instruction as well as that class environment can be considered class level variables that affect achievement. According to the model they developed the cognitive variables were found to be the most powerful predictors of mathematics achievement. However, motivational determinants, leisure activities, and students gender were also significant predictors of mathematics achievement while, mass media that is measuring amount of watching TV and playing computer games, and home educational background that is measuring education level of parents, their job prestige and their number of books at home had no direct impact on learning. Moreover, home environment had a significant path on academic leisure time behavior. That is students with higher educational parental background spent more time an academic out-of-school activities. Also, mathematics achievement in grade 8 was influenced by achievement in grade 7 and non-academic leisure activities with fear of failure had negative effects on mathematics achievement.

Differently form the previously mentioned modeling studies, Yang (2003) used only the socioeconomic status variable. He examined the dimensionality of socioeconomic status and its relationships with mathematics and science performance at student and school levels. In the study, data of 13-year-olds from

17 countries participated in TIMSS 1995 were used. The dimensions of socioeconomic status were measured by the items asking information about the ownership of a set of household materials. Yang (2003) interpreted the results of the study as the ownership of set household materials can be used as socioeconomic indicators.

Using multilevel modeling, Webster and Fisher (2000) investigated the resource availability in rural and urban Australian schools and included the variables of students' attitudes towards science and mathematics and career aspirations of these students as well as socioeconomic status and gender of these students. They used multilevel model accounting school, classroom, and student level variance using the effect of available school resources, students' attitudes, and students' career choices on mathematics and science achievement in both rural and urban schools using TIMSS 1995 data of 12852 thirteen-year-old students in 161 schools. One of the control variables was socioeconomic status. It was measured with father's occupation, father's and mother's education. In multi-level analysis, the effects were positive for school average SES that is achievement was higher for those students attending schools where their peers came from higher socioeconomic backgrounds. According to the results a strong and negative effect of rurality was observed on student mathematics and science achievement. Besides, there was no strong or significant effect of the availability of recourses in school on student achievement in mathematics and science. As in accordance with most researches, students' attitudes towards mathematics have a strong and significant effect on achievement, and as expected the more positive the attitude the higher the standard of achievement. Also the career aspirations of the students have a strong and positive effect on achievement.

In another study carried out by Schiller, Khmelkov, and Wang (2002), Hierarchical Linear Modeling (HLM) was used to explore the relationship between nations' level of economic development and the influence of students' social backgrounds; parents' education and family structure, on their mathematics achievement using data of TIMSS 1995. The researchers found that the positive effect of higher parents' education on middle school students' mathematics test scores is considerably consistent among the 34 nations investigated. However, the relative advantage of living in a traditional family for mathematics achievement differs from systematically among nations, being significantly grater in those with stronger economy. They pointed that more educated parents appear to be able to provide their children with academic and social supports important for educational success.

Finally, Schreiber (2002) examined advanced mathematics achievement with 1839 students from 162 schools with the data from TIMSS 1995. He used hierarchical (multilevel) linear modeling to examine student- and school-level factors. According to the results average parents education was observed to be associated with the magnitude of the coefficient for attitude toward mathematics on achievement. Especially, at the students level students whose parents had lower levels of formal education scored lower than did those students whose parents had higher formal education levels. One explanation for this result may be that in schools that have higher average parent education, attitude has more of an influence on achievement. If a student's is low and the student is in a school with high average formal parent education, the impact may be stronger on that student than on one with a similar poor attitude in a school with a lower formal average parent education. Also, it was reported that the magnitude of this relationship varied from school to school. With regards to students' beliefs, it was found that the students who had a poor attitude toward mathematics tended to perform poorly on the test. Additionally, the more students who believe the key success is based on hard work traditionally perform better than those students who do not. While the amount of time spent studying mathematics was not significantly related to advanced mathematics achievement in the model, the amount of time spent engaging non-academic activities (television, employment, sports) was negatively associated with advanced mathematics scores.

2.2 Other Types of Studies Conducted by TIMSS Data

Not all of the studies using TIMSS data developed models. There are also other types of studies. For instance, Papanastasiou (2002) examined how attitudinal and instructional variables differentiated 4 th-grade students in Cyprus, Hong Kong, and USA and determined how those variables were related to math performance on the TIMSS test. She conducted a discriminant analysis to examine how these variables differentiated the students in the 3 countries. According to the results, fourth grade students who liked math, who taught it was important to do well in math for their friends, who did not need special instruction, and who had not been taught using computers or small group procedures, tended to be more successful students. With regards to small group work used in mathematics classroom, the results showed that the less the students use groups in their mathematics classes, the higher the mathematics scores of those students. Specifically, the highest average score was obtained by the Hong-Kong-like students who never used small groups. She proposed a possible reason for this result that teachers may not know how to effectively implement small group work in their classes and concluded that it is not effective or appropriate to use small group work in most mathematics teaching situations.

Shen (2002) investigated the relationships between eighth graders' mathematics and science achievement and their self-perceptions using TIMSS 1999 data of 38 participated country both for within-country (unit of analysis being the individual) and between-country (unit of analysis being the country). The study had reliability limitations since only a single item is used from TIMSS 1999 student questionnaire to represent each variable. When the individuals were the unit of analysis, there was generally a positive a positive relationship between students' achievement and three measures of their self perception: how much they like the two subjects, their self-perceived competence in the subjects and their perceived easiness of the subjects. Nevertheless, opposite findings are found when unit of analysis was country. So the results of the very similar study conducted by Shen and Pedulla (2000) with TIMSS 1995 data were verified. Shen and Pedulla (2000) suggested that this contradiction might be the result of high performing countries have high academic standards while low performing countries have low academic standards. Also, it was pointed that although it is commonly believed that a positive self-regard is an important motivating force and provides to increase students' achievement, some researchers argue that the need for self-regard is culturally variant because the construction of self and regard themselves differ across cultures.

Papanastasiou (2000) evaluated some empirical findings of TIMSS 1995 in terms of internal and external factors affecting achievement in mathematics. He listed the factors such as format of items, content of the test, quality of the items, and structure of the items as internal factors while socioeconomic status, educational background of the family, the school climate, and students' attitudes toward mathematics comprised the external factors. It has been found that in Australia and South Africa socioeconomic status is positively related with mathematics achievement. It was also found that students in South Africa having no technological resources at home achieve worse than the students in Australia having a number technological resources. The educational background of the family was found to be another important factor correlated to mathematics achievement. In both Australia and South Africa this correlation is found to be positive same with the number of books at home. Besides, the students' attitudes appear to be affect the mathematics achievement positively in South Africa while in Australia and Cyprus attitudes by themselves are not predictors of mathematics achievement. Also, it was found that the attitudes of peers and parents are important factor in determining the students' attitudes. Additionally, self-efficacy or believing that one is doing well in mathematics was correlated with achievement.

House (2001) assessed the efficacy of selected classroom activities using data from TIMSS 1995. He examined a number of classroom activities and employed variance estimation procedures for complex sampling designs. The findings identified that several instructional strategies that were related to the mathematics achievement of students in Japan.

Differently from others studies, Dossey, Jones, and Martin (2002) examined the patterns and findings associated with the use of such two-digit rubrics to score the free-response items in TIMSS 1995. This examination of the item level findings provided mathematics educators and policy researchers with a variety of findings, such as the varied response rates of students across countries, links between patterns of misconceptions and predominant solution methods to various groups of students, and the strengths and weaknesses of the students by this way the school programs of the countries.

In sum, all of these mentioned studies benefit TIMSS data, using large samples, cross-national data and diverse variables in their studies.

2.3 Models Related to Mathematics Achievement

The identification and examination of the factors that explain achievement have long been searched by the researchers. Though the investigation of individual factors that affect achievement is important, modeling suggests an advantage of examination and investigation of not only each individual factor but also the relationships among those factors (Schreiber, 2002). In 1989 Shavelson, McDonnell , and Oakes and in 1987 McDonnell, Oakes, and Carey (as cited in Schreiber, 2002) argued that a model is required because a single indicator is not able to provide information about a "phenomenon as complex education".

Literature review about mathematics achievement and modeling shows that many studies proposing theoretical models have been conducted to explain mathematics achievement and its relationships between psychological, pedagogical, social, and cognitive constructs. For example, Abu-Hilal (2000) assumed that mathematics achievement is both an outcome and an antecedent variable in the academic and psychological development of children, Ethington (1991) confirmed the importance of the psychological constructs within the theoretical model, and showed that the proposed model works differently for males and females, an empirical support is provided for the internal-external frame of reference model by Marsh (1986). Additionally, Marsh (1994), evaluated the National Educational Longitudinal Survey of 1988 (NELS:88), provided a comprehensive comparison of U.S. and Australian self-concept responses, and tested a variety of theoretical self-concept models with uniquely appropriate NELS:88 data. Ferry, Fouad, and Smith (2000) examined the effects of family context and person input variables on learning experiences, self-efficacy, outcome expectancies, interest and goals by applying multivariate causal modeling techniques to the previously developed model of Lent, Brown, and Hackett in 1994 (as cited in Ferry, Fouad, & Smith, 2000). The results showed that as a family background context variable, parental encouragement has significant direct effects on grades in math and science and outcome expectancies. Based on the results of the study the researchers implied that parent need to be informed and educated about the impact they might have in making easy the career development of their children.

In more detail, Abu-Hilal (2000) assumed that achievement plays a central role in the academic and psychological development of children, namely being both an outcome and an antecedent variable. He tested his model using data of 215 male and 179 female six and nine grade students. In the model, academic effort was defined as the amount of time spend on studying, and for the mathematics anxiety three indexes were computed; dread index, anxiety index, and mathematics dislike index. Mathematics self-concept was defined as general feelings of doing well or poorly in mathematic and mathematics achievement was the aggregate scores of assignments, quizzes, and examinations. EQS program was used to test the models using structural equations modeling. As predicted, Abu-Hilal (2000) found that perceived mathematics importance was positively related to effort exerted in learning. Also the findings showed that mathematics importance or attitude relates positively to achievement. The results of this study showed that achievement was more strongly related to effort than to importance. Achievement found to be the strongest predictive power concerning predictors of self-concept. In addition to that the students, who perceive mathematics as an important subject, tend to develop positive self-concept in mathematics. In accordance with his expectations, Abu-Hilal found a strong negative direct relationship between achievement and anxiety.

In terms of evaluating achievement behaviors with gender issue, Ethington (1991) sought to determine the degree to which the key constructs within the model developed by Eccless and colleagues (as cited in Ethington); students' expectations for success and task value, directly influence achievement behavior and serve as mediators for the indirect influence of prior constructs. She used the data of 869 eighth graders in United States collected in the Seconds International Mathematics Study (SIMS). The variable of family socioeconomic status was constructed by mother's and father's level of education and current occupation. Other variables were parental help, parents' attitudes and expectations, appropriate sex-role behaviors, the perceived difficulty of mathematics, the value of mathematics, self-concept in mathematics, goals, expectations for success, and intention to take more mathematics. In the study the causal model was estimated with ordinary least squares procedures. The indirect effects and their standard errors also with the usual regression results were computed. It was found that self-conception and perception of the difficulty of mathematics show direct significant effects on expectations for success for both gender. The socioeconomic status found to exert additional influence for females, while self-concept and perception of the difficulty of mathematics show additional effects for males.

Meece, Wigfield, and Eccles (1990) used structural modeling techniques to assess the influence of past math grades, math ability, perceptions, performance expectations on the level of math anxiety using the data of 250 7th through 9th graders. The perceived math ability measure consisted of three items asking students' sense of their math ability and how well they were doing in math. The importance measure consisted of two items asking students to rate how important it was to them to be good at math and to get good grades in math. The findings showed that math anxiety was most directly related to students' math ability perceptions, performance expectations, and value perceptions. Students' performance expectations predicted subsequent math grades, whereas their value perceptions predicted course enrollment intentions. Additionally math anxiety did not have significant direct effects on either grades or intentions.

Demir-Gülşen (1998) developed a model in order to see the effects of cognitive, metacognitive and affective characteristics of students on their mathematics achievement in general and probability in particular. She indicated that the model testing showed that in predicting math achievement metacognitive skills and as an affective variable only motivation were significant variables whereas in predicting probability achievement not the affective variables but the cognitive and metacognitive variables were found as significant. Similarly, Tağ (2000), modeled the reciprocal relationship between attitude toward mathematics and achievement in mathematics. According to the results, it was reported that there was reciprocal relationship between attitudes toward mathematics and achievement in mathematics. Additionally, confidence in learning mathematics which was measured as students' beliefs about their ability to learn and perform well on mathematical tasks, success attribution in mathematics, mathematics anxiety, importance of mathematics referring to students' beliefs about the importance of mathematics in relationship to their life, effectance motivation, usefulness of mathematics positively and significantly loaded on attitudes toward mathematics. Furthermore, father quality reflecting students' perceptions of father's attitudes toward them as learners of mathematics had a positive statistically significant direct effect on both attitudes toward mathematics and achievement in mathematics while mother quality had a positive statistically significant direct effect on achievement in mathematics but a negative statistically significant direct effect on attitudes toward mathematics.

Marsh (1986) examined the empirical support for the internal-external model that describes the relation between Verbal and Math self-concepts, and between these academic self-concepts and verbal and math achievement. Based on the data gathered from 6010 students, Marsh found that (1) verbal and math self-concepts are nearly uncorrelated with each other although verbal and math achievement are substantially correlated each other; (2) the direct effects of math achievement of verbal self-concept, and of verbal achievement on math self-concept are both negative.

2.4 Perception of Failure

There are many studies that investigating the reasons of perceptions of success and failure. Stodolsky, Salk, and Glassner (1991) investigated the differences in students' ideas about how they learn the math and social subjects and express different reasons for positive and negative experiences in each subject. Interviews of 60 fifth grade students showed that students identified positive and negative experiences in math in terms of their success or ability to do the work while social subjects experiences were assessed in term of whether they were interesting or boring. They used the “ease and success” and “difficult and failure” relationships to define the subjects. Students associated dislike in math with frustration, anxiety, embarrassment, while they associated positive experiences with easiness of math, their success or having fun. Since they feel that they could not learn a new topic in math on their own, they feel that they are dependent on someone to learn how to do math correctly. Also Stodolsky et al. (1991) believed that instructional experiences in classrooms are central element in the development and the shaping of beliefs and attitudes. Similarly Gipps and Tunstall (1998) investigated the understanding of success and failure in relation to mathematics, painting, reading, and “getting on” with work of 49 six and seven year-old children. According to the results effort was the most commonly cited reason for success/failure and being good at a particular activity was the second most commonly cited response. Additionally Gipps and Tunstall (1998) reported that the children did see the teacher as having a role in success and failure.

Affective background factors, such as attitudes and beliefs, play a central role in mathematics achievement (McLeod, 1992). The general relationship between attitude and achievement is based on the concept that the better the attitude a student has toward a subject or task, the higher the achievement or performance level tends to be. According to the results of many studies that found significant and strong relationships between attitudes towards mathematics and achievement in mathematics and between perception of academic failure in mathematics and mathematics achievement; the teachers and the school in general should give special attention to these variables, containing in its planing, objectives that aim to develop attitudes in students that are more positive (Utsimi & Mendes, 2000). In contrast to many studies found significant and strong relationships between attitudes towards mathematics and mathematics achievement, Papanastasiou (2000), could not find any significant relationships in all three structural models of Cyprus, Japan, and US. However, Bos and Kuiper

(1999) reported a positive relationship between attitudes towards mathematics and mathematics achievement in most of European countries. Similarly, Lokan and Greenwood (2000) indicated that the students' liking for mathematics contributed achievement through its relationship with self-efficacy. Additionally, Webster and Fisher (2000) found a strong and significant effect of students' attitudes towards mathematics on achievement as expected the more positive the attitude the higher the standard of achievement. Also, Ethington (1991) reported that self-conception and perception of the difficulty of mathematics show direct significant effects on expectations for success for both males and females. Besides, it was reported that there were statistical differences in the attitudes according to the type of school, the frequency in which the subjects understood the mathematics problems solved in the classroom, grade, age, and to the self-perception of mathematical performance (Utsimi & Mendes 2000).

Also, Wigfield and Meece (1988) made a connection between perception of math ability and math anxiety. They identified the cognitive and affective components of math anxiety. They showed that, however math ability perceptions and math anxiety are conceptually distinct constructs, the components of math anxiety related to students' perceptions of math ability, valuing of math, and math performance. According to the results they suggested that students who have low perceptions of their math abilities and do not value mathematics may not report as much math anxiety as students who have low perceptions of their math abilities but think it is important do well in mathematics. These results are in consistent with the results of the study conducted by Meece, Wigfield, and Eccles (1990) who found that math anxiety was most directly related to students' math ability perceptions, performance expectations, and value perceptions.

As Stodolsky, Salk, and Glaessner (1991) indicated that math is one of the liked subjects and is rated most important in the elementary grades. But as the students get older fewer students report liking math and many students find it hard for them. So it should be investigated why this change occurs. Based on the previous studies' results finding positive relationship between attitudes and academic achievement, it should be noted that necessary importance should be given to the perception of academic failure, attitudes towards mathematics and math anxiety. Senemoğlu (1990) suggested that academic self-concept which is a cognitive characteristic, should be shaped positively by making the students come across success as much as possible. Thus students become more self-confident and have more desire to be more successful. Furthermore the documents of the National Council of Teachers of Mathematics (NCTM) (1989) emphasizes the importance of promoting positive attitudes and interest hand-in-hand with the understanding of mathematical concepts.

2.5 Socioeconomic Status

St John stated in 1970 (as cited in White, 1982) that since there is a common belief about that socioeconomic status is strongly correlated with academic achievement, it is not surprising that behavioral scientist frequently use it. Socioeconomic status is generally defined as a person's relative standing in society and is measured by such indicators as income, occupation, education, access to health coverage and community resources, and political power and prestige (Secada, 1992). It is widely believed that the social and economic characteristics of parents have a considerable impact in shaping opportunities for children which provide them discriminatory educational experiences and thus suggesting school achievement (Alwin & Thornton, 1984).

Alwin and Thornton (1984) explored the effects of potential family socioeconomic factors; parental education, paternal occupation, family economic level, maternal employment and family size, on school experiences and achievements at two separate periods; early childhood and during late adolescence with the data of 18-year longitudinal study. The results displayed that conventional indicators of parental socioeconomic status tend to be positively related to these school-achievement variables, while family size is negatively related. Similarly, Bos and Kuiper (1999) reported that home educational background has significant influence on mathematics achievement however, is has no direct link to attitude.

One general and consistent finding of many studies assessing multiple factors of academic achievement is that a student's academic achievement is strongly related to the socioeconomic status of the student's parents (Baker & Stevenson, 1986). Baker and Stevenson (1986) indicated that parents manage the school careers of their children by using resources and experiences of how schooling works, and emphasizing the importance of schooling. They suggested that parents must help their children move skillfully through the organization of schooling, besides they must help them develop cognitively. In the light of these, they explored the relationship between socioeconomic status and academic achievement by considering specific actions parents can and do take to manage their child's school career by interviewing 41 mothers. The results of the study showed that mothers with more education have knowledge of their child's schooling. For example, they are more likely to be able to name their child's teachers, identify their child's best and worst subjects, and evaluate their child's performance and they are more likely to have seen their child's last report card. Also these mothers are more likely to meet their child's teachers and to attend parent-teacher conferences and school events. The findings of this study make clear the understanding of how parents' socioeconomic status affects the academic achievement of the child. For example, high-educated mothers tend to have two important resources (1) they know more about their child's school performance, and (2) they have more social contact with school personnel. Thus, if a problem exists they are more likely to know the problem and to use the school resources to solve the problem. Furthermore, more educated parents, who are unable to afford private school tuition may still effectively insist their children to assigned to gifted programs, college preparatory courses, or classes of particularly good teachers in public schools while, children of low educated parents are likely to have limited access to quality educational services.

In consistent with the previous researches, Kelecioğlu (1993) reported that there were differences between two different schools with different socioeconomic levels in achieving both desired objectives and behaviors in the subject of natural numbers in favor of the school with higher socioeconomic level.

Also she observed a decrease in understanding difficulty of what students read and the opportunities provided outside the school from high-level socioeconomic school to low-level of socioeconomic schools. Similarly, Köse (1990) indicated that family socioeconomic status measured by father's occupational prestige determines a big proportion of the educational success of 1354 third grade high schools students in Ankara.

Up to now, a sizeable body of studies have shown that the relationship between SES and student academic achievement at individual level is around .30 even though it is commonly believed that socioeconomic status is strongly related with academic achievement. To identify this contradiction White (1982) examined almost 200 studies that considered the relation between socioeconomic status and academic achievement. Results showed that socioeconomic status is typically defined as income, education, or occupation of parents and generally individuals are used as the unit of analysis. White (1982) also indicated, the reason that studies reported different strengths of the relationships is using different indicators of the variable of socioeconomic status. Moreover the reason of the variability in the correlation coefficients is using different unit of analysis in computing the coefficients. Similarly, Warner et al. (1949) (as cited in Yang, 2003) and Hollingshead and Redlich (1958) (as cited in Yang, 2003) criticized the way socioeconomic status is measured. Conventionally, socioeconomic status is measured by using a mixed of education levels and occupation of parents, and family income. However, socioeconomic status has not a uni-dimensional but a multi-dimensional construct with different aspects such as; economic level, education and learning environment, cultural and educative resources of home.

2.6 Out-of-school Activities

It is certainly known that many factors influence the development and socialization of students including family, peers, schools, and the media. Though family and peers influence the development of the students, the opportunities and context suggested by schools also have impact on the development of students such as extracurricular activities. Positive associations between after-school activities and achievement have been observed. Students involved in extracurricular activities such as sports also tend to have positive attitudes and self-concept and higher achievement than do students not participated in these activities (Holland & Andre, 1987). Marsh (1992) examined the effects of extracurricular activity participation during the last years of high school using the large, nationally representative High School and Beyond data. It was found that extracurricular activity participation had small but statistically significant and positive relations with social and academic self-concept, academic achievement, and so on when the background variables were controlled such as socioeconomic status and initial ability level. Based on the findings of this study, Marsh (1992) concluded that participating extracurricular activities such as sports enhances academic self-concept and that improved academic self-concept mediates positive effects other educationally relevant outcomes. So, it can be interpreted that participation in extracurricular activities inferentially leads to increased commitment to school and school values, which leads indirectly to increased academic achievement. Similarly, Atalay and Emirler (1992) pointed that leisure activities given in the spare time of the students in the school not only improve the relationship between teacher and student positively, but also, contributed the improvements in mental, physical, and emotional aspects of the students. In contrast, Bos and Kuiper (1999) reported a negative relationship between out-of-school activities and mathematics achievement.

Similarly, Bergin (1992) investigated the mutual relationship between high school students' school achievement and their leisure time activities. The reasons for the relation between leisure activities and school achievement can be proposed as; (1) the content of the leisure activities, (2) benefits can be obtained such as generalizing habits of discipline, self-regulation, and problem solving, and (3) experience gained during the leisure activity may be relevant to school. Subjects in the study were 159 students at grades 9 through 12. Leisure activities were measured by asking student how much time per week they spent in each 43 leisure activities such as, sports, music, drama, writing, computer programming and so on. According to the results, the most common intense leisure activities were found sports, learning about current events, reading and computer use. Bergin found that leisure activities are related to academic achievement modestly and suggested that what teenagers do during activities should be examined closely.

Henggeler et al. (1991) evaluated association of family contextual nature between children's television viewing and as well as their academic achievement. Participants were 25 third-grade children from an elementary school and their parent. Academic achievement was found to be negatively correlated with television viewing, and this association was independent of the child's verbal ability. Also Henggeler and his colleagues suggested that high rates of television viewing may be linked with problematic family contexts. Keith, Reimers, Fehrman, Pottebaum, and Aubey (1986) observed a small but negative relationship between the amount of television watched and achievement. They evaluated the television viewing as a activity that displays academic activities and reduces the amount of time available for completing homework and other types of academic activities, thus reducing achievement.

2.7 Instructional Activities and Classroom Climate

The classroom can be defined as the nucleus where other influences on the learning of students and outcomes from their education are found. These influences can be relationships with peers, peer groups in general, teachers and textbooks. Actually, all the contributing factors or variables to educational outcomes exists in classroom (Webster & Fisher, 2000).

Since the instruction begins formally in the classrooms, the instructional activities used in the classrooms are the most important ones. In the classrooms teachers show their experiences using different and effective methods, motivate students, prepare suitable conditions for the teaching and the learning, and try to transmit all his or her knowledge to students. National Council of Teachers of Mathematics (NCTM) (2000) offered principles reflecting basic precepts that are fundamental to a high quality mathematics education. These principles guide educators in making decisions about teaching and learning and in creating a classroom environment conducive to learning. Three of six principles for school mathematics are:

1. Equity: Excellence in mathematics education requires equity-high expectations and strong support for all students.
2. Teaching: Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.
3. Learning: Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

It is important that teachers consider these principles when planning mathematics instruction and designing mathematics learning environment.

One report, "Mathematics Achievement and Classroom Instructional Activities: National Assessment of Educational Progress (NAEP). 1985-86," (as cited in Lewis, 1991) drew relationships based on the data from the last NAEP assessment of mathematics with K-12 students, between instructional activities and math achievement, pointing out that:

1. Daily exposure to traditional instruction, such as working math problems alone, doing math homework, or working from a textbook, is associated with higher achievement.
2. Such exposure is more helpful to earning how to compute and math terms than it is to problem solving or forming concepts.
3. Computer use enhances math courses, particularly for eleventh-graders.

Duruhan, Akdağ, and Güven (1990) indicated that most students expected that mathematics teachers should encourage student participation and consider the differences in success level of students during student participation. Additionally, Pehlivan (1995) listed some teacher's behaviors those contribute to displaying their roles in structuring the instructional activities, performing these activities, and obtaining fruitful outcomes. She mentioned about the studies that focused on the factors affecting instruction such as, student participation, feedback-correction, giving clue and the teachers' competencies in using these factors.

Bos and Kuiper (1999) reported that although the factors class climate and instructional formats (co-operative learning) were supposed to have direct influence on mathematics achievement, they did not show significant path coefficient in the most of the models of European countries. Also, Bos and Kuiper (1999) defined the variable teaching style as reflecting more student oriented and more teacher oriented teaching. The results showed that the dominating teaching style (student or teacher) has no influence in most of the European countries. Furthermore, students' attitude towards mathematics is linked to class climate significantly in six systems.

The results of the study conducted by House (2001) identified a number of instructional activities that were significantly related to the mathematics achievement of students in Japan. When teaching new mathematics topics, for instance, students whose teachers more frequently explained rules and definitions tended to show higher mathematics achievement test scores. Similarly, students who reported that their teachers more frequently solved an example related to the new topic also showed higher mathematics test scores. Considering instructional activities used in typical mathematics lessons, students who more often used things from everyday life to solve mathematics problems showed higher test scores. However, more frequent use of collaborate learning activities such as working together in pairs or small groups when learning new topics and working together in pairs or small groups in mathematics lessons, was associated with lower mathematics test scores.

2.8 Importance Given to Mathematics

Showing high performance at school is highly valued among parents, peers and generally in society. Hereby unfavorable impact of academic failure is not easily minimized (Valas, 2001).

Bos and Kuiper (1999) defined maternal and friends' expectations as reflecting the perception of student of the extent to which his/her mother and friends thought it is important for him/her to do well at school in mathematics, science, and his/her mother tongue. In most of European countries maternal and friends' expectations have a positive link to attitude. Additionally, the factor friends' and mother expectations of achievement influenced attitude in nine countries out of ten.

Papanastasiou (2000) described the factor of reinforcement as measuring whether the students' mother, friends, and the student him- or herself think that placement in a class with high-achieving students is important. He reported that there is a positive significant relationship between this variable and attitudes towards mathematics in the model of Cyprus, while this relationship is significantly related negative in the model of US and Japan. Also, the results showed that the path from reinforcement to beliefs regarding success in mathematics included on the need for natural ability/talent, hard work, studying at home and memorization of textbooks and notes is positively significant in all of the three models.

In the first international mathematics study (FIMS) of IEA's, Robitaille and Travers (1992) interpreted one of the majors findings as surprising that senior students tended to rate the importance of the role of mathematics in contemporary society less highly than did the 13-year olds, especially in English-speaking countries. They suggested an explanation for this unexpected result such as, senior students were indicating that they did not see very much in the way of applications of the mathematics they were studying in school to everyday life. Furthermore, in Second International Mathematics Study (SIMS), most students indicated that they believe that mathematics, and that a good knowledge of mathematics will be important to them in their careers. They also indicated that their parents share these opinions, and their parents encourage them to do well in mathematics

2.9 Background Information of Countries

Some background information on the educational systems in Turkey, The Netherlands, and Italy may be helpful for providing a context for the study.

2.9.1 Turkey

Since 1997 (following the new system which replaced the former system of five years of primary school, followed by three years of middle school/junior high school/lower secondary school education), secondary education follows eight years of primary education and covers general, vocational and technical high schools that provide three years of education and four in the case of technical high schools. General high schools do not prepare students for a specific profession but rather for higher education. The following institutions are considered to fall within general secondary education: high schools; high schools with intensive foreign language teaching; Anatolian high schools where a foreign language - English, French or German - is taught during the preparatory year and the teaching of certain subjects is provided in that language in upper grades; science high schools; teacher training high schools; Anatolian fine arts schools; multi-curricula high schools; evening high schools; and private high schools. In general high schools, the average number of weekly periods of teaching in each grade varies from a minimum of 33 to a maximum of 41. In their second year, students in high schools where the general program is applied may choose to attend branches which specialize in the natural sciences, literature and mathematics, the social sciences, foreign languages, art or physical education. Vocational high schools provide three-year secondary education, train qualified people for various professions and also prepare students for higher education. Technical high schools offer a four-year program. Subjects offered in the first year are the same as in the vocational high schools. Secondary education students obtain the Lise Diploması that is the prerequisite for entry to higher education. Admission to university is centralized and based on the Student Selection Examination (ÖSS) (EuroEducation, n.d.).

2.9.2 The Netherlands

A distinctive feature of the Dutch education system is that it combines a centralized education policy with the decentralized administration and management of schools. Central government controls education by means of legislation and regulations with due regard for the provisions of the Constitution. Control is exercised in this way over both publicly and privately run institutions All schools, both public and private, are governed by a legally recognized competent authority (school board). The competent authority is the body responsible for implementing legislation and regulations in schools. One of the key features of the Dutch education system, guaranteed under article 23 of the Constitution, is freedom of education, i.e. the freedom to found schools (freedom of establishment), to organize the teaching in schools (freedom of organization of teaching) and to determine the principles on which they are based (freedom of conviction). Every child must attend school full time from the first school day of the month following its fifth birthday; in fact, however, nearly all children attend school from the age of four. Children must attend school full time for 12 full school years and, in any event, until the end of the school year in which they turn16 (Eurobase, n.d.).

In the Netherlands, secondary education provides to students aged 12 to 17-18 years old. As Kuiper and Knuver stated in 1997 (as cited in Kuiper, Bos, & Plomp, 1999) students may follow one of four main ability tracks:

- Junior secondary vocational or prevocational education, known as VBO. This is 4-year program, specialising in technical, home economics, commercial, trade or agricultural studies.
- Junior general secondary education, known as MAVO, a 4-year long program.
- Senior general secondary education, known as HAVO. This is a 5-year program, preparing students for higher vocational education.

Pre-university education, known as VWO. It is a 6-year course, preparing students for university and higher vocational education.

2.9.3 Italy

Overall responsibility lies with the Ministry of Education, University and Research (Ministero dell'Istruzione, dell'Università e della Ricerca – MIUR). The Ministry of Education, University and Research is represented at local level by regional and provincial education offices. Regions may delegate certain responsibilities to the provinces and municipalities. From school year 2000/2001, all the schools have autonomy in the fields of administration, organisation, pedagogy, research, experimentation, and development (Eurydice, 2003, February).

Daycare centres or crèches are available for children up to the age of 3. From then on, children can attend nursery school, which is the first stage of the schooling system. Nursery schools are free of charge. Children should be aged 6 to attend primary school. Students must have the primary school leaving certificate to be admitted to *scuola media*. Children normally attend the nearest school within the school catchment area. Compulsory education is free of charge. The school year comprises at least 200 days between the beginning of September and the end of June. Schools open five or six days, full or half days, depending on the institution. Primary and secondary schools offer up to 30 hours of teaching a week. The length of lessons varies. At primary and secondary level there is a maximum of 25 students per class. Students are grouped by age in mixed ability classes. In primary school, team teaching is the norm. At primary level, there is usually more than one teacher in each class. At secondary level, students have separate subject teachers. The general curriculum is nationally determined and adapted to local needs by each school. Curricular content, targets, teaching methods and possible links between the various subject areas are determined for each subject. At primary level, the core curriculum comprises Italian, a foreign language, mathematics, sciences, humanities, social studies, art, music and physical education. Religious education is an optional subject. At lower secondary level, technical education is added. Teachers select teaching methods, textbooks and materials (Eurydice, 2003, February).

2.10 The Summary of the Literature Review

1. After the results of TIMSS 1995 and TIMSS 1999 released many secondary analyses, comparing the countries especially the high- versus low-performing countries by various statistical methods (Papanastasiou,

2000; Bos & Kuiper, 1999; Lokan & Greenwood, 2000; Köller, Baumert, Clausen, & Hosenfeld, 1999; Yang, 2003; Webster & Fisher, 2000; Schiller, Khmelkov, & Wang, 2002; Schreiber, 2002; Papanastasiou, 2002; Shen, 2002; Shen & Pedulla, 2000; House, 2001).

2. Students' academic achievements are usually affected by many important sources. These sources were systematized by many theorists and researchers by modeling techniques (Schreiber, 2002). Especially many studies proposing theoretical models have been conducted to explain mathematics achievement and its relationships between psychological, pedagogical, social, and cognitive constructs (Abu-Hilal, 2000; Ethington, 1991; Meece, Wigfield, & Eccles, 1990; Demir-Gülşen, 1998; Tağ, 2000)
3. Students usually associate relationships between the easiness and success; difficulty and failure; success/failure and being good at mathematics; perception of math ability and math anxiety (Stodolsky, Salk, & Glassner 1991; Gipps & Tunstall 1998; Wigfield & Meece 1988; Meece, Wigfield, & Eccles, 1990).
4. It was found in many studies that attitudes and beliefs influence positively the mathematics achievement (McLeod, 1992; Utsimi & Mendes, 2000; Bos & Kuiper 1999; Webster & Fisher 2000; Stodolsky, Salk, & Glaessner 1991; Lokan and Greenwood 2000).
5. Parental socioeconomic status, home educational background have significant influence on academic achievement (Alwin & Thornton 1984; Bos and Kuiper (1999; Baker & Stevenson, 1986).
6. Extracurricular activities such as sports develop positive attitudes and self-concept and high achievement (Holland & Andre, 1987; Marsh, 1992). However, television viewing and out-of-school activities are found to be negatively related with academic achievement (Bos & Kuiper, 1999; Henggeler et al., 1991; Keith, et al., 1986).
7. The classroom and instructional activities are the most important ones for the learning of students and the outcomes for education (Webster & Fisher, 2000; NCTM, 2000). However, class climate, instructional formats

(co-operative learning), and teaching style (student or teacher) do not have influence on mathematics (Bos and Kuiper, 1999; House; 2000).

8. Showing high performance at school is highly valued among parents, peers and maternal and friends expectations have a positive link to attitude (Valas, 2001; Bos & Kuiper, 1999; Papanastasiou 2000).

The literature review shows that up to now many studies conducted developing models explaining mathematics achievement with various aspects. Moreover many studies comparing different countries' performances were carried out with data of international studies, especially TIMSS. However, in Turkey there is no study comparing the performances of Turkish students with performances of other students participating from other nations, inferentially. Thus study will be a first step for cross-cultural studies including Turkey data and also a replication study of other cross-cultural studies providing evidence to make generalizations.

CHAPTER 3

METHODOLOGY

3.1 Population and Sample

As it was mentioned before the target population for all countries was "All students enrolled in the upper of the two adjacent grades that contain the largest proportion of 13-year-olds at the time of testing" (Martin, Gregory & Stemler, 2000 p. 30). According to this information, names for grade tested were "8" in Turkey, "Secondary 2" in the Netherlands, and "3rd Grade Middle School" in Italy (Gonzales & Miles, 2001). With this explanation of the target population the basic sample design for TIMSS 1999 was referred to as a two-stage stratified cluster sample design. The first stage consisted of a sample of schools, which may be stratified; the second consisted of a single classroom selected randomly from the target grade in sampled schools. In order to have an effective sample for international comparisons, the TIMSS required each country to sample at least 150 schools per target population. The numbers of sampled schools and students were; 204 schools and 7841 students for Turkey, 150 schools and 2962 for the Netherlands, and 180 schools and 3328 for Italy. The schools were government or state schools. Also Turkey selected the 8 th grade for the state schools and the 7 th grade for the Anatolian high schools from 40 cities (Martin, Gregory & Stemler, 2001).

The average ages of students tested were 14.2 for Turkey and the Netherlands, and 14.0 for Italy (Gonzales & Miles, 2001). The subset of students used in this study was selected from among TIMSS 1999 sampled students, only those who had completed the entire students' questionnaire and participated in the mathematics test. So the listwise deletion of the students from the data set led to a final sample less than that of TIMSS 1999. In Table 3.1 average age, the percentages of female and male students, and final sample for each country after listwise deletion is given. Also in Turkey 1.5% of the students were from Anatolian high schools and the others were from state schools.

Table 3.1 Average Age and Percentages of Female and Male Students

	Average Age	Female	Male	Final Sample
Turkey	14.2	44.2%	55.8%	4772
Netherlands	14.2	51.6%	48.4%	2728
Italy	13.9	52.0%	48.0%	2781

3.2 Instruments

In this study data of TIMSS 1999 Student Questionnaire and TIMSS 1999 Mathematics Achievement Test were used.

3.2.1 Student Questionnaire

In TIMSS 1999, each student in the sampled class was asked to complete a student questionnaire. This questionnaire sought information about the student's home background, attitudes and beliefs about mathematics and science, and experiences in mathematics and science classes (Gonzales & Miles, 2001). The international version of the student questionnaire was obtained from the Internet (IEA, n.d.). From the student questionnaire 37 items were selected according literature review and percentages of missing data to conduct factor analyses. Also, while selecting the items from the student questionnaire it was considered that the most of the selected items should be possibly manipulated. It means that if these variables are found that they influence mathematics achievement strongly, improvement in educational area can be made easily by manipulating these variables. The selected items are given below as in the order of the student questionnaire:

1. On a normal school day, how much time do you spend before or after school doing each of these things?

   1a. watching television and videos

   1b. playing computer games

   1c. playing or talking with friends outside of school

   1d. doing jobs at home

   1e. playing sports

   1f. reading a book for enjoyment

The items 1a, 1b, 1c, 1d, 1e, and 1f were scaled on a five-point likert type scale: No time, Less than 1 hour, 1-2 hours, 3-5 hours, and More than 5 hours. The items were scored 1 if the student spends no time and 5 if the student spends more than 5 hours.

2. How far in school did your mother and father go?

   2a. mother

   2b. father

The items 2a and 2b were scaled on a eight-point likert type scale: some primary school, or not go to the school, finished primary school, some secondary school, finished secondary school, some vocational/technical education after secondary school, some university, finished university, and I don’t know. Each item was scored 1 point if the student’s mother/father did not go to school and 8 if the student does not know. But before the analyses were conducted the scale “I don’t know” which was scored 8 point recoded as system missing.

3a. About how many books are there in your home?

The item 3a were scaled on a four-point likert type scale: none or very few (0-10 books), enough to fill one shelf (11-25 books), enough to fill one bookcase (26-100 books), enough to fill three or more bookcase (more than 200). The item was scored 1 point if the student has no/few books and 4 if the student has more than 200 books in his/her home.

4a. My mother thinks it is important for me to do well in mathematics at school.
4b. Most of my friends think it is important to do well in mathematics at school.
4c. I think it is important to do well in mathematics at school.
5a. In my mathematics class students often neglect their school work.
5b. In my mathematics class students are orderly and quiet during lessons.
5c. In my mathematics class students do exactly as the teacher says.
6a. I would like to mathematics much more if it were not so difficult.
6b. Although I do my best, mathematics is more difficult for me than for many of my classmates.
6c. Nobody can be good in every subject, and I am just not talented in mathematics.
6d. Sometimes, when I do not understand a new topic in mathematics initially, I know that I will never really understand it.
6e. Mathematics is not one of my strengths.
7a I usually do well in mathematics.
7b. I enjoy learning mathematics.
7c. Mathematics is boring.
7d. Mathematics is an easy subject.
7e. Mathematics is important to everyone’s life.
7f. I would like a job that involved using mathematics.

The items 4a-c, 5a-c, 6a-e, and 7a-f were scaled on a four-point likert type scale: strongly agree, agree, disagree, and strongly disagree. Each item was scored

1 point if the student strongly agrees and 4 if the student strongly disagrees. But before the analyses conducted the items were reversed.

8a. The teacher shows us how to do mathematics problems.
8b. We copy notes from the board.
8c. We work on mathematics projects.
8d. We work from worksheets or textbooks on our own.
8e. We work together in pairs or small groups.
8f. We check each other's homework
9a. When we begin a new topic in mathematics, we begin by having the teacher explain the rules and definitions.
9b. When we begin a new topic in mathematics, we begin by discussing a practical or story problem related to everyday life.
9c. When we begin a new topic in mathematics, we begin by working together in pairs or small groups on a problem or projects.
9d. When we begin a new topic in mathematics, we begin by having the teacher ask what we know related to the new topic.
9e. When we begin a new topic in mathematics, we begin by looking at the textbook while the teacher talks about it.

The item 8a-f and 19a-e were scaled on a four-point likert type scale: almost always, pretty often, once in a while, and never. Each item was scored 1 point if the student responds "almost always" and 4 if the student responds "never". But before the analyses conducted the items were reversed.

3.2.2 Grouping of Student Questionnaire Items

After factor analyses were conducted for each country with selected items from student questionnaire, items with higher loadings were clustered to form the latent variables that would be included in the model testing, based on the factor analysis results of Turkey data, as it will be explained in detail in the results section.

Postlethwaite and Wiley (1992) stated (cited in Bos & Kuiper, 1999) that it is important that clustering the items should reflect meaningful homogeneity within clusters both conceptually and empirically. Conceptually means the latent variable must make sense, that is has a meaning in literature; empirically means the latent variable must have meaningful loadings on one factor in principle component analysis and a correlation higher than .10 (absolute value) with the criterion variable. Since, items with highest loadings were clustered together and the names of the clustered items were very similar to the names used in the literature, latent variables used in this study reflect meaningful homogeneity both conceptually and empirically.

3.2.3 Mathematics Achievement Test

The TIMSS curriculum framework contains three dimensions or aspects. They are content, performance expectations, and perspective aspects. The content aspect represents the subject matter content of school mathematics; the performance expectations aspect explains the many kinds of performance or behavior that might be expected of students in school mathematics, but not in a hierarchical way; and the perspectives aspect focuses on the development of students' attitudes, interests, and motivation in the subjects. The five content areas included in the TIMSS 1999 mathematics test are fractions and number sense; measurement; data representation, analysis and probability; geometry; and algebra. The performance expectations described for mathematics test are knowing, using routine procedures, investigating and problem solving, mathematical reasoning, and communicating. The perspectives determined for mathematics test are attitudes, careers, participation, increasing, and habits of mind (Gonzales & Miles, 2001).

There are three types of items in TIMSS 1999 Mathematics achievement test. Most of the items are in multiple-choice format. The short-answer questions required students to write short answers while the extended response items required students to show their work or to provide explanations for their answers. One point was given to correct answers for most of the questions. But the extended response questions were evaluated for partial credit, with fully correct answer worth two points. The Table 3.2 shows the number of items by item type and content with the associated maximum number of score points (Gonzales & Miles, 2001).

Table 3.2. Number of TIMSS 1999 Mathematics Test Items and Score Points by Type and Content

	Item type				
Content	Multiple-Choice	Short-answer	Extended-response	Number of items	Score points
Fractions and number sense	47	11	3	61	62
Measurement	15	4	5	24	26
Data representation, analysis and probability	19	1	1	21	22
Geometry	20	1	--	21	21
Algebra	24	4	7	35	38
Total	125	21	16	162	169

TIMSS 1999 developed two-digit coded rubrics specific to each item. The first digit illustrated the correctness level of the response. The second digit, combined with the first, illustrated a diagnostic code identifying specific types of approaches, strategies, or common errors and misconceptions. To provide the scoring reliability, a random sample of about 200 of each booklet type was selected for each country. These booklets were independently scored by two scorers (Gonzales & Miles). A high percentage of exact agreement was observed for each of the countries. The TIMSS data from the reliability studies indicated that scoring procedures were robust for mathematics items (Mullis et al., 2000).

The Table 3.3 displays the average correctness and diagnostic score agreement with the range of exact percent agreement for each country.

Table 3.3. TIMSS 1999 Within-Country Free-Response Scoring Reliability Data for Mathematics Items

Countries	Correctness score agreement			Diagnostic score agreement		
	Average of exact percent agreement across items	Range of exact percent agreement		Average of exact percent agreement across items	Range of exact percent agreement	
		Min	Max		Min	Max
Turkey	100	97	100	99	97	100
Netherlands	99	85	100	94	79	100
Italy	99	95	100	97	89	100

The TIMSS 1999 instruments were prepared in English and translated into 33 languages. Since it was very important, explicit guidelines for translation and cultural adaptation were developed. Consultation of two or more independent translators was provided with high control of national centers. The languages of testing were Turkish, Dutch, and Italian in Turkey, the Netherlands, and Italy, respectively. However, less than 1% of the population took the assessment and student questionnaire in German in Italy (Gonzales & Miles).

In TIMSS 1999 assessment not all of the students responded to all of the mathematics items. So TIMSS ensured broad subject matter coverage of the mathematics area while keeping the response burden on individual students to a minimum. TIMSS achievement data was based primarily on item response theory (IRT) scaling methods. A three-parameter model was used with multiple-choice items and two-parameter model was used for free response items. The TIMSS IRT scaling used the multiple imputation or “plausible values” method to obtain proficiency scores in mathematics and their content areas for all students, although each student responded to only some of the all items. Because of the error involved in the imputation process, TIMSS generated not one but five plausible values for each student for each of the content area in mathematics as well as for overall scores in mathematics. Also, it was suggested to use at least two plausible values in the secondary analyses (Gonzales & Miles). So in this study, all of the five overall mathematics plausible values were used as observed variables to represent the mathematics achievement latent variable. Since the high standards for quality of the TIMSS 1999 design it was assumed that test instrument were highly valid and reliable.

3.2.4 Validity and Reliability

After the items were selected, factor analyses were conducted to determine factors that would be included in the model as latent variables. As the results of factor analyses will be explained in detail in the results chapter, the latent variables were composed of the items that had high loadings in the factor analysis. Also the items selected to compose latent variables and the naming the latent variables were very similar with the previous researches (Bos & Kuiper, 1999; Papanastasiou, 2000). Conducting factor analysis provides us evidence for construct-related validity. By this way, construct validity was provided by the factor analysis. After the latent variables were composed the internal-consistency estimates of reliability were checked for each latent variables and for each country separately. The observed and latent variables, and alpha reliability coefficients are given in Table 3.4.

Table 3.4. The Observed and Latent Variables, and Reliabilities of the Latent Variables

Observed variables	Latent variables	Alpha reliability coefficients		
		Turkey	Netherlands	Italy
Watch tv or videos Play with friends Playing sports	OUTOFSCH	.45	.39	.31
Education level – mother Education level – father # of books in student’s home	SES	66	.66	.69

Table 3.4 (Continued)

Mother importance – do well in math Friend importance – do well in math Self importance – do well in math	IMPT	.71	.68	.63
Students neglect school work in class Students orderly and quiet in class Students do exactly as told in class	CLIMATE	.54	.69	.66
Like more if not so difficult More difficult for me than for others I am just not talented I will never really understand it Not one of my strengths	PERFAIL	.81	.83	.83
Teacher shows how to do problems Copy notes from the board New topic – teacher explains	TEACACT	.48	.56	.35
Work on projects Work in pairs or small groups New topic – discuss practical problem New topic – work in small groups New topic – ask what students know	STUACT	.66	.54	66

The procedure of naming the latent variables was carried out based on literature review. There are different alternatives for naming the observed variables included in the latent variable of perception of academic perception. This variable can be defined as self-concept of ability. It is a cognitive representation of students' perceptions of their own competencies and can initiate and influence motivational processes (Marsh, 1986).

Since the reliabilities were somehow low ($r < .50$) for the measures of OUTOFSCH for all of the countries and TEACACT for Turkey and Italy, results referring to these variables must be interpreted carefully. The mathematics test reliability coefficients were .86, .89, and .89 for Turkey, the Netherlands, and Italy, respectively. This coefficient is the median KR-20 reliability across the eight test booklets (Martin, Gregory & Stemler). The values of the reliability coefficients were quite high.

3.3 Procedures

In the fall semester of 2001 extensive and detailed information was obtained about international reports, participants, population and sampling design, test instruments, data collection procedures, scaling methodology and achievement scores, and database files of TIMSS 1999 by the help of the publications and supporting documentation (Mullis et al., 2000; Martin, Gregory & Stemler, 2000; Gonzales & Miles, 2001). Then a limited computer search was conducted (Educational Resources Information Center [ERIC]) about related studies used TIMSS 1999 data. Then several books were searched in METU library to have information about structural equation modeling.

In September 2002 many factor analyses was conducted with the student questionnaire items to investigate the constructs of the questionnaire. Then with the help of the related literature and results of the descriptive statistics, items were determined that would be included in the factors analyses. The other two European countries whose results would be modeled were selected according to the location in the increasing order of the mathematics achievement, one from top; the Netherlands, and one from middle; Italy. After the problems and related keywords were determined a detailed computer searched was conducted for literature review. In February and March 2003 actual models were tested and necessary modifications were done for each of the country.

Also, it should be mentioned that a field test was conducted by TIMSS 1999 to meet the goals of the instrument development and to improve survey operations. Out of 38 countries, 31 countries participated in this field test. Turkey didn’t participated in this field test. By the help of results and experience obtained in the field test, the TIMSS participants were able to proceed with confidence into the main-survey data collection (Martin, Gregory & Stemler, 2000).

3.4 Data Collection

The testing was conducted in May 1999 in Turkey, from February to July 1999 in the Netherlands, and from April to May 1999 in Italy. Testing was conducted mostly by the teachers of the selected classes or different teachers from the selected schools. Each country participating in TIMSS 1999 was responsible for collecting its national data using standardized procedures developed for the study. Training manuals were generated for School Coordinators and Test Administrators that explained procedures for receipt and distribution of testing materials besides the activities related to the testing. These manuals included procedures for test security, standardized scripts to regulate directions and timing, rules for answering students' questions, and steps to provide that the identification on the test booklet and questionnaires corresponded to the information on the forms used to track students. In each country, a national research center and National Research Coordinators (NRC) were authorized to implement these activities. Also, the International Study Center implemented an international quality control program. In this program international quality monitors visited a sample of 15 schools in each country and observed the test administration (Gonzales & Miles, 2001).

The data collected in the TIMSS 1999 testing administration were entered into data files with the same format across all countries at the national research centers of the countries. Again TIMSS prepared manuals and software for countries to use entering their data. Then these data files were submitted to the IEA Data Processing Center for cleaning and verification (Gonzales & Miles, 2001).

Necessary data files used in this study were downloaded from the TIMSS International Database (IEA, n.d.). SPSS system files were created by using control files. All information related to the structure of the data files was obtained from codebook files and "User Guide for the TIMSS 1999 International Database" (Gonzales & Miles, 2001).

3.5 Data Analyses

After all variables in the TIMSS 1999 student questionnaire data files were investigated, unnecessary variables were deleted.

3.5.1 Missing Data Analysis

One of the criterions consulted during defining the items that would be analyzed was the missing percentages of the questionnaire items. All of the three countries' students' questionnaire items were analyzed to identify the missing data percentages. This criterion was 10% however Turkey data had four exceptions with values; highest education level of father 10.3%, doing jobs at home 11.7%, playing sports 10.2%, and play computer games 19.25%. Nevertheless, most of the other values were under 10% ranging from 1.5% to 9.6% in Turkey's students questionnaire. For the Netherlands the values ranged from 2.7% to 5.0%. Since the missing data percentages for the items "highest education level of mother" and "highest education level of father" were 35.4% and 36.6% respectively, these items were not included in the achievement model of the Netherlands. For Italy these values ranged from 0.2% to 7.7%. While conducting factor analyses, pairwise deletion method and while estimating models listwise deletion method were used for handling missing data. The final samples were given in section 3.1. Also, the final models of each country were tested with pairwise deletion method to observe the differences. The results were very similar to the models estimated with listwise deletion method. In addition the missing values imputed by PRELIS 2.30 for Windows (SSI Inc., 1999a) and again each model was tested without having no missing values. Again the results were very similar to the actual models tested with listwise method except one path was nonsignificant differently from the Netherlands's model.

3.5.2. Effect Size

An effect size measure is an indicator of the association that exists between two or more variables (Denis, 2003) and the effect size can be defined as the magnitude of an independent variable's effect, usually expressed as a proportion of explained variance in the dependent variables (Weinfurt, 1995).

The measure of effect size used in multiple regression is roughly equivalent to the squared multiple correlation (R^2). Cohen's (1977) (as cited in Weinfurt, 1995) classification of effect sizes has become somewhat of a standard in social research. As Weinfurt (1995) stated Cohen suggested a proper standard classification scheme for effect sizes measured through R^2. This classification scheme suggests that 0.01 is small, 0.09 is medium and 0.25 or greater is large for the magnitude of R^2. Also, the social researches generally produce small to medium effect sizes (Weinfurt, 1995). Because of the relationship between structural equation modeling and multiple regression (Schumacher, & Lomax), measures of squared multiple correlation were used as the index of effect size for each country's endogenous variables in this study

3.5.3 Structural Equation Modeling and Goodness-of-Fit Criteria

After the data was examined, varimax rotated principle components factor analyses were run for each country's data by using SPSS 11.0 for Windows in order to explore the factor structures of the questionnaires. According to the results of the Turkey factor analysis, latent variables were generated by selecting highly loaded observed variables. The final data files including items that would be included in the model were imported from SPSS 11.0 for Windows to PRELIS 2.30 for Windows (SSI Inc., 1999a). Later on, data screening was run in order to output the distributions of the variables in these files and check their normality.

Finally, LISREL 8.30 for Windows (SSI Inc., 1999b) with SIMPLIS command language was used for formulating and estimating LISREL models of the factors affecting mathematics achievement of the eighth grade students participated in TIMSS 1999 in Turkey, the Netherlands, and Italy. The structural equation modeling is an approach to develop measurement models in order to define latent variables and to establish relationships or structural equations among the latent variables (Schumacker & Lomax, 1996). There are five steps of structural equation modeling (Bollen & Long, 1993)

1. Model specification: It was ascribed as formulating the initial theoretical model. This model should be hypothesized on the basis of a literature review. In this study the theoretical model was based on the models that were previously created by using TIMSS 1995 or 1999 data for other countries.

2. Identification: It refers to inquiring whether single values can be found for the parameters to be estimated in the theoretical model. All the observed variables were constrained to load on only one latent variable. The model identification level was just-identified (Schumacher & Lomax, 1996).
3. Estimation: It requires the knowledge of the various estimation techniques that are used depending on the variable scale and/or distributional property of the variable(s) used in the model. Several estimations are currently available such as maximum likelihood (ML), generalized least squares (GLS), and unweighted or ordinary least squares (ULS or OLS). ML estimation methods have desirable asymptotic properties (i.e., large sample properties), such as minimum variance and unbiasedness (Schumacher & Lomax, 1996). ML estimation is the default method in many model-fitting programs. Non of the other estimation options are as widely used as ML estimation. ML estimation works just fine for most types of structural equation models so long as the data have been properly screened and their distributions are reasonably normal (Kline, 1998). So, since the data was appropriate, ML estimation method was used in this study.
4. Testing fit: It involves interpreting model fit or comparing fit indices for alternative or nested models. A number of other goodness-of-fit criteria (GOF) have been proposed and studied in the literature (Jöreskog & Sörbom, 1993). The commonly used criteria are summarized as in the following;

   Chi-Square (χ^2): A significant χ^2 value relative to the degrees of freedom points that the observed and estimated matrices differ. A non significant χ^2 value points that the two matrices are not statistically different. It is interested in obtaining a nonsignificant χ^2 value with associated degrees of freedom. The chi-square is sensitive to sample size, because as sample size increases, the χ^2 test has a tendency to indicate a significant probability level (Schumacher & Lomax, 1996; Kline, 1998). Since the samples used in this study are large, chi-square is not considered as a fit criterion for this study. Also it should be noted that, all of the other GOF criteria are functions of chi-square (Jöreskog & Sörbom, 1993).

Goodness-of-Fit (GOF) Index: Allowing the scale the GFI is based on a ratio of the sum of the squared differences between the observed and reproduced matrices to the observed variances (Schumacher & Lomax, 1996). Values served covariances explained by the model such as the Jöreskog-Sörbom GFI should be greater than .90 (Kline, 1998).

Adjusted Goodness-of-Fit (AGFI) Index: The AGFI adjusts the GFI index for the degrees of freedom of a model relative to the number of variables (Schumacher & Lomax, 1996). The goodness-of fit indices GFI and AGFI of Jöreskog & Sörbom (1989) (cited in Jöreskog & Sörbom, 1993) do not depend on sample size explicitly and measure how much better the model fits as compared to no model at all. Same with GFI index AGFI index is interpreted as value adjusted for degrees of freedom, with .90 a good model fit (Schumacher & Lomax, 1996).

Standardized Root Mean Squared Residual (SRMR): Another widely used index is the SRMR, which is a summary of the average covariance residuals (Kline, 1998). A favorable value of the SRMR is less than .05. However, a value of SRMR less than .10 is also acceptable (Kline, 1998).

Root-Mean-Square Error of Approximation (RMSEA): RMSEA adjusts for degrees of freedom. Values of RMSEA less than .05 are acceptable to indicate a good model fit.

Table 3.5 summarizes the goodness-of-fit (GOF) criteria and acceptable fit interpretation for the overall model. Another issue is the significance of the relationships between the variables. The absolute t-values of parameter estimates greater than 1.96 indicates a significant relationship at $\alpha = .05$. An additional fit statistics that is used for measurement models is the squared multiple correlation (R^2) calculated for each indicator, which equals the proportions of explained variance. Values of R^2 less than .05 mean that more than half of an indicator's variance is unique and thus unexplained by the factor(s) it is specified to measure (Kline, 1998). Also, the R^2 values of the observed variables were examined.

Table 3.5 GOF Criteria and Accepted Fit Interpretation

GOF Criterion	Acceptable Level	Interpretation
Chi-square	Tabled χ^2 value	Compares obtained χ^2 value with tabled value for given df.
Goodness-of-fit (GFI)	0 (no fit) to 1 (perfect fit)	Value close to .90 reflects a good fit.
Adjusted GFI (AGFI)	0 (no fit) to 1 (perfect fit)	Value adjusted for df, with .90 a good model fit.
Standardized-root-mean-square residual (S-RMR)	< .05	Value less than .05 indicates a good model fit.
Root-mean-square error of approximation (RMSEA)	< .05	Value less than .05 indicates a good model fit.

Schumacher and Lomax (1996).

5. Respecification: It usually occurs when the model fit indices suggest a poor fit. In this instance, the researcher makes a decision regarding how to delete, add, or modify paths in the model, and subsequently reruns the analysis. In this study, after appropriate modifications were done according to the modification indices given in the output

such as adding a new path in the model or adding a covariance term in the syntax of the model, the model was retested.

In sum, with the final data the LISREL models were estimated according to the steps mentioned above and some of the goodness-of-fit criteria were used for testing fit of the developed models.

CHAPTER 4

RESULTS

What follow in the present chapter are the results of descriptive and inferential statistics. In the descriptive statistics, the variables were tested and factor analyses were conducted to examine the factors for each country. In the inferential statistics, mathematics achievement models were explained for each country.

4.1 Descriptive Statistics

Firstly, the variables that would be used in the factor analyses and plausible values were examined by using descriptive statistics with deleting only missing values for each item. In Turkey data the values of skewness ranged from 2.18 to -1.79 and the kurtosis values ranged from 5.98 to –1.07. The values of skewness in the Netherlands data ranged from 3.12 to –1.59 and the values of kurtosis ranged from 9.66 to –0.95. In Italy data the values of skewness ranged from 0.84 to –1.79 and the values of skewness ranged from 2.62 to –1.22. Since most of the values of skewness and kurtosis were between +2 and –2 they can be assumed approximately normal as suggested by Kunnan in 1998 (as cited in Ağazade, 2001). Besides, the values out of this range represent non-normality. But these values are not problematic (Kline, 1998). Appendix A, B, and C display the descriptive statistics of all selected items used in factor analysis of Turkey, the Netherlands, and Italy, respectively.

After factor analyses were conducted for each country, observed variables representing latent variables were selected based on the results of the factor analysis of Turkey data. Data screening was conducted on the final data by using

PRELIS 2.30 for Windows for each country (SSI Inc., 1999a). The univariate distributions for the ordinal observed variables and histograms of the continuous observed variables were in Appendix D, Appendix E, and Appendix F for Turkey, the Netherlands and Italy data, respectively.

4.1.1 Results of Factor Analysis of Turkey

The dimensionality of the 37 items selected from the TIMSS 1999 Student Questionnaire was analyzed using principle components factor analysis. Two criteria were used to determine the number of factors to rotate: the scree test and the interpretability of the factor solution. Although the eigenvalue-greater-than-1 criterion suggested that there were 9 factors underlying the measure, the scree test indicated 7 factors. The scree test indicated that the dimensionality of the items was not unidimensional. Consequently, seven factors were rotated using a Varimax rotation procedure to yield interpretable factors. The rotated solution, as shown in Table 4.1, yielded seven interpretable factors; attitudes towards math, instructional activities (student-centered), importance given to math, socioeconomic status, out-of-school activities, math lesson climate, and instructional activities (teacher-centered). The factors were interpreted by naming them based on the size of the loadings and the meanings of the items. The eigenvalues, % of variance, % cumulative, and alpha values for reliability of factors were displayed in Table 4.2. Also the scale of some items with negative loadings was reversed for reliability analyses. The total variance accounted by all the factors was 43.56 %.

Table 4.1 Principle Component Factor Analysis Results of Turkey

	Factor Loading						
Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
I am just not talented	**0.768**	-	-	-	-	-	-
More difficult for me than others	**0.758**	-	-	-	-	-	-
Like more if not so difficult	**0.723**	-	-	-	-	-	-
Not one of my strength	**0.720**	-	-	-	-	-	-
Math is boring	**0.620**	-	-0.193	-	-	-	-
I will never really understand it	**0.603**	0.103	-	-	-	-0.106	-0.194
Usually do well in math	**-0.578**	0.151	0.302	-	-	-	-0.146

Table 4.1 (Continued)

Enjoy learning math	**-0.544**	0.240	0.425	-	-	-	-0.114
Math is an easy subject	**-0.490**	0.325	0.222	-	-	-	-0.274
Like job involving math	**-0.421**	0.337	0.291	-	-	-	-0.285
New topic - work in small groups	-	**0.701**	-	-	-	-	-
Work in pairs or small groups	-	**0.589**	-	-	-	-	-
Work on projects	-	**0.579**	-	-	-	-	-
New topic – ask what students know	-	**0.555**	-	-	-	-	0.167
New topic – discuss practical problem	-	**0.554**	-	-	-	-	0.136
Work from worksheets on our own	-0.117	**0.532**	-	-	-	0.120	0.102
New topic – look at textbook	0.114	**0.406**	-	-	-	-	-
Check each other’s homework	-	**0.401**	-	-	-	-	0.120
Self importance – do well in math	-	-	**0.748**	-	-	-	0.149
Mother importance – do well in math	-	-	**0.707**	0.101	-	-	0.109
Friends’ importance – do well in math	-	-	**0.673**	-	-	0.207	0.126
Math is important in life	-0.122	0.139	**0.479**	-	-	-	-
Education level – father	-	-	-	**0.809**	-	-	-
Education level – mother	-	-	-	**0.770**	-	-	-
# of books in student’s home	-	-	-	**0.642**	-	-	-
Outside school - doing jobs at home	-	-	-	-0.295	0.202	0.107	0.131
Outside school - play with friends	-	-	-	-0.118	**0.703**	-	-
Outside school - playing sports	-	-0.177	-	-	**0.626**	-	-0.172
Outside school - watch tv or videos	-	-0.135	-	-	**0.572**	-0.133	0.147
Outside school - play computer games	-	0.110	-	0.230	**0.517**	-	-0.174
Outside school - reading a book	-	0.105	-	-	0.220	0.170	0.158
Students orderly and quite in class	-	0.191	0.139	-	-	**0.745**	-0.135
Students do exactly as told in class	-	0.189	0.188	-	-	**0.722**	-
Students neglect school work in class	0.199	-	-	-	0.274	**-0.544**	-0.128
Copy notes from the board	-	-	-	-	-	-	**0.591**
New topic - teacher explains rules	-	0.227	0.196	-	-0.201	-	**0.580**
Teacher shows how to do problems	-	0.292	0.100	-	-	-	**0.488**

Note. Loadings below 0.1 were suppressed in the table.

Table 4.2 Rotation Sums of Squared Loadings and Reliability of Factors of Turkey

Component	Eigenvalue	% of Variance	Cumulative %	Reliability
1. Attitudes towards math	4.13	11.18	11.18	0.85
2. Instructional activities (Student-centered)	3.05	8.25	19.43	0.70
3. Importance given to math (Self-mother-friends)	2.34	6.33	25.76	0.65
4. Socioeconomic status	1.90	5.14	30.90	0.66

Table 4.2 (Continued)

5. Out-of-school activities	1.62	4.40	35.30	0.49
6. Math lesson climate	1.57	4.27	36.57	0.54
7. Instructional activities (Teacher-centered)	1.47	4.00	43.56	0.47

4.1.2 Results of Factor Analysis of the Netherlands

The dimensionality of the 37 items same with Turkey's factor analysis was analyzed using principle components factor analysis. Although the eigenvalue-greater-than-1 criterion suggested that there were 11 factors underlying the measure, the scree test indicated 7 factors. The scree test indicated that the dimensionality of the items was not unidimensional. Consequently, seven factors were rotated using a Varimax rotation procedure to yield interpretable factors. The factors were interpreted by naming them based on the size of the loadings and the meanings of the items. The rotated solution, as shown in Table 4.3, yielded seven interpretable factors; attitudes towards math, instructional activities (student and teacher-centered), importance given to math, socioeconomic status, math lesson climate, instructional activities (student-centered, group work), and out-of-school activities. The eigenvalues, % of variance, % cumulative, and alpha values for reliability of factors were displayed in Table 4.4. Also the scale of some items with negative loadings was reversed for reliability analyses. The total variance accounted by all the factors was 44.82 %.

Table 4.3 Principle Component Factor Analysis Results of the Netherlands

	Factor Loading						
Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Not one of my strengths	**0.807**	-	-	-	-	-	-
I am just not talented	**0.785**	-	-	-	-	-	-
More difficult for me than others	**0.741**	-	-	-	-	-	-
Like more if not so difficult	**0.739**	-	0.109	-	-	-	-
Math is an easy subject	**-0.738**	-	-	-	-	-	0.100
Usually do well in math	**-0.725**	-	-	-	-	-	-
Enjoy learning math	**-0.700**	0.171	0.208	-	0.125	-	-
Math is boring	**0.584**	-0.186	-0.177	-	-0.186	-	0.109

Table 4.3 (Continued)

I will never really understand it	**0.576**	-	-	-0.108	-	-	-0.203
Like job involving math	**-0.536**	0.106	0.225	-	-	-	-
New topic - teacher explains rules	-	**0.696**	-	-	-	-	-
Teacher shows how to do problems	-	**0.588**	-	0.123	-	0.191	0.165
New topic - ask what students know	-	**0.582**	-	-0.126	-	0.222	0.134
New topic - discuss practical problem	-	**0.575**	-	-	-	0.208	-
Copy notes from the board	-	**0.556**	-	-	0.197	0.106	-
New topic – look at textbook	-	**0.545**	-	-	-	-	-
Self importance – do well in math	-0.117	-	**0.794**	-	-	-	-
Mother importance – do well in math	-	-	**0.761**	-	-	-	-
Friends' importance – do well in math	-	-	**0.693**	-	0.117	-	-
Math is important in life	-0.153	0.153	**0.404**	-	-	-	-
Education level – father	-	-	-	**0.791**	-	-	-
Education level – mother	-	-	-	**0.784**	-	-	0.106
# of books in student's home	-	-	-	**0.663**	-	-	-0.169
Outside school - reading a book	-	-	-	0.283	-	-	-0.214
Students orderly and quite in class	-	-	-	-	**0.788**	-	-
Students do exactly as told in class	-	-	-	-	**0.758**	-	-
Students neglect school work in class	0.106	-0.130	-	-	**-0.732**	-	-
Work from worksheets on our own	-	-	-	-	0.119	-0.104	-
New topic - work in small groups	-	-	-	-	-	**0.805**	-
Work in pairs or small groups	-	-	-	-	-	**0.776**	-
Work on projects	-	-	-	-	-	**0.407**	-
Check each other's homework	-	0.140	-	-	-	**0.395**	-
Outside school - watch tv or videos	-	-	-	-0.168	-	-0.104	**0.660**
Outside school - play with friends	0.132	-	-	-	-	0.111	**0.641**
Outside school - play computer games	-0.107	-	0.124	-	-0.121	-	**0.553**
Outside school - playing sports	-	-	-	0.151	-	-	**0.483**
Outside school - doing jobs at home	-	-	-	-	0.114	0.124	0.151

Note. Loadings below 0.1 were suppressed in the table.

Table 4.4 Rotation Sums of Squared Loadings and Reliability of Factors of the Netherlands

Component	Eigenvalue	% of Variance	Cumulative %	Reliability
1. Attitudes towards math	5.01	13.54	13.54	0.88
2. Instructional activities (Student-teacher-centered)	2.28	6.18	19.72	0.66
3. Importance given to math (Self-mother-friends)	2.06	5.59	25.31	0.64
4. Socioeconomic status	1.93	5.22	30.53	0.66

Table 4.4 (Continued)

5. Math lesson climate	1.92	5.20	35.73	0.69
6. Instructional activities (Student-centered-group work)	1.77	4.77	40.52	0.51
7. Out-of-school activities	1.59	4.30	44.82	0.44

4.1.3 Results of Factor Analysis of Italy

The dimensionality of the 37 items same with Turkey's factor analysis was analyzed using principle components factor analysis. Although the eigenvalue-greater-than-1 criterion suggested that there were 9 factors underlying the measure, the scree test indicated 7 factors. The scree test indicated that the dimensionality of the items was not unidimensional. Consequently, seven factors were rotated using a Varimax rotation procedure to yield interpretable factors. The factors were interpreted by naming them based on the size of the loadings and the meanings of the items. The rotated solution, as shown in Table 4.5 yielded seven interpretable factors; attitudes towards math, instructional activities (student-centered), importance given to math, socioeconomic status, math lesson climate, out-of-school activities (I), and out-of-school activities (II). The eigenvalues, % of variance, % cumulative, and alpha values for reliability of factors were displayed in Table 4.6. Also the scale of some items with negative loadings was reversed for reliability analyses. The total variance accounted by all the factors was 44.94 %.

Table 4.5 Principle Component Factor Analysis Results of Italy

	Factor Loading						
Items	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7
Not one of my strengths	**0.840**	-	-	-	-	-	-
I am just not talented	**0.800**	0.134	-	-0.100	-	-	-
Enjoy learning math	**-0.748**	0.123	0.268	-	-	-	-
More difficult for me than others	**0.742**	0.165	-0.170	-	-	-	-
Usually do well in math	**-0.706**	-	0.132	-	0.129	-	-
Math is boring	**0.689**	-	-0.117	-	-	0.110	-
Like job involving math	**-0.652**	0.133	0.245	-	-	0.105	-
Like more if not so difficult	**0.620**	-	0.162	-	-	0.155	-
I will never really understand it	**0.609**	0.170	-	-0.169	-	-	-
Math is an easy subject	**-0.566**	0.173	-	-0.130	-	0.169	-

Table 4.5 (Continued)

New topic - work in small groups	-	**0.742**	-	-	-	-	-
Work in pairs or small groups	-	**0.627**	-0.102	-	-	-	-
Work on projects	-	**0.619**	-	-	-	-	-
New topic - ask what students know	-	**0.546**	0.121	-	-	0.149	-
New topic - discuss practical problem	-	**0.527**	-	-	-	-	-
Work from worksheets on our own	-	**0.437**	-	-	-	0.106	-
Check each other's homework	-	**0.393**	-	-	-	-	-
New topic – look at textbook	-	0.271	0.128	-	-	0.210	0.122
Self importance – do well in math	-0.255	-	**0.724**	-	-	-0.116	-
Mother importance – do well in math	-0.139	-	**0.681**	-	-	-0.142	-
Math is important in life	-0.157	-	**0.558**	-	-	-	-
Friends' importance – do well in math	-	-	**0.490**	-	0.439	-0.105	-
New topic - teacher explains rules	-	-	0.293	-	-	0.153	-
Copy notes from the board	0.101	0.188	0.283	-	-	0.119	-
Teacher shows how to do problems	0.101	0.189	0.276	-	-0.136	0.179	-0.202
Education level – father	-	-	-	**0.804**	-	-	-
Education level – mother	-	-	-	**0.801**	-	-	-
# of books in student's home	-	-	-	**0.648**	-	-	0.189
Students do exactly as told in class	-	0.152	-	-	**0.789**	-	-
Students orderly and quite in class	-	0.125	0.101	-	**0.775**	-	-
Students neglect school work in class	0.125	-	0.153	-	**-0.668**	-	-
Outside school - play with friends	-	-	-	-	-	**0.671**	0.114
Outside school - watch tv or videos	-	-0.126	-	-	-	**0.556**	0.154
Outside school - play computer games	-	-	-	0.133	-	**0.508**	-0.294
Outside school - playing sports	-	0.110	-	0.190	-	**0.499**	-0.150
Outside school - doing jobs at home	-	-	-	-0.158	-	-	**0.711**
Outside school - reading a book	-	-	-	0.287	-	-	**0.672**

Note. Loadings below 0.1 were suppressed in the table.

Table 4.6 Rotation Sums of Squared Loadings and Reliability of Factors of Italy

Component	Eigenvalue	% of Variance	Cumulative %	Reliability
1. Attitudes towards math	5.13	13.87	13.87	0.89
2. Instructional activities (Student-centered)	2.64	7.14	21.00	0.66
3. Importance given to math (Self-mother-friends)	2.09	5.66	26.66	0.64
4. Socioeconomic status	2.04	5.54	32.20	0.69
5. Math lesson climate	1.96	5.30	37.50	0.66
6. Out-of-school activities (I)	1.47	3.98	41.49	0.40
7. Out-of-school activities (II)	1.27	3.45	44.94	0.30

4.1.4 Summary of the Results of the Factor Analyses

The purpose to conduct factor analyses was to define the dimensions of a set of selected items from TIMSS 1999 student questionnaire and to select appropriate observed variables to form the latent variables that would be included in the model testing. Firstly, the factor structures of the three countries for the selected items were very similar. Especially, the factors; “attitudes towards mathematics”, “importance”, “socioeconomic status”, “out-of-school activities”, and “classroom climate” showed almost the same positive and negative loading values for each country. On the contrary, the factors; “instructional activities (student-centered)”, and “instructional activities (teacher-centered)” did not perform the same results for each country. While the factor analysis indicated two separate dimensions for the instructional activities in Turkey, the same structure was not observed for the Netherlands and Italy. They showed a mixed structure in terms of these two factors. Except that, the number of factors extracted for each country was equal and the total variances explained by all factors and the reliabilities of the same factors for each country were roughly the same.

As mentioned before the observed variables were selected according to the results of the factor analysis of Turkey. To form the latent variables at least three items with highest loadings were selected from each factor. Since the dimension of the instructional activities is very important to investigate in terms of Turkish education system, based on the findings in the Turkey data, these activities were divided into two latent variables, such as teacher-centered and student-centered activities. The other dimensions were same for all of the three countries. The names of the latent variables were same with the factors except “perception of failure”. Since the first items were related with the perception of academic failure in mathematics and the difficulty about mathematics, this latent variable was named as “perception of failure (PERFAIL)”. The selected observed variables and the name of latent variables were given in Table 4.7. Also, before the models were tested the item (5a) was reversed.

Table 4.7. Observed and Latent Variables

Latent Variable	Observed Variable
Out of school activities (OUTOFSCH)	Watch tv or videos (1a) Play with friends (1c) Playing sports (1e)
Socioeconomic status (SES)	Education level – mother (2a) Education level – father (2b) # of books in student's home (2c)
Importance given to math (IMPT)	Mother importance – do well in math (4a) Friend importance – do well in math (4b) Self importance – do well in math (4c)
Math classroom climate (CLIMATE)	Students neglect school work in class (5a) Students orderly and quiet in class (5b) Students do exactly as told in class (5c)
Perception of failure (PERFAIL)	Like more if not so difficult (6a) More difficult for me than for others (6b) I am just not talented (6c) I will never really understand it (6d) Not one of my strengths (6e)
Teacher-centered activities (TEACACT)	Teacher shows how to do problems (8a) Copy notes from the board (8b) New topic – teacher explains (8c)
Student-centered activities (STUACT)	Work on projects (8c) Work in pairs or small groups (8e) New topic – discuss practical problem (9b) New topic – work in small groups (9c) New topic – ask what students know (9d)

4.2 Inferential Statistics

After the factor analyses were conducted, LISREL 8.30 for Windows (SSI Inc., 1999b) with SIMPLIS command language was used for formulating and estimating LISREL models of the eighth grade students in Turkey, Netherlands, and Italy.

4.2.1 Mathematics Achievement Model of Turkey

Firstly the actual model presented in Chapter 1 was tested with Turkey data. Since the paths between PERFAIL and STUACT; and PERFAIL and

CLIMATE had nonsignificant t-values, these paths were deleted. Then three covariance terms were added in the SIMPLIS syntax to improve the model considering the highest three meaningful modification indexes. The final SIMPLIS syntax for Mathematics Achievement Model of Turkey is given in Appendix G. The structural model is presented in Figure 4.1. Also the Figure 4.2 shows the t-values that are significant at .05-level. The basic model with estimates and t-values of mathematics achievement model of Turkey is given in Appendix H and Appendix I.

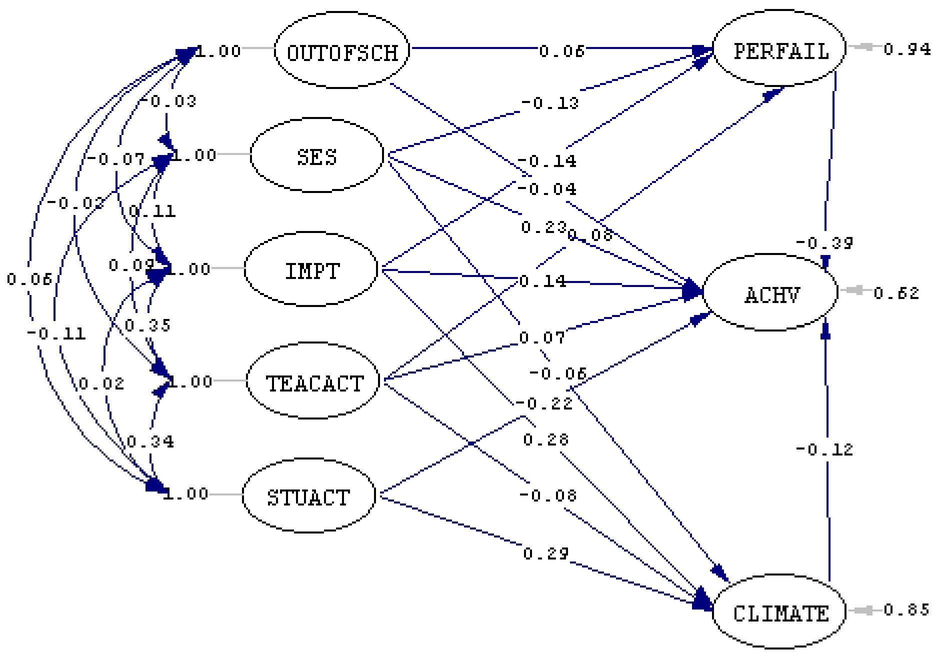

Figure 4.1 Structural Model of Mathematics Achievement of Turkey

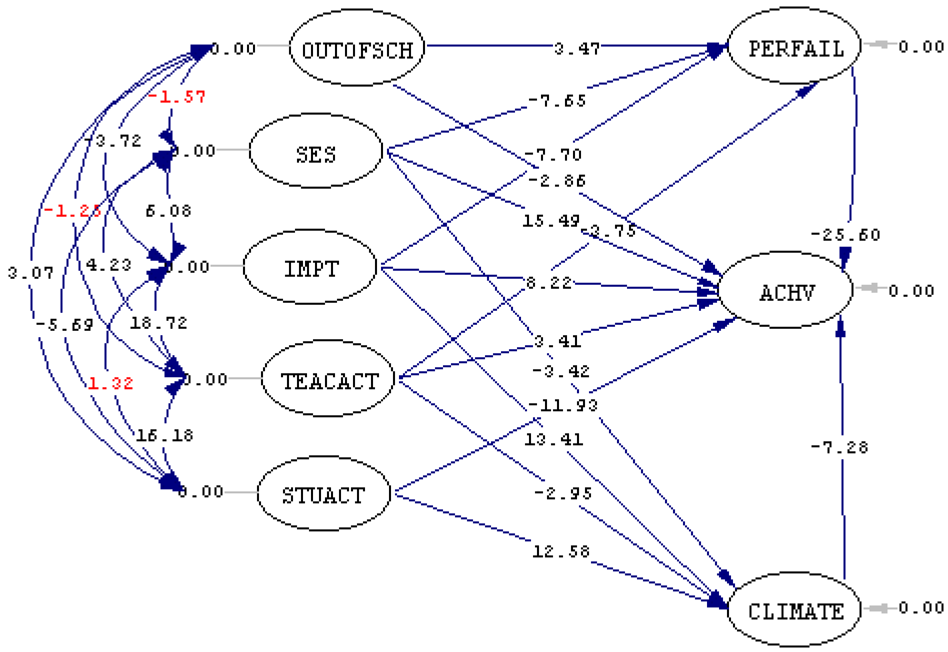

Figure 4.2 Structural Model of Turkey with t-values

Table 4.8 displays the λ_y, λ_x, and measurement errors of the observed variables; ε (lowercase epsilon) and δ (lowercase delta) for the model of Turkey.

Table 4.8 λ_y and λ_x Values and Measurement Errors of the Model of Turkey

Latent variables	λ	Observed variables	Measurement errors
PERFAIL	0.67 (λ_y)	Likemore	0.55 (ε)
	0.80 (λ_y)	Diff	0.36 (ε)
	0.82 (λ_y)	Notalent	0.32 (ε)
	0.63 (λ_y)	Never	0.61 (ε)
	0.79 (λ_y)	Nostreng	0.37 (ε)
ACHV	0.91 (λ_y)	Mat 1	0.17 (ε)
	0.90 (λ_y)	Mat 2	0.19 (ε)
	0.91 (λ_y)	Mat 3	0.18 (ε)
	0.91 (λ_y)	Mat 4	0.17 (ε)
	0.90 (λ_y)	Mat 5	0.18 (ε)
CLIMATE	0.27 (λ_y)	Neglect	0.93 (ε)
	0.76 (λ_y)	Orderly	0.43 (ε)
	0.81 (λ_y)	Doastold	0.34 (ε)
OUTOFSCH	0.29 (λ_x)	Watchtv	0.92 (δ)
	0.89 (λ_x)	Playing	0.22 (δ)
	0.36 (λ_x)	Sports	0.87 (δ)

Table 4.8 (Continued)

SES	0.73 (λ_x)	Edumot	0.47 (δ)
	0.84 (λ_x)	Edufat	0.29 (δ)
	0.48 (λ_x)	Books	0.77 (δ)
IMPT	0.75 (λ_x)	Motimpt	0.44 (δ)
	0.71 (λ_x)	Friendim	0.50 (δ)
	0.87 (λ_x)	Selfimpt	0.25 (δ)
TEACACT	0.55 (λ_x)	Teashow	0.69 (δ)
	0.48 (λ_x)	Copynotes	0.77 (δ)
	0.66 (λ_x)	Teaexpru	0.57 (δ)
STUACT	0.57 (λ_x)	Projects	0.68 (δ)
	0.47 (λ_x)	Pairsmgr	0.78 (δ)
	0.58 (λ_x)	Discussp	0.67 (δ)
	0.71 (λ_x)	Smlgrp	0.50 (δ)
	0.53 (λ_x)	Askstu	0.72 (δ)

Table 4.9 and Table 4.10 show the structure coefficients; β (lowercase beta) and γ (lowercase gamma) values of the final model of Turkey, respectively.

Table 4.9 β (lowercase beta) Values of the Final Model of Turkey

Endogenous variables	β	Endogenous variables
ACHV	-0.39	PERFAIL
ACHV	-0.12	CLIMATE

Table 4.10 γ (lowercase gamma) Values of the Final Model of Turkey

Exogenous variables	γ	Endogenous variables
OUTOFSCH	-0.04	ACHV
SES	0.23	
IMPT	0.14	
TEACACT	0.07	
STUACT	-0.22	
OUTOFSCH	0.06	PERFAIL
SES	-0.13	
IMPT	-0.14	

Table 4.10 (Continued)

TEACACT	-0.08	PERFAIL
STUACT	-	
OUTOFSCH	-	CLIMATE
SES	-0.06	
IMPT	0.28	
TEACACT	-0.08	
STUACT	0.29	

According to the final model of Turkey, differently from the hypothesized model, the paths from STUACT to PERFAIL, and CLIMATE to PERFAIL were nonsignificant. As Figures 4.1 and 4.2 show, the paths from OUTOFSCH to ACHV (-.04, t = -2.86), and to PERFAIL (.06, t = 3.47), from SES to ACHV (.23, t = 15.49), to CLIMATE (-.06, t = -3.42), and to PERFAIL (-.13, t = -7.65), from IMPT to ACHV (.14, t = 8.22), to CLIMATE (.28, t = 13.41), to PERFAIL (-.14, t = -7.70), from TEACACT to ACHV (.07, t = 3.41), to CLIMATE (-.08, t = -2.95), to PERFAIL (-.08, t = -3.75), from STUACT to ACHV (-.22, t = -11.93), to CLIMATE (.29, t = 12.58), from PERFAIL to ACHV (-.38, t = -18.05), and from CLIMATE to ACHV (-.12, t = -7.28).

Table 4.11 displays the goodness-of-fit indices; goodness of fit index (GFI), Adjusted GFI (AGFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) of the Mathematics Achievement Model of Turkey. As can be seen all the given indices reflects a good model fit.

Table 4.11 Goodness of Fit Indices of the Mathematics Achievement Model of Turkey

Index	Value	Criterion
GFI	.96	GFI > .90
AGFI	.95	AGFI > .90

Table 4.11 (Continued)

SRMR	.042	SRMR < .05
RMSEA	.038	RMSEA < .05

Also an additional fit statistics, squared multiple correlation (R^2), which is calculated for each observed variable is given in Table 4.12 R^2 equals the proportion of explained variance. Values of R^2 less than .50 mean that more than half of an indicator's variance is unique and so unexplained by the factor(s) it is specified to measure (Kline, 1998).

Table 4.12 Squared Multiple Correlations for the Mathematics Achievement Model of Turkey

Variable	R^2	Variable	R^2	Variable	R^2
edumot	0.63	diff	0.72	discussp	0.27
edufat	0.62	notalent	0.74	smlgrp	0.52
books	0.23	never	0.52	mat1	0.88
motimpt	0.47	nostreng	0.65	mat2	0.89
friendimp	0.20	teashow	0.34	mat3	0.88
selfimpt	0.95	askstu	0.28	mat4	0.88
neglect	0.22	copynotes	0.32	mat5	0.88
orderly	0.58	teaexpru	0.08	ACHV	0.38
doastold	0.64	projects	0.32	PERFAIL	0.06
likemore	0.35	pairsmgr	0.18	CLIMATE	0.15

4.2.2 Mathematics Achievement Model of the Netherlands

Firstly the actual model presented in Chapter 1 was tested with Netherlands data. Since the paths between ACHV and CLIMATE; STUACT and PERFAIL; STUACT and CLIMATE; STUACT; and ACHV had nonsignificant t-values at .05-level, these paths were deleted. So the latent variable "STUACT" did not remain in the model. Following the modification indexes two covariance terms were added in the SIMPLIS syntax to improve the model. The final SIMPLIS syntax for Mathematics Achievement Model of Netherlands is given in Appendix J. The structural model is presented in Figure 4.3. Also the Figure 4.4 shows the t-values that are significant at .05-level. The basic model with estimates and t-values of mathematics achievement model of the Netherlands is given in Appendix K and Appendix L.

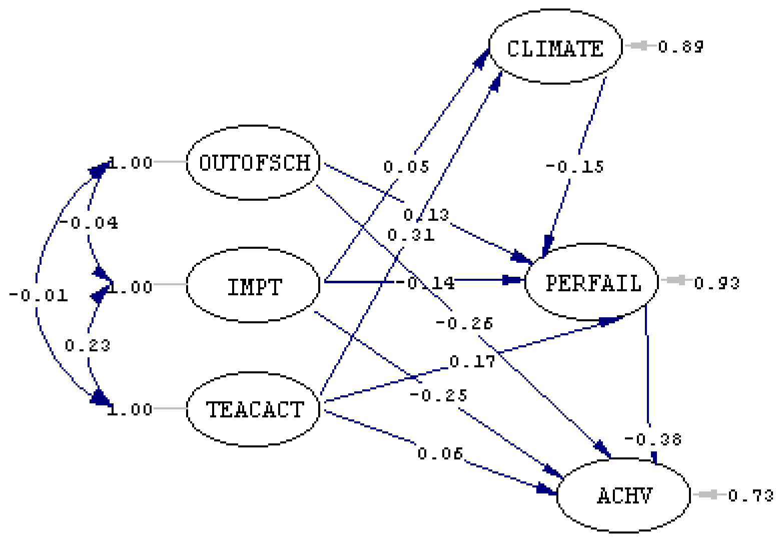

Figure 4.3 Structural Model of Mathematics Achievement of the Netherlands

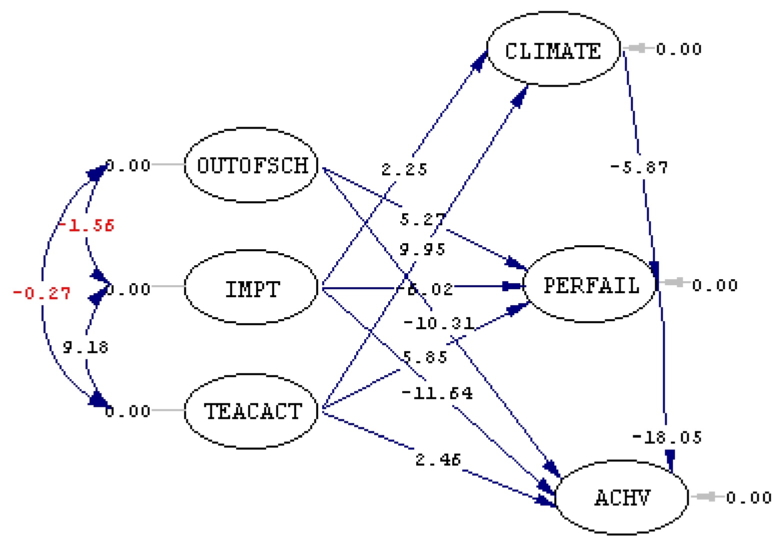

Figure 4.4 Structural Model of the Netherlands with t-values

Table 4.13 displays the λ_y, λ_x, and measurement errors of the observed variables; ε (lowercase epsilon) and δ (lowercase delta) for the model of the Netherlands.

Table 4.13 λ_y and λ_x values and measurement errors of the model of the Netherlands

Latent variables	λ	Observed variables	Measurement errors
PERFAIL	0.75 (λ_y)	Likemore	0.44 (ε)
	0.83 (λ_y)	Diff	0.31 (ε)
	0.81 (λ_y)	Notalent	0.34 (ε)
	0.63 (λ_y)	Never	0.60 (ε)
	0.78 (λ_y)	Nostreng	0.40 (ε)
ACHV	0.92 (λ_y)	Mat 1	0.15 (ε)
	0.92 (λ_y)	Mat 2	0.14 (ε)
	0.93 (λ_y)	Mat 3	0.13 (ε)
	0.93 (λ_y)	Mat 4	0.13 (ε)
	0.92 (λ_y)	Mat 5	0.15 (ε)
CLIMATE	0.87 (λ_y)	Neglect	0.25 (ε)
	0.55 (λ_y)	Orderly	0.70 (ε)
	0.51 (λ_y)	Doastold	0.74 (ε)
OUTOFSCH	0.36 (λ_x)	Watchtv	0.87 (δ)
	0.85 (λ_x)	Playing	0.28 (δ)
	0.26 (λ_x)	Sports	0.93 (δ)
IMPT	0.77 (λ_x)	Motimpt	0.41 (δ)
	0.61 (λ_x)	Friendim	0.62 (δ)
	0.86 (λ_x)	Selfimpt	0.25 (δ)
TEACACT	0.57 (λ_x)	Teashow	0.27 (δ)
	0.66 (λ_x)	Copynotes	0.57 (δ)
	0.56 (λ_x)	Teaexpru	0.68 (δ)

Table 4.14 and Table 4.15 show the structure coefficients; β (lowercase beta) and γ (lowercase gamma) values of the final model of the Netherlands, respectively.

Table 4.14 β (lowercase beta) Values of the Final Model of the Netherlands

Endogenous variables	β	Endogenous variables
ACHV	-0.38	PERFAIL
PERFAIL	-0.15	CLIMATE

Table 4.15 γ (lowercase gamma) Values of the Final Model of the Netherlands

Exogenous variables	γ	Endogenous variables
OUTOFSCH	-0.26	ACHV
IMPT	-0.25	
TEACACT	0.06	
OUTOFSCH	0.13	PERFAIL
IMPT	-0.14	
TEACACT	0.17	
IMPT	0.05	CLIMATE
TEACACT	-0.26	
STUACT	0.29	

Since the missing percentages of the variables EDUMOT and EDUFAT were very high (over 35 %) in Netherlands data, the latent variable SES was not included in the model of Netherlands. Unlike the hypothesized model, in the model of Netherlands, STUACT did not remain in the model and the path from CLIMATE to ACHV was nonsignificant at .05-level. As Figures 4.3 and 4.4 display, the path from OUTOFSCH to ACHV (-.26 t = -10.31), to PERFAIL (.13, t = 5.27), from IMPT to ACHV (-.25, t = -11.64), to PERFAIL (-.14, t = -6.02), to CLIMATE (.05, t = 2.25), from TEACACT to ACHV (.06, t = 2.46), to PERFAIL (.17, t = 5.85), to CLIMATE (.05, t = 2.25), from PERFAIL to ACHV (-.38, t = -18.05), and from CLIMATE to PERFAIL (-.15, t = -5.87).

Table 4.16 displays the goodness-of-fit indices; goodness of fit index (GFI), Adjusted GFI (AGFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) of the Mathematics Achievement Model of Netherlands. As can be seen all the given indices reflects a good model fit.

Table 4.16 Goodness of Fit Indices of the Mathematics Achievement Model of Netherlands

Index	Value	Criterion
GFI	.97	GFI > .90
AGFI	.96	AGFI > .90
SRMR	.035	SRMR < .05
RMSEA	.036	RMSEA < .05

Also an additional fit statistics, squared multiple correlation (R^2), which is calculated for each observed variable is given in Table 4.17.

Table 4.17 Squared Multiple Correlations for the Mathematics Achievement Model of Netherlands

Variable	R^2	Variable	R^2	Variable	R^2
watchtv	0.13	likemore	0.56	mat1	0.85
playing	0.72	diff	0.69	mat2	0.86
sports	0.07	notalent	0.66	mat3	0.87
motimpt	0.59	never	0.39	mat4	0.87
friendimp	0.38	nostreng	0.60	mat5	0.85
selfimpt	0.73	neglect	0.75	ACHV	0.27
teashow	0.33	orderly	0.30	PERFAIL	0.07
copynote	0.4	doastold	0.26	CLIMATE	0.11
teaexpru	0.32				

4.2.3 Mathematics Achievement Model of Italy

Firstly the actual model presented in Chapter 1 was tested with Italy data. Since the t-values of the observed variables that represent the latent variable “OUTOFSCH” were nonsignificant this latent variable did not remain in the model of Italy. After this latent variable was removed the model retested. This time paths between the TEACACT and CLIMATE; IMPT and ACHV; and TEACACT and ACHV were deleted, because they were nonsignificant. Modification indices were used to alter the original model in order to improve model fit. Following the modification indices, five covariance terms and a path from “neglect” to “PERFAIL” were added in the SIMPLIS syntax of the model. Finally, the nonsignificant path between CLIMATE and PERFAIL was deleted. The final SIMPLIS syntax for Mathematics Achievement Model of Italy is given in Appendix M. The structural model is presented in Figure 4.5. Also the Figure 4.6 shows the t-values that are significant at .05-level. The basic model with estimates and t-values of mathematics achievement model of Italy is given in Appendix N and Appendix O.

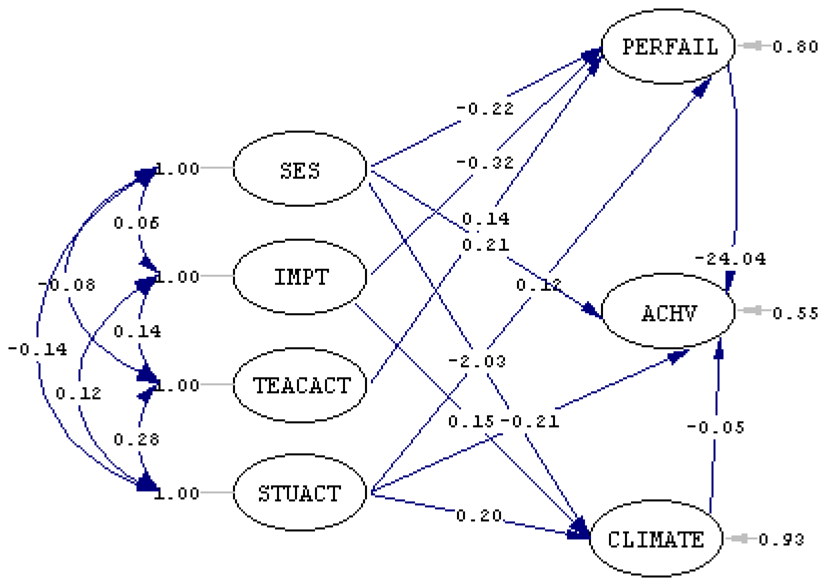

Figure 4.5 Structural Model of Mathematics Achievement of Italy

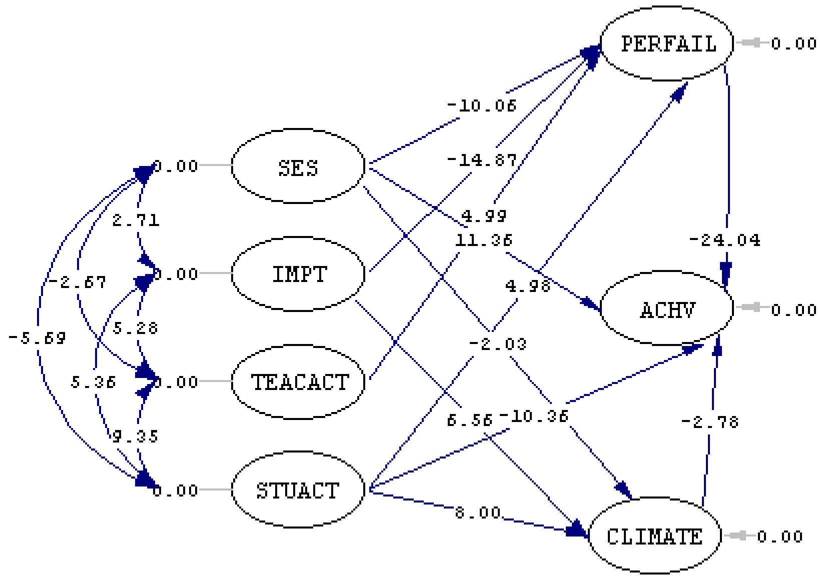

Figure 4.6 Structural Model of Italy with t-values

Table 4.18 displays the λ_y, λ_x, and measurement errors of the observed variables; ε (lowercase epsilon) and δ (lowercase delta) for the model of Italy.

Table 4.18 λ_y and λ_x values and measurement errors of the model of Italy

Latent variables	λ	Observed variables	Measurement errors
PERFAIL	0.59 (λ_y)	Likemore	0.65 (ε)
	0.85 (λ_y)	Diff	0.28 (ε)
	0.86 (λ_y)	Notalent	0.26 (ε)
	0.72 (λ_y)	Never	0.48 (ε)
	0.81 (λ_y)	Nostreng	0.35 (ε)
ACHV	0.94 (λ_y)	Mat 1	0.12 (ε)
	0.94 (λ_y)	Mat 2	0.11 (ε)
	0.94 (λ_y)	Mat 3	0.12 (ε)
	0.94 (λ_y)	Mat 4	0.12 (ε)
	0.94 (λ_y)	Mat 5	0.12 (ε)
CLIMATE	0.45 (λ_y)	Neglect	0.78 (ε)
	0.75 (λ_y)	Orderly	0.41 (ε)
	0.79 (λ_y)	Doastold	0.34 (ε)

Table 4.18 (Continued)

SES	0.79 (λ_x)	Edumot	0.37 (δ)
	0.79 (λ_x)	Edufat	0.38 (δ)
	0.48 (λ_x)	Books	0.48 (δ)
IMPT	0.69 (λ_x)	Motimpt	0.53 (δ)
	0.45 (λ_x)	Friendim	0.79 (δ)
	0.98 (λ_x)	Selfimpt	0.05 (δ)
TEACACT	0.58 (λ_x)	Teashow	0.66 (δ)
	0.57 (λ_x)	Copynotes	0.68 (δ)
	0.29 (λ_x)	Teaexpru	0.92 (δ)
STUACT	0.57 (λ_x)	Projects	0.68 (δ)
	0.43 (λ_x)	Pairsmgr	0.82 (δ)
	0.52 (λ_x)	Discussp	0.73 (δ)
	0.72 (λ_x)	Smlgrp	0.48 (δ)
	0.55 (λ_x)	Askstu	0.69 (δ)

Table 4.19 and Table 4.20 show the structure coefficients; β (lowercase beta) and γ (lowercase gamma) values of the final model of Italy, respectively.

Table 4.19 β (lowercase beta) Values of the Final model of Italy

Endogenous variables	β	Endogenous variables
ACHV	-0.50	PERFAIL
ACHV	-0.05	CLIMATE

Table 4.20 γ (lowercase gamma) Values of the Final Model of Italy

Exogenous variables	γ	Endogenous variables
SES	0.21	ACHV
STUACT	-0.21	
SES	-0.22	PERFAIL
IMPT	-0.32	
TEACACT	0.14	
STUACT	0.12	
SES	0.21	CLIMATE
IMPT	0.15	
STUACT	0.20	

As it was mentioned before OUTOFSCH did not remain in the model of Italy. Differently from the hypothesized model, the paths between ACHV and IMPT, ACHV and TEACACT, PERFAIL and CLIMATE, and CLIMATE and STUACT were nonsignificant. As Figures 4.5 and 4.6 show, the paths from SES to ACHV (.21, t = 11.36), to PERFAIL (-.22 t = -10.06), to CLIMATE (-.05, t = 2.03), from IMPT to PERFAIL (-.32, t = -14.87), to CLIMATE (.15, t = 6.56), from TEACACT to PERFAIL (.14, t = 4.99), from STUACT to ACHV (-.21, t = -10.36), to PERFAIL (.12, t = 4.98), to CLIMATE (.20, t = 8.00), from PERFAIL to ACHV (-.50, t = -24.04), from CLIMATE to ACHV (-.05, t = -2.78)

Table 4.21 displays the goodness-of-fit indices; goodness of fit index (GFI), Adjusted GFI (AGFI), standardized root mean square residual (SRMR), and root mean square error of approximation (RMSEA) of the Mathematics Achievement Model of Italy. As can be seen all the given indices reflects a good model fit.

Table 4.21 Goodness of Fit Indices of the Mathematics Achievement Model of Italy

Index	Value	Criterion
GFI	.96	GFI > .90
AGFI	.95	AGFI > .90
SRMR	.047	SRMR < .05
RMSEA	.041	RMSEA < .05

Also an additional fit statistics, squared multiple correlation (R^2), which is calculated for each observed variable is given in Table 4.22.

Table 4.22 Squared Multiple Correlations for the Mathematics Achievement Model of Italy

Variable	R^2	Variable	R^2	Variable	R^2
watchtv	0.13	likemore	0.56	mat1	0.85
playing	0.72	diff	0.69	mat2	0.86
sports	0.07	notalent	0.66	mat3	0.87

Table 4.22 (Continued)

motimpt	0.59	never	0.39	mat4	0.87
friendimp	0.38	nostreng	0.60	mat5	0.85
selfimpt	0.73	neglect	0.75	ACHV	0.45
teashow	0.33	orderly	0.30	PERFAIL	0.20
copynote	0.43	doastold	0.26	CLIMATE	0.08
teaexpru	0.32				

4.2.4 Summary of the Results of the Modeling Analyses

The actual model given in Chapter 1 was tested separately using the data of each country. The hypothesized models were evaluated and modified until the model-data fit was attained. Finally, the final models with estimates, and t-values, goodness-of-fit indices, and squared multiple correlations were given. Table 4.23 summarizes the estimates and t-values of paths between latent variables for all of the models.

Table 4.23 Estimates and t-values of the Paths between Latent Variables for all of the Models

Paths Between	Turkey		Netherlands		Italy	
Latent Variables	Estimates	t-values	Estimates	t-values	Estimates	t-values
ACHV and OUTOFSCH	-.04	-2.86	-.26	-10.31	***	***
ACHV and SES	.23	15.49	**	**	.21	11.36
ACHV and IMPT	.14	8.22	-.25	-11.64	*	*
ACHV and PERFAIL	-.39	-25.60	-.38	-18.05	-.50	-24.04
ACHV and CLIMATE	-.12	-7.28	*	*	-.05	-2.78
ACHV and TEACACT	.07	3.41	.06	2.46	*	*
ACHV and STUACT	-.22	-11.93	***	***	-.21	-10.36
PERFAIL and OUTOFSCH	.06	3.47	.13	5.27	***	***
PERFAIL and SES	-.13	-7.65	**	**	-.22	-10.06
PERFAIL and IMPT	-.14	-7.70	-.14	-6.02	-3.2	-14.87
PERFAIL and CLIMATE	*	*	-.15	-5.87	*	*
PERFAIL and TEACACT	-.08	-3.75	.17	5.85	.14	4.99
PERFAIL and STUACT	*	*	***	***	.12	4.98
CLIMATE and SES	-.06	-3.42	**	**	-.05	-2.03
CLIMATE and IMPT	.28	13.41	.05	2.25	.15	6.56
CLIMATE and TEACACT	-.08	-2.95	.31	9.95	*	*
CLIMATE and STUACT	.29	12.58	***	***	.20	8.00

* Represents the nonsignificant paths
** SES was not included in the model of Netherlands
*** The second latent variable did not remain in the model

First of all, the percentage of variance in eighth grade students' mathematics achievement scores explained by the latent variables of the structural models were 38%, 27%, and 45% for Turkey, Netherlands, and Italy respectively. Generally, the path coefficients are not so high. In all of the models PERFAIL shows the highest (negative) path coefficients. The other factors those have significant influence on mathematics achievement are; out of school activities, socio economic status, importance given to math, math classroom climate, teacher-centered activities, student-centered activities. Out of school activities shows negative path coefficients in the models of Turkey and Netherlands, however this latent variable did not remain in the model of Italy. SES is not included in the model of Netherlands but it shows positive path coefficients in the models of Turkey and Italy. While IMPT shows a positive path coefficient in the model of Turkey, surprisingly this path coefficient is negative in the model of Netherlands. Moreover, CLIMATE and STUACT show negative path coefficients in the models of Turkey and Italy. Lastly, TEACACT shows positive small path coefficients in the models of Turkey and Netherlands.

In the hypothesized model proposed in Chapter 1, PERFAIL is supposed to be influenced by OUTOFSCH, SES, IMPT, CLIMATE, TEACACT, and STUACT. The percentages of variance in PERFAIL explained by the latent variables are 6%, 7%, and 20% for the models of Turkey, Netherlands, and Italy respectively. The low variances are partly the consequences of keeping some latent variables in the models although they showed low path coefficients. IMPT shows the highest (negative) path coefficients in all of the models. In the models of Turkey and Netherlands, OUTOFSCH shows positive significant path coefficients, while SES shows negative significant path coefficients in the models of Turkey and Italy. CLIMATE shows nonsignificant path coefficients in both the models of Turkey and Italy, whereas this path coefficient is negative in the model of Netherlands. TEACACT shows negative significant path coefficients in the model of Turkey, differently from the models of Netherlands and Italy. Only in the model of Italy STUACT shows a significant path coefficient.

As hypothesized model proposed, SES, IMPT, TEACACT, and STUACT are supposed to influence CLIMATE. The percentages of variance in CLIMATE explained by latent variables are .15, .11, and .08 for the models of Turkey, the Netherlands, and Italy respectively. The highest path coefficients belong to STUACT in the models of Turkey and Italy, and TEACACT in the model of Netherlands. SES has negative path coefficients in both of the models of Turkey and Italy. In all of the models IMPT shows positive path coefficients. TEACACT shows negative path coefficients in the model of Turkey, while this path coefficient is positive in the model of the Netherlands.

Also, some suggestions about the interpretations of absolute magnitudes of path coefficients are offered. These guidelines reflect recommendations by Cohen (1988) (as cited in Kline, 1998) about effect size interpretations of correlations in the social sciences. Standardized path coefficients with absolute values less than .10 may indicate a “small” effect; values around .30 a “medium” one; and “large” effects may be suggested by coefficients with absolute values of .50 or more (Kline, 1998). According to this, path coefficients of perception of failure which is the strongest factor effecting mathematics achievement for all of the three countries have medium effect sizes for Turkey and the Netherlands; and has large effect size for Italy.

4.2.5 Effect Sizes

As mentioned in the methodology section the measure of effect size used in multiple regression is roughly equivalent to the squared multiple correlation (R^2). So according to the results of model the magnitude of effect sizes for each country’s endogenous variables were reported in measures of squared multiple correlation in Table 4.24.

Table 4.24 The Effect Sizes of the Models of Each Country in R^2

Endogenous Variables	Multiple Squared Correlation (R^2)		
	Turkey	The Netherlands	Italy
ACHV	0.38	0.27	0.45

Table 4.24 (Continued)

PERFAIL	0.06	0.07	0.20
CLIMATE	0.15	0.11	0.08

The values of R^2 can be interpreted according to the Cohen's classification scheme. The magnitude of the association between ACHV and its exogenous variables is large both for Turkey, the Netherlands, and Italy. Additionally, the model of Italy has the largest effect size with the value of 0.45 in comparison with the models of Turkey and the Netherlands for ACHV. Although the models of Turkey and the Netherlands have a small effect size for PERFAIL, these values are very close to the value of medium effect size. Similarly, the effect size value of the model of Italy for PERFAIL is very close to the value of large effect size. Finally all of the models have medium effect sizes for CLIMATE.

CHAPTER 5

DISCUSSION, CONCLUSIONS AND IMPLICATIONS

The purpose of this research study had two phases. In the first phase a model that explains students' mathematics achievement in TIMMS-R was proposed, and then this model was evaluated across three culturally and linguistically different countries to interpret similarities and differences. Firstly the items in the student questionnaire were grouped under latent variables, and then the related models were established. In this section the results are discussed and conclusions are presented. After that the limitations, implications and recommendations for the further research are given.

5.1 Discussion of the Results

5.1.1 Results of Factor Analysis

The results of the factor analyses conducted using the items in TIMSS 1999 student questionnaire showed that item groupings were quite similar across the three countries. Especially, the factors; attitudes towards mathematics, importance given to mathematics, socioeconomic status, out-of-school activities, and mathematics classroom climate are easily defined in each of the country's dataset with approximately the same items and similar factor loadings. However, two items related to the dimension of out-of-school activities did not load on this factor. These two items are doing jobs at home and reading a book outside school. It seems that, these two items were not perceived as out-of-school activities by the eighth graders in all of the three countries. Most probably, students did not perceive these two activities as enjoyable as the other items in the same dimension, such as watching television, playing with friends, playing sports, or playing computer games. Also, these two items formed a separate factor in Italy.

The major difference between Turkey and other countries in the factor structure was having two separate dimensions for the items in instructional activities in the Turkish data set. Out of 11 items for instructional activities, in the Turkish data set, items were grouped separately into two factors as to form student-centered and teacher-centered activities. On the other hand, in Italy, even the student-centered activities were clearly identified as a result of the factor analysis, items reflecting teacher-centered activities were not loaded together on a separate dimension. Similarly, in the Netherlands data set, not all the items reflecting student-centered activities but items reflecting small group work, working projects, and checking each other's homework loaded together on a separate dimension. However, some of the items reflecting student-centered activities mixed with the items reflecting teacher-centered activities.

This result might be the reflection of the differences in the classroom activities across the cultures. In Turkey, since the majority of the curriculum implementations based on teacher-centered practices, students' perceptions about the student-centered activities could be different naturally. This result in the factor structure might also be supporting the critics of TIMSS survey data. As Bos and Kuiper (1999) pointed out before that TIMSS 1999 student questionnaire may not contain well-tested scales necessary to operationalise some important constructs such as the students questionnaire of TIMSS 1995. If the items were prepared more specifically to measure the patterns of mathematics classroom organizations, these constructs might be distinctly separated from each other.

In sum, the evidence collected for the dimensionality of the student questionnaire items supported the idea of similar factor structures across the cultures.

5.1.2 Results of Model Testing

5.1.2.1 Mathematics Achievement

In the model of Turkey the exogenous variables effecting mathematics achievement were OUTOFSCH, SES; IMPT, PERFAIL, CLIMATE, TEACACT; and STUACT. Differently, in the model of the Netherlands, only OUTOFSCH, IMPT, PERFAIL, and TEACACT explained the mathematics achievement of Dutch eighth graders while the mathematics achievement of Italian eighth graders was effected by SES, PERFAIL, CLIMATE, and STUACT. One reason for these differences may be that the observed variables were selected based on only the results of the factor analysis of Turkey dataset.

As given in the fourth chapter, the proportion of variance in students' mathematics scores explained by the latent variables were 38%, 27%, and 45% for the mathematics achievement model of Turkey, the Netherlands, and Italy, respectively. These percentages are more than that of a study conducted with ten European countries' TIMSS 1995 dataset (Bos & Kuiper, 1999). The latent variables used in this study explained more variance in mathematics achievement of eighth graders than did the latent variables used in modeling of mathematics achievement in ten European countries. Also, the variance explained in the mathematics achievement of Italian students is more than that of the Turkish and Dutch students. The model of the Netherlands had the lowest proportion of explained variance, since the latent variable SES was not included in the model of the Netherlands because of the high percentage of missing values.

As expected, in all of the models, perception of academic failure shows the strongest negative relation with mathematics achievement. This finding suggests that the feeling of doing badly in mathematics and to feel herself/himself unsuccessful and incapable in mathematics decrease the mathematics scores. This finding is supported by the previous research studies (Abu-Hilal, 2000). Similarly (Köller et al., 1999) reported of negative effect of fear of failure on mathematics achievement. Consistent with this result Shen (2002) and Shen and Pedulla (2000) indicated that students who reported doing well in mathematics and science tended to have higher achievement scores.

It is found that socioeconomic status is positively related with mathematics achievement in the models of Turkey and Italy. No interpretation can be made for the model of Netherlands since this latent variable was not included in the model. Similarly Bos and Kuiper (1999) found that in most of ten European countries, home educational background, which was represented by the number of books in the student's home, had significant influence on achievement. Schreiber (2002) reported that students whose parents had lower levels of formal education scored lower than did those students whose parents had higher formal education levels. Parents who have more formal education may have more engaged in mathematics achievement of their children and provide more opportunity and resources for their academic studies. Thus, mathematics achievement of these students becomes higher than that of students coming from low educated parents is more probable. Schreiber (2002) emphasized that the lack of access, or opportunity to learn can detrimentally affect achievement.

It can be easily interpreted that socioeconomic status is positively related to mathematics achievement in both country. As Baker and Stevenson (1986) indicated socioeconomic advantages of the family increase the likelihood of school attendance, and since more lengthy schooling increases access school achievement. Furthermore high socioeconomic status is related with easy access to financial social resources that parents can use improve their children's academic careers. Greater financial sources allow more educated parents to access better homes, health care, and educational services. Moreover, their experiences and the knowledge of the school system permit them to be more effective managers of their children's school careers.

In the models of Turkey and Netherlands teacher-centered activities were found to be positively related with mathematics achievement while the student-centered activities negatively related in the models of Turkey and Italy. The students experience relatively more teacher-centered activities in their mathematics classes, tend to get higher mathematics scores. Oppositely, students who experiences more student-centered experiences in the mathematics classes tend to get lower mathematics scores. Likewise Papanastasiou (2002) found that using small group work frequently in mathematics classes does not necessarily increase mathematics performance. However, Bos and Kuiper (1999) found no significant relationship between mathematics achievement and instructional formats, which measures the extent to which students work in pairs or small groups according to the teacher. Also in the study carried out by Zabulionis in 1997 (cited in Lokan & Greenwood, 2000) with TIMSS 1995 data of nine central and eastern European counties, none of the lesson climate or teaching style variables contributed to the variance in achievement. Lokan and Greenwood (2000) also found that the use of student-centered teaching strategies was negatively related to achievement. The same result was also reported by Rosier and Banks in 1990 (cited in Lokan & Greenwood, 2000) in data of Seconds International Science Study of Australia. Teacher-centered activities seem to have positive effect on students' achievement level. As teachers explain the rules when the students begin a new topic in mathematics, show how to do problems, and as the students copy notes from the board, mathematics achievement of the students tend to be higher. Within the classical teaching activities, this result clearly indicates the importance of teachers in an educational system. When the frequencies of the items reflecting teacher-centered instructional activities were observed it was found that most of the Turkish, Dutch, and Italian eighth graders practices these activities almost always and pretty often (see Appendix P).

However, having negative effect from student-centered activities on mathematics achievement in TIMSS-R could be due to couple of different reasons. First, the content of TIMSS tests are curriculum oriented. However student-centered activities are basically designated to enhance students' social skills, ability to get information, and organize the collected information. From this perspective student-centered activities cannot have any meaningful impact on curriculum based learning outcomes. Second, the quality of student-centered activities is always questionable. These sorts of activities definitely need a high quality guidance skills of teachers. Students may claim that they frequently have discussion in the classroom about the math concepts, but the quality of the discussion and teachers' role as a discussion moderator are not known very clearly. This issue definitely needs further investigations. Third, culturally in Turkey students are expected to listen to teachers and their lectures, rather having discussions or projects about the math concepts. Any activity within the student-centered domain may not be suitable for the cultural expectations. Having the same result in Italy as another Mediterranean country seems supporting that premise. Fourth, it should be questioned how the students perceive these items in the questionnaire. Also, when the frequencies of these observed variables forming the latent variable of student-centered activities are considered, a very low frequency was observed both in Turkey and Italy (see Appendix R). So, the students in Turkey and Italy experienced this kind of instructional activities very rarely. Thus it can be interpreted as, these activities are not implemented very often to be effective on mathematics achievement of the students.

The mathematics classroom climate as perceived by the students was found to be negatively related with mathematics achievement in the models of Turkey and Italy. It means the more orderly and quiet the students are and the more they do as told in the classroom the less their mathematics achievement is. In contrast, this latent variable did not show significant path coefficients in the majority of the education systems (Bos & Kuiper, 1999). Similarly, this relationship was not significant in the model of Netherlands. This finding suggests that a quiet and orderly mathematics classroom climate does not provide achievement. Creating a classroom environment conducive to learning is different than simply listening to the teacher. Most probably, students who are not interested in math indicate no performance in the classroom and prefer being silent, so that their achievement is low.

As predicted, importance given to mathematics is positively related to mathematics achievement in the model of Turkey. This finding is in line with the previous studies conducted in academic settings (Abu-Hilal, 2000; Lokan & Greenwood). Students who strongly agree that their mothers, friends, and themselves think doing well in mathematics is important, have higher mathematics scores. However, this relation is negative in the model of Netherlands. This result is not in accordance with the expectations. One explanation for this result may be the importance given to mathematics by peers, mother, and himself/herself is not challenging for Dutch students. Reinforcement given by peers or mother is not enough for them to be motivated to study and achieve in mathematics. They may not really believe in that mathematics has application in everyday life. Also, family structure that may differ between the countries may create that difference. In the Mediterranean countries, being parent may still be an important aspect of the culture. So, it may still have impact on students' academic performance at school.

In the model of Turkey and Italy the latent variable out-of-school activities was found to influence mathematics achievement negatively. The more time a student spends on watching TV, playing friends, and playing sports, the less his or her achievement in mathematics is. This finding is supported by previous findings (Bos & Kuiper, 1999; Lokan & Greenwood; Keith et al., 1986). Similary, Köller et al. (1999) found a negative relationship between non-academic out-of-school activities and mathematics achievement but they indicated that reviews on studies on the relationship especially between watching TV and academic achievement shows a very heterogeneous picture. For example Heggeler et al. (1991) reported a negative correlation between academic achievement and televison viewing. In contrast, Bergin (1992) reported a positive but weak relationship between leisure activities and academic achievement. One explanation for this negative relationship between the mathematics achievement and out-of-school activities may that these activities take time from the time that students should engage in doing homework or studying mathematics.

5.1.2.2 Perception of Academic Failure

In the model of Turkey and the Netherlands the exogenous variables effecting perception of academic failure in mathematics were OUTOFSCH, SES, IMPT, and TEACACT. Differently in the model of Italy, SES, IMPT, TEACACT, and STUACT explained the perception of academic failure in mathematics.

As given in the Chapter 4, the proportion of variance in students' perception of failure in mathematics by the latent variables were 6%, 7%, and 20% for the models of Turkey, the Netherlands, and Italy, respectively. The difference is originating from the stronger relationships between the perception of academic failure in mathematics of Italian students; and socioeconomic status and importance to given math than those in the models of Turkey and the Netherlands.

As expected, academic perception of failure is negatively related with importance given to math in all of the three models. This result is supported by the previous findings (Abu-Hilal, 2000). The students, who perceive doing well in mathematics is important, tend to develop less negative perceptions of their failure or their inabilities in mathematics. This relationship is more strongly for Italian students than those in the models of Turkey and the Netherlands. This is also valid for the relationship between mathematics achievement and perception of academic failure of Italian students. We can conclude that affective characteristics of Italian students play a more powerful role in explaining mathematics achievement than those of the Turkish and Dutch students.

In the models of Turkey and the Netherlands, out-of-school activities were positively related with the perception of academic failure. This finding suggests that students spending more time for watching television, playing with friends or playing sports, tended to develop more negative perceptions of their failure or their inabilities in mathematics. This result is in contrast with some previous findings (Marsh, 1992; Holland & Andre, 1987). The reason for this negative relationship may be that students spending many hours for out-of-school activities reduce the amount of time requiring for academic activities such as making homework thus reducing the achievement and increasing the perception of academic failure (Keith et al., 1986).

Socioeconomic status was negatively related with perception of academic failure in the models of Turkey and Italy. This means that students having more educated parents and more books in their homes tended to developed less negative perceptions about their abilities in mathematics. Since socioeconomic status is related positively with mathematics achievement and the perception of academic failure has the most powerful effect on mathematics achievement, it is very certain to find a negative relationship between socioeconomic status and achievement.

The only significant relationship between perception of academic failure and math classroom climate was observed in the model of the Netherlands. According to the results, the students believing that they have ability and they can understand mathematics tended to be more quiet and orderly in the mathematics classroom. It is probable to conclude that high achieving Dutch students prefer to be quiet in math classroom, try to understand the mathematical concepts by themselves without distrusting the classroom.

In all of the models the relationship between the perception of academic failure and teacher-centered activities was found negatively significant. This finding suggests that the students experience teacher-centered activities more frequently they tended to develop less negative perceptions about their abilities in mathematics. Teacher-centered experiences help them to be more successful in mathematics thus increasing the positive perception about their abilities in doing well in mathematics.

The only significant relationship between the perception of academic failure and student-centered activities was in the model of Italy. This path coefficient showed a positive relationship. The students experience more student-centered activities tended to develop more negative perceptions of failure in mathematics.

5.1.2.3 Math Classroom Climate

In the model of Turkey and the Netherlands the exogenous variables effecting math classroom climate were SES, IMPT, TEACACT, and STUACT. Differently in the model of the Netherlands, IMPT and TEACACT explained the math classroom climate while these variables were SES, IMPT, and STUACT.

As is was mentioned before the proportion of variance in math classroom climate by the exogenous latent variables were 15%, 11%, and 8% for the models of Turkey, the Netherlands, and Italy, respectively.

Classroom climate is supposed to be influenced by student- or teacher-centered instructional activities in the hypothesized model. In contrast with the expectations in the model of Turkey, it was found that mathematics classroom climate is influenced negatively by teacher-centered instructional activities and positively by student-centered activities. Also the relationship between student-centered activities and math classroom climate was positively significant whereas the relationship between teacher-centered activities and math classroom climate was nonsignificant. One explanation for this finding is that, these students may be bored and be noisy while the teacher is lecturing but quiet while they are in direct relationship with mathematics subjects such as in working pairs or discussing a problem. However this result is not true for the students in Netherlands. Mathematics classroom climate is positively related with teacher-centered activities in Netherlands as expected. These findings are not in accordance with the results of the study carried out by Bos and Kuiper (1999). They found that in the majority of the countries teaching style does not influence class climate.

It was observed that importance given to doing well in mathematics by mother, friends, and himself/herself was positively related with the math classroom climate in all of the models. This finding suggests that students believe that it is important to do well in mathematics tended to be more quiet and orderly in mathematics classroom. The socioeconomic status was found to influence classroom climate negatively in the models of Turkey and Italy. The students who have more books in their home and whose parents are more educated tend to perform less quiet and orderly classroom climate. This may be originating from that students coming from parent with high socioeconomic status do not consider learning in the class, since they have more opportunities to learn the subjects in anywhere out-of-school.

5.2 Conclusions

According to the results of the factor analyses and the model testing the following conclusions can be made;

1. Italy and Turkey have more similar results. Since they are both Mediterranean countries they may have similar students' expectations, teacher practices and classroom activities.
2. Different from the other countries, in Turkey classroom activities could be considered teacher-centered and student-centered very clearly. That also implies the importance of teacher's role in the Turkish education system.
3. Student affective characteristics are very important variables to explain success. The feeling of doing badly in mathematics and to feel herself/himself unsuccessful and incapable in mathematics strongly influence mathematics achievement. Being the strongest dimension among the other dimensions effecting mathematics achievement perception of failure was the strongest factor influencing mathematics in all of the three countries.
4. The items reflecting student-centered activities such as working on projects or working in pairs or small groups, effect the mathematics achievement negatively. It means that students practicing more student-centered activities in math classroom tend to get lower mathematics scores. It does not mean that the student-centered activities should not be implemented in math classrooms. Firstly, such activities are expected to be successful with the guidance of the teacher. This finding shows that many teachers are incapable of giving proper and enough service in developing the math projects or giving feedback to the pairs or small groups. Also, tests used in TIMSS are curriculum based. However the aim of students-centered activities is to develop the subjects of the curriculum besides developing social skills of the students. So, the content of this achievement test is far from assessing this outcome. More research studies and investigations should be carried out for the benefits of the Turkish education system.
5. Differently from student-centered instructional activities, teacher-centered instructional activities influence mathematics achievement weakly but positively. In other words, students whose teachers explain the rules and

show how to do problems get higher mathematics achievement scores. This findings shows that such activities which can be included in the classical teaching method can be helpful it they are used effectively. Moreover, this kind of activities decreases the perception of failure of the students weakly but significantly.

6. As the rate of participation to out-of-school activities such as watching television, playing with friends, and playing sports increases, the mathematics achievement levels of the students decrease.
7. When the importance given to math is high in the classrooms where student-centered instructional activities are implemented frequently, a quiet and orderly classroom climate is observed. However, as the frequency of teacher-centered instructional activities and the level of socioeconomic status increase, this is not the case. Being quiet and orderly and doing as told the teacher in the classroom, decrease the achievement scores of the students. Most probably, the quiet and orderly students who do as told the teacher are not interested in mathematics. So it can be said that this is an expected result. A quiet and orderly classroom climate is not always related with high achievement.
8. As the socioeconomic status, teacher-centered instructional activities, the importance given to math increase, the perception of success is influenced positively. When the socioeconomic status is high and as the teacher-centered instruction activities increases, the perception of failure decreases.
9. Socioeconomic status influences the importance given to math weakly, but positively. However, as the frequency rate of student-centered instructional activities increases, the importance given to math decreases, and as the teacher-centered instructional activities the importance given to math increases. Also, participating out-of-school activities reflects a negative relationship with the importance given to math.
10. Math classroom climate is related positively with the importance given to math. As the importance given to math increases the classroom climate

tends to be more quiet and orderly. However, considering the negative relationship between the math classroom climate and achievement, it is difficult to say a quiet and orderly classroom climate has always an effect to increase the achievement.

5.3 Limitations

It should be noted that the TIMSS mathematics achievement test does not cover the overall mathematics ability of the eighth grade students in each country. The TIMSS mathematics scores are just indicators of students' mathematics performance on that specific test. So the interpretations should be made not overall but peculiar to this test. Also the appropriateness of the whole items, at least the released items used in the TIMSS 1999 mathematics test should be addressed in terms of the intended and the implemented curriculum for each country such as the study conducted by Kuiper, Bos, and Plomp (1999) for Netherlands and TIMSS 1995 mathematics test items.

Since it is hard to met the conditions; (1) isolation, (2) association, and (3) direction of causality, used to establish a causal relationship (see Bollen, 1989, pp. 45-67) between the variables in this study, we only interpreted the results as negatively and positively relationships without proposing a cause and effect condition.

As this study involved a secondary analysis of data already collected, one of the major limitations was that it was not possible to include a measure of students' prior ability. There is still a big proportion of variance in student achievement left unexplained and it would be important to find differences among the models of the three countries.

All these cross-national differences should be taken into account when examining the relationships between students' achievement and the other latent variables used in this study. For example, "strongly agree" does not necessarily mean exactly the same thing in different languages and cultural contexts. Therefore, caution must be taken when drawing conclusions from cross-national comparisons based on these items. Nonetheless, these constraints should preclude our utilizing the data from such an unprecedentedly large-scale study to test the possible relationship between students' achievement and the latent variables but merely provide caution with regard to overgeneralising any findings.

Since the observed variables were selected to form latent variables based on only the results of factors analysis of Turkish dataset for the easiness of comparison across the countries, latent variables related with instructional activities were fictitious for Italy and the Netherlands. However, this was not the case for most of the latent variables.

Considering the low R^2 of perception of failure and class climate plus the low or nonsignificant path coefficients from these latent variables towards achievement in mathematics, one can conclude that these factors cannot be kept in the model unless better observed variables can be found in TIMSS 1999 dataset.

5.4 Implications

According to the findings of this study and the literature review the following suggestions can be offered:

1. First of all, educational policy makers should make the requiring regulations more seriously considering the importance of the role of the teachers and the ways they follow in implementing the instructional activities than the regulations in the curriculum.
2. The teachers should be guided with detailed handbooks explaining effective teaching methods that are proper for using in the Turkish education system, such as proper for large classrooms. Also these methods should reflect the important role of the teacher in the instruction process.
3. Since classroom activities are important, the mathematics teachers should be given seminars about special teaching methods for various mathematics subjects and how to use these methods effectively.
4. While designing the curriculum and the instructional methods in the classrooms, activities increasing the students' affective characteristics should be included.

5. Teachers should increase the interests of students for mathematics and help them to gain the feeling of being successful.
6. Teachers and parents should frequently emphasize the importance of mathematics to their students and children.
7. Providing individually adapted education for students who have the feeling of doing badly in mathematics and feel herself/himself unsuccessful and incapable in mathematics may improve their mathematics achievement. Also, counselors should investigate the reasons of perception of failure.
8. Parents should try to follow how much time students spend for each of the out-of-school activity. Also, they should control this amount of time for preventing exceeding the time that should be spent for studying mathematics.
9. The administrators should require parents to observe their child' school performance to maximize their child's school achievement. Especially, low educated parents should be given special education to use specific strategies to help their children through school. Also parents should be encouraged to contact frequently with school staff to follow their child's school performance and to work together with school staff to assure the highest possible academic achievement.
10. Student coming from families with low socioeconomic status should be provided educational resources and opportunities, such as books, technology access and so on.
11. Turkish educational policy makers should frequently participate and give proper attention to cross cultural studies such TIMSS, because such studies provide very rich information about all educational areas both for us and the other countries all over the world.

5.5 Suggestions for Further Research

1. Comparative educational research should provide more latent variables those of more meaningful, reliable and valid. TIMSS 1999 student

questionnaire did not contain well-tested scales to evaluate some important constructs such as motivation. A similar study should be conducted more reliable and more important constructs. If the other important constructs can be included in the models, percentage of variance in mathematics achievement explained by all of the latent variables increases. So, simply manipulating these variables mathematics achievement can be increased as desired.

2. Cross-validation and replication are required to provide an over fit of model evaluation measure (Bollen, 1989).
3. The same study should be replicated with the scores of five content areas in mathematics; fractions and number sense, measurement, data representation, analysis and probability, geometry, and algebra to see if the effects of factors used in this present study differ in explaining the achievement in the subject level.

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APPENDIX A

DESCRIPTIVE STATISTICS OF ITEMS OF TURKEY DATA

Item	Min	Max	Mean	SD	Skewness	Kurtosis
Watch tv or videos	1	5	2.75	0.91	0.26	0.07
Play computer games	1	5	1.53	0.89	1.80	2.89
Play with friends	1	5	2.56	1.00	0.32	-0.23
Doing jobs at home	1	5	2.24	1.01	0.70	0.14
Playing sports	1	5	2.47	1.07	0.42	-0.37
Reading a book	1	5	2.44	0.91	0.44	0.09
Highest education level-mother	1	7	2.07	1.17	2.18	5.98
Highest education level-father	1	7	2.84	1.66	1.40	1.02
Number of books	1	5	2.42	1.10	0.61	-0.13
Mother importance – do well in math	1	4	3.51	0.67	-1.37	2.02
Friends' importance – do well in math	1	4	3.42	0.68	-1.08	1.19
Self importance – do well in math	1	4	3.63	0.61	-1.79	3.69
Students neglect school work	1	4	2.65	0.96	-0.13	-0.94
Students orderly and quite	1	4	2.81	0.89	-0.29	-0.69
Students do as told	1	4	2.98	0.87	-0.49	-0.50
Usually do well in math	1	4	2.80	0.80	-0.12	-0.57
Like more if not so difficult	1	4	2.79	0.97	-0.27	-0.94
More difficult for me than for others	1	4	2.63	0.93	-0.09	-0.87
I am just not talented	1	4	2.51	0.93	0.07	-0.87
I will never really understand it	1	4	2.49	0.93	0.87	-0.85
Not one of my strengths	1	4	2.53	0.90	-0.02	-0.78
Enjoy learning math	1	4	3.09	0.81	-0.61	-0.11
Math is boring	1	4	2.16	0.84	0.47	-025
Math is an easy subject	1	4	2.47	0.82	0.21	-0.49
Math is important in life	1	4	3.35	0.73	-1.12	1.27
Like job involving math	1	4	2.64	0.91	-0.13	-0.80
Teacher shows how to do problems	1	4	3.34	0.78	-0.84	-0.30
Copy notes from the board	1	4	3.57	0.63	-1.41	1.72
Work on projects	1	4	1.86	1.00	0.94	-0.26
Work from worksheets on our own	1	4	2.33	1.04	0.32	-1.07
Work in pairs or small groups	1	4	1.95	0.95	0.81	-0.25
Check each other's homework	1	4	2.17	1.08	049	-1.05
New topic – teacher explains rules	1	4	3.48	0.76	-1.30	0.95
New topic – discuss practical problem	1	4	2.21	0.98	0.48	-0.76
New topic – work in small groups	1	4	1.86	0.94	0.92	-0.08
New topic – ask what students know	1	4	2.58	0.97	0.10	-1.03
New topic – look at textbook	1	4	2.46	0.98	0.19	-0.99
1 st plausible value of math scores	67.61	754.63	427.23	83.72	0.05	0.15
2 nd plausible value of math scores	89.13	898.70	424.24	87.26	-0.02	0.15
3 rd plausible value of math scores	105.84	837.90	427.00	85.69	0.07	0.09
4 th plausible value of math scores	99.14	752.76	422.42	87.01	0.06	0.04
5 th plausible value of math scores	84.46	849.37	424.86	86.87	0.01	0.06

APPENDIX B

DESCRIPTIVE STATISTICS OF ITEMS OF THE NETHERLANDS DATA

Item	Min	Max	Mean	SD	Skewness	Kurtosis
Watch tv or videos	1	5	3.21	0.86	0.06	0.05
Play computer games	1	5	2.16	0.98	0.73	0.28
Play with friends	1	5	3.18	1.07	0.11	-0.66
Doing jobs at home	1	5	2.15	0.71	0.93	2.16
Playing sports	1	5	2.75	1.08	-0.06	-0.43
Reading a book	1	5	1.88	0.87	0.84	0.49
Highest education level-mother	1	7	4.31	1.16	0.09	1.14
Highest education level-father	1	7	4.73	1.34	-0.02	0.07
Number of books	1	5	3.40	1.21	-0.25	-0.83
Mother importance – do well in math	1	4	3.37	0.55	-0.23	-0.13
Friends' importance – do well in math	1	4	3.04	0.61	-0.41	1.03
Self importance – do well in math	1	4	3.44	0.55	-0.39	-0.05
Students neglect school work	1	4	2.51	0.77	0.37	-0.41
Students orderly and quite	1	4	2.36	0.72	-0.00	-0.31
Students do as told	1	4	2.28	0.71	0.08	-0.27
Usually do well in math	1	4	3.11	0.83	-0.59	-0.42
Like more if not so difficult	1	4	2.60	0.92	0.00	-0.88
More difficult for me than for others	1	4	2.03	0.80	0.65	0.25
I am just not talented	1	4	2.23	0.91	0.41	-0.57
I will never really understand it	1	4	2.10	0.83	0.54	-0.12
Not one of my strengths	1	4	2.56	0.98	-0.10	-1.00
Enjoy learning math	1	4	2.62	0.82	-0.15	-0.50
Math is boring	1	4	2.43	0.87	0.21	-0.62
Math is an easy subject	1	4	2.25	0.82	0.34	-0.34
Math is important in life	1	4	2.98	0.74	-0.47	0.11
Like job involving math	1	4	2.21	0.89	0.30	-0.64
Teacher shows how to do problems	1	4	2.99	0.87	-0.39	-0.76
Copy notes from the board	1	4	2.37	0.94	0.29	-0.81
Work on projects	1	4	1.23	0.52	2.59	7.78
Work from worksheets on our own	1	4	3.56	0.69	-1.59	2.13
Work in pairs or small groups	1	4	1.91	1.02	0.85	-0.47
Check each other's homework	1	4	1.22	0.62	3.12	9.66
New topic – teacher explains rules	1	4	2.84	0.97	-0.32	-0.95
New topic – discuss practical problem	1	4	1.72	0.81	1.03	0.61
New topic – work in small groups	1	4	1.48	0.83	1.76	2.24
New topic – ask what students know	1	4	1.85	0.88	0.82	-0.06
New topic – look at textbook	1	4	2.56	0.93	-0.03	-0.86
1 st plausible value of math scores	281.24	747.19	544.39	67.63	-0.29	-0.03
2 nd plausible value of math scores	281.51	766.27	547.76	69.99	-0.28	0.19
3 rd plausible value of math scores	229.94	755.14	546.63	70.14	-0.25	0.21
4 th plausible value of math scores	233.66	792.53	547.06	70.05	-0.26	0.31
5 th plausible value of math scores	256.06	760.60	549.24	67.87	-0.25	0.13

APPENDIX C

DESCRIPTIVE STATISTICS OF ITEMS OF ITALY DATA

Item	Min	Max	Mean	SD	Skewness	Kurtosis
Watch tv or videos	1	5	2.89	0.85	0.17	0.14
Play computer games	1	5	2.12	1.04	0.66	-0.22
Play with friends	1	5	3.28	1.04	-0.12	-0.58
Doing jobs at home	1	5	2.39	0.89	0.74	0.75
Playing sports	1	5	2.65	1.18	-0.00	-0.84
Reading a book	1	5	1.97	0.85	0.73	0.38
Highest education level-mother	1	7	3.51	1.34	0.90	0.92
Highest education level-father	1	7	3.65	1.42	0.84	0.52
Number of books	1	5	3.06	1.30	0.11	-1.09
Mother importance – do well in math	1	4	3.58	0.54	-0.94	0.79
Friends' importance – do well in math	1	4	2.99	0.73	-0.53	0.38
Self importance – do well in math	1	4	3.52	0.60	-1.10	1.55
Students neglect school work	1	4	2.72	0.79	-0.09	-0.50
Students orderly and quite	1	4	2.53	0.80	0.05	-0.49
Students do as told	1	4	2.50	0.80	0.03	-0.48
Usually do well in math	1	4	2.95	0.81	-0.43	-0.32
Like more if not so difficult	1	4	2.83	0.88	-0.26	-0.71
More difficult for me than for others	1	4	2.30	0.94	0.33	-0.76
I am just not talented	1	4	2.27	0.98	0.36	-0.86
I will never really understand it	1	4	2.13	0.93	0.54	-0.50
Not one of my strengths	1	4	2.42	1.03	0.12	-1.14
Enjoy learning math	1	4	2.78	0.87	-0.31	-0.58
Math is boring	1	4	2.32	0.88	0.30	-0.59
Math is an easy subject	1	4	2.29	0.81	0.36	-0.26
Math is important in life	1	4	3.30	0.67	-0.86	1.23
Like job involving math	1	4	2.42	0.96	0.05	-0.96
Teacher shows how to do problems	1	4	3.28	0.81	-0.74	-0.56
Copy notes from the board	1	4	3.07	0.93	-0.54	-0.83
Work on projects	1	4	1.86	0.89	0.78	-0.23
Work from worksheets on our own	1	4	2.18	1.03	0.44	-0.95
Work in pairs or small groups	1	4	2.03	0.95	0.64	-0.51
Check each other's homework	1	4	2.21	1.05	0.45	-1.01
New topic – teacher explains rules	1	4	3.58	0.74	-1.79	2.62
New topic – discuss practical problem	1	4	2.17	0.97	0.45	-0.75
New topic – work in small groups	1	4	1.70	0.88	1.16	0.53
New topic – ask what students know	1	4	2.35	0.99	0.25	-0.98
New topic – look at textbook	1	4	2.76	1.07	-0.27	-1.22
1 st plausible value of math scores	29.35	784.55	479.34	85.42	-0.30	0.27
2 nd plausible value of math scores	192.99	838.09	480.53	85.45	-0.23	0.01
3 rd plausible value of math scores	78.16	874.53	480.09	86.35	-0.19	0.23
4 th plausible value of math scores	195.04	890.97	479.85	87.76	-0.20	0.04
5 th plausible value of math scores	168.44	832.69	481.13	85.57	-0.17	0.05

APPENDIX D

UNIVARIATE DISTRIBUTIONS FOR ORDINAL VARIABLES AND HISTOGRAMS FOR CONTINUOUS VARIABLES OF THE MATHEMATICS ACHIEVEMENT MODEL OF TURKEY

1. WATCHTV

WATCHTV	Frequency	Percentage	Bar Chart
1	304	6.4	□□□□□□□
2	1464	30.7	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
3	2179	45.7	□□
4	664	13.9	□□□□□□□□□□□□□□□
5	161	3.4	□□□

2. PLAYING

PLAYING	Frequency	Percentage	Bar Chart
1	665	13.9	□□□□□□□□□□□□□□□□□□□
2	1673	35.1	□□□
3	1720	36.0	□□
4	549	11.5	□□□□□□□□□□□□□□□□
5	165	3.5	□□□□□

3. SPORTS

SPORTS	Frequency	Percentage	Bar Chart
1	975	20.4	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
2	1591	33.3	□□
3	1495	31.3	□□□
4	509	10.7	□□□□□□□□□□□□□□□□
5	202	4.2	□□□□□□

4. EDUMOT

EDUMOT	Frequency	Percentage	Bar Chart
1	1335	28.0	□□□□□□□□□□□□□□□□□□□□□□□□□□
2	2627	55.1	□□
3	144	3.0	□□□
4	483	10.1	□□□□□□□□□□
5	35	0.7	□
6	14	0.3	
7	134	2.8	□□

5. EDUFAT

EDUFAT	Frequency	Percentage	Bar Chart
1	511	10.7	□□□□□□□□□□□
2	2524	52.9	□□
3	287	6.0	□□□□□
4	777	16.3	□□□□□□□□□□□□□□□
5	125	2.6	□□□
6	59	1.2	□
7	489	10.2	□□□□□□□□□□

6. BOOKS

	Frequency	Percentage	Bar Chart
1	911	19.1	□□□□□□□□□□□□□□□□□□□□□□□□□
2	1744	36.5	□□□
3	1379	28.9	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	445	9.3	□□□□□□□□□□□□
5	293	6.1	□□□□□□□□

7. MOTIMPT

	Frequency	Percentage	Bar Chart
1	63	1.3	□
2	187	3.9	□□□
3	1625	34.1	□□□□□□□□□□□□□□□□□□□□□□□□□□
4	2897	60.7	□□□

8. FRIENDIM

	Frequency	Percentage	Bar Chart
1	71	1.5	□
2	255	5.3	□□□□□
3	1953	40.9	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	2493	52.2	□□□

9. SELFIMPT

	Frequency	Percentage	Bar Chart
1	49	1.0	□
2	96	2.0	□
3	1208	25.3	□□□□□□□□□□□□□□□□□
4	3419	71.6	□□□

10. LIKEMORE

	Frequency	Percentage	Bar Chart
1	531	11.1	□□□□□□□□□□□□□□□□
2	1441	30.2	□□□
3	1575	33.0	□□
4	1225	25.7	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

11. DIFF

	Frequency	Percentage	Bar Chart
1	632	13.2	□□□□□□□□□□□□□□□□□□
2	1650	34.6	□□□
3	1657	34.7	□□□
4	833	17.5	□□□□□□□□□□□□□□□□□□□□□□□□

12. NOTALENT

	Frequency	Percentage	Bar Chart
1	759	15.9	□□□□□□□□□□□□□□□□□□□
2	1863	39.0	□□□
3	1456	30.5	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	694	14.5	□□□□□□□□□□□□□□□□□□

13. NEVER

	Frequency	Percentage	Bar Chart
1	717	15.0	□□□□□□□□□□□□□□□□□□
2	1923	40.3	□□□
3	1416	29.7	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	716	15.0	□□□□□□□□□□□□□□□□□

14. NOSTRENG

	Frequency	Percentage	Bar Chart
1	649	13.6	□□□□□□□□□□□□□□□□□
2	1746	36.6	□□□
3	1727	36.2	□□
4	650	13.6	□□□□□□□□□□□□□□□□□

15. NEGLECT	Frequency	Percentage	Bar Chart
1	898	18.8	
2	1691	35.4	
3	1553	32.5	
4	630	13.2	

16. ORDERLY	Frequency	Percentage	Bar Chart
1	377	7.9	
2	1389	29.1	
3	1932	40.5	
4	1074	22.5	

17. DOASTOLD	Frequency	Percentage	Bar Chart
1	289	6.1	
2	1090	22.8	
3	2029	42.5	
4	1364	28.6	

18. TEASHOW	Frequency	Percentage	Bar Chart
1	46	1.0	
2	697	14.6	
3	1580	33.1	
4	2449	51.3	

19. COPYNOTE	Frequency	Percentage	Bar Chart
1	29	0.6	
2	219	4.6	
3	1379	28.9	
4	3145	65.9	

20. TEAEXPRU	Frequency	Percentage	Bar Chart
1	80	1.7	
2	445	9.3	
3	1282	26.9	
4	2965	62.1	

21. PROJECTS	Frequency	Percentage	Bar Chart
1	2301	48.2	
2	1475	30.9	
3	533	11.2	
4	463	9.7	

22. PAIRSMGR	Frequency	Percentage	Bar Chart
1	1846	38.7	
2	1961	41.1	
3	549	11.5	
4	416	8.7	

23. DISCUSSP	Frequency	Percentage	Bar Chart
1	1219	25.5	
2	2039	42.7	
3	854	17.9	
4	660	13.8	

24. SMLGRP	Frequency	Percentage	Bar Chart
1	2204	46.2	
2	1711	35.9	
3	494	10.4	
4	363	7.6	

25. ASKSTU

ASKSTU	Frequency	Percentage	Bar Chart
1	603	12.6	
2	1918	40.2	
3	1248	26.2	
4	1003	21.0	

26. MAT1

Frequency	Percentage	Lower Class Limit
3	0.1	97.270
21	0.4	163.006
120	2.5	228.742
538	11.3	294.478
1271	26.6	360.214
1447	30.3	425.950
951	19.9	491.686
334	7.0	557.422
83	1.7	623.158
4	0.1	688.894

27. MAT2

Frequency	Percentage	Lower Class Limit
31	0.6	144.420
176	3.7	219.848
681	14.3	295.276
1546	32.4	370.704
1465	30.7	446.132
724	15.2	521.560
132	2.8	596.988
15	0.3	672.416
1	0.0	747.844
1	0.0	823.272

28. MAT3

Frequency	Percentage	Lower Class Limit
9	0.2	126.000
60	1.3	197.190
388	8.1	268.380
1124	23.6	339.570
1585	33.2	410.760
1111	23.3	481.950
418	8.8	553.140
67	1.4	624.330
9	0.2	695.520
1	0.0	766.710

29. MAT4

Frequency	Percentage	Lower Class Limit
8	0.2	113.020
32	0.7	176.994
197	4.1	240.968
646	13.5	304.942
1273	26.7	368.916
1380	28.9	432.890
837	17.5	496.864
330	6.9	560.838
57	1.2	624.812
12	0.3	688.786

30. MAT5

Frequency	Percentage	Lower Class Limit	
42	0.9	176.740	□
213	4.5	244.003	□□□□□
738	15.5	311.266	□□□□□□□□□□□□□□□□□□□
1417	29.7	378.529	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
1362	28.5	445.792	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
737	15.4	513.055	□□□□□□□□□□□□□□□□□□□
231	4.8	580.318	□□□□□□
31	0.6	647.581	
0	0.0	714.844	
1	0.0	782.107	

APPENDIX E

UNIVARIATE DISTRIBUTIONS FOR ORDINAL VARIABLES AND HISTOGRAMS FOR CONTINUOUS VARIABLES OF THE MATHEMATICS ACHIEVEMENT MODEL OF THE NETHERLANDS

1. WATCHTV	Frequency	Percentage	Bar Chart
1	55	2.0	
2	421	15.4	
3	1339	49.1	
4	723	26.5	
5	190	7.0	

2. PLAYING	Frequency	Percentage	Bar Chart
1	115	4.2	
2	613	22.5	
3	1036	38.0	
4	578	21.2	
5	386	14.1	

3. SPORTS	Frequency	Percentage	Bar Chart
1	469	17.2	
2	431	15.8	
3	1269	46.5	
4	411	15.1	
5	148	5.4	

4. MOTIMPT	Frequency	Percentage	Bar Chart
1	9	0.3	
2	71	2.6	
3	1551	56.9	
4	1097	40.2	

5. FRIENDIM	Frequency	Percentage	Bar Chart
1	39	1.4	
2	348	12.8	
3	1818	66.6	
4	523	19.2	

6. SELFIMPT	Frequency	Percentage	Bar Chart
1	10	0.4	
2	37	1.4	
3	1416	51.9	
4	1265	46.4	

7. LIKEMORE	Frequency	Percentage	Bar Chart
1	312	11.4	
2	1004	36.8	
3	885	32.4	
4	527	19.3	

8. DIFF	Frequency	Percentage	Bar Chart
1	661	24.2	
2	1493	54.7	
3	411	15.1	
4	163	6.0	

9. NOTALENT	Frequency	Percentage	Bar Chart
1	578	21.2	
2	1247	45.7	
3	608	22.3	
4	295	10.8	

10. NEVER	Frequency	Percentage	Bar Chart
1	631	23.1	
2	1396	51.2	
3	510	18.7	
4	191	7.0	

11. NOSTRENG	Frequency	Percentage	Bar Chart
1	464	17.0	
2	818	30.0	
3	930	34.1	
4	516	18.9	

12. NEGLECT	Frequency	Percentage	Bar Chart
1	315	11.5	
2	909	33.3	
3	1357	49.7	
4	147	5.4	

13. ORDERLY	Frequency	Percentage	Bar Chart
1	270	9.9	
2	1308	47.9	
3	1041	38.2	
4	109	4.0	

14. DOASTOLD	Frequency	Percentage	Bar Chart
1	328	12.0	
2	1399	51.3	
3	911	33.4	
4	90	3.3	

15. TEASHOW	Frequency	Percentage	Bar Chart
1	122	4.5	
2	680	24.9	
3	1026	37.6	
4	900	33.0	

16. COPYNOTE	Frequency	Percentage	Bar Chart
1	488	17.9	
2	1166	42.7	
3	656	24.0	
4	418	15.3	

17. TEAEXPRU

TEAEXPRU	Frequency	Percentage	Bar Chart
1	266	9.8	
2	740	27.1	
3	887	32.5	
4	835	30.6	

18. MAT1

Frequency	Percentage	Lower Class Limit
4	0.1	281.240
20	0.7	327.835
92	3.4	374.430
238	8.7	421.025
470	17.2	467.620
711	26.1	514.215
683	25.0	560.810
403	14.8	607.405
93	3.4	654.000
14	0.5	700.595

19. MAT2

Frequency	Percentage	Lower Class Limit
6	0.2	281.510
30	1.1	329.986
92	3.4	378.462
241	8.8	426.938
571	20.9	475.414
732	26.8	523.890
669	24.5	572.366
298	10.9	620.842
75	2.7	669.318
14	0.5	717.794

20. MAT3

Frequency	Percentage	Lower Class Limit
1	0.0	229.940
9	0.3	282.460
36	1.3	334.980
134	4.9	387.500
390	14.3	440.020
687	25.2	492.540
809	29.7	545.060
500	18.3	597.580
136	5.0	650.100
26	1.0	702.620

21. MAT4

Frequency	Percentage	Lower Class Limit
1	0.0	233.660
14	0.5	289.547
37	1.4	345.434
188	6.9	401.321
559	20.5	457.208
820	30.1	513.095
757	27.7	568.982
301	11.0	624.869
41	1.5	680.756
10	0.4	736.643

22.MAT5

Frequency	Percentage	Lower Class Limit	
4	0.1	280.160	
21	0.8	328.204	□
71	2.6	376.248	□□□
241	8.8	424.292	□□□□□□□□□□□□
517	19.0	472.336	□□□□□□□□□□□□□□□□□□□□□□□□□□
734	26.9	520.380	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
693	25.4	568.424	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
338	12.4	616.468	□□□□□□□□□□□□□□□□□
97	3.6	664.512	□□□□□
12	0.4	712.556	

APPENDIX F

UNIVARIATE DISTRIBUTIONS FOR ORDINAL VARIABLES AND HISTOGRAMS FOR CONTINUOUS VARIABLES OF THE MATHEMATICS ACHIEVEMENT MODEL OF ITALY

1. EDUMOT	Frequency	Percentage	Bar Chart
1	82	2.9	□□□□
2	433	15.6	□□□□□□□□□□□□□□□□□□□□□
3	1019	36.6	□□□
4	848	30.5	□□□
5	127	4.6	□□□□□□
6	102	3.7	□□□□□
7	170	6.1	□□□□□□□□

2. EDUFAT	Frequency	Percentage	Bar Chart
1	94	3.4	□□□□
2	351	12.6	□□□□□□□□□□□□□□□□□
3	1015	36.5	□□□
4	836	30.1	□□□
5	150	5.4	□□□□□□□
6	109	3.9	□□□□□
7	226	8.1	□□□□□□□□□□

3. BOOKS	Frequency	Percentage	Bar Chart
1	305	11.0	□□□□□□□□□□□□□□□□□□□
2	691	24.8	□□
3	779	28.0	□□□
4	424	15.2	□□□□□□□□□□□□□□□□□□□□□□□□□□□
5	582	20.9	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□

4. MOTIMPT	Frequency	Percentage	Bar Chart
1	10	0.4	
2	17	0.6	
3	1058	38.0	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	1696	61.0	□□□

5. FRIENDIM	Frequency	Percentage	Bar Chart
1	99	3.6	□□□
2	455	16.4	□□□□□□□□□□□□□□
3	1632	58.7	□□□
4	595	21.4	□□□□□□□□□□□□□□□□□□

6. SELFIMPT	Frequency	Percentage	Bar Chart
1	23	0.8	□
2	56	2.0	□□
3	1123	40.4	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	1579	56.8	□□

7. LIKEMORE	Frequency	Percentage	Bar Chart
1	196	7.0	□□□□□□□□
2	813	29.2	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
3	1119	40.2	□□□
4	653	23.5	□□□□□□□□□□□□□□

8. DIFF	Frequency	Percentage	Bar Chart
1	609	21.9	□□□□□□□□□□□□□□□□□□□□□□□
2	1203	43.3	□□
3	623	22.4	□□□□□□□□□□□□□□□□□□□□□□□□
4	346	12.4	□□□□□□□□□□□□□□

9. NOTALENT	Frequency	Percentage	Bar Chart
1	710	25.5	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
2	1104	39.7	□□□
3	587	21.1	□□□□□□□□□□□□□□□□□□□□□□□□□
4	380	13.7	□□□□□□□□□□□□□□□□

10. NEVER	Frequency	Percentage	Bar Chart
1	782	28.1	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
2	1231	44.3	□□
3	488	17.5	□□□□□□□□□□
4	280	10.1	□□□□□□□□□□□

11. NOSTRENG	Frequency	Percentage	Bar Chart
1	656	23.6	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
2	897	32.3	□□
3	726	26.1	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	502	18.1	□□□□□□□□□□□□□□□□□□□□□□□□□□

12. NEGLECT	Frequency	Percentage	Bar Chart
1	421	15.1	□□□□□□□□□□□□□□□□□
2	1268	45.6	□□□
3	952	34.2	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	140	5.0	□□□□□

13. ORDERLY	Frequency	Percentage	Bar Chart
1	240	8.6	□□□□□□□□□□
2	1154	41.5	□□□
3	1091	39.2	□□□
4	296	10.6	□□□□□□□□□□□□

14. DOASTOLD	Frequency	Percentage	Bar Chart
1	276	9.9	□□□□□□□□□□□
2	1159	41.7	□□
3	1084	39.0	□□□
4	262	9.4	□□□□□□□□□□□

15. TEASHOW	Frequency	Percentage	Bar Chart
1	45	1.6	□□
2	506	18.2	□□□□□□□□□□□□□□□□□
3	861	31.0	□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
4	1369	49.2	□□

16. COPYNOTE	Frequency	Percentage	Bar Chart
1	152	5.5	
2	661	23.8	
3	803	28.9	
4	1165	41.9	

17. TEAEXPRU	Frequency	Percentage	Bar Chart
1	76	2.7	
2	185	6.7	
3	558	20.1	
4	1962	70.6	

18. PROJECTS	Frequency	Percentage	Bar Chart
1	1139	41.0	
2	1035	37.2	
3	441	15.9	
4	166	6.0	

19. PAIRSMGR	Frequency	Percentage	Bar Chart
1	938	33.7	
2	1111	39.9	
3	462	16.6	
4	270	9.7	

20. DISCUSSP	Frequency	Percentage	Bar Chart
1	765	27.5	
2	1116	40.1	
3	562	20.2	
4	338	12.2	

21. SMLGRP	Frequency	Percentage	Bar Chart
1	1474	53.0	
2	882	31.7	
3	271	9.7	
4	154	5.5	

22. ASKSTU	Frequency	Percentage	Bar Chart
1	618	22.2	
2	1068	38.4	
3	662	23.8	
4	433	15.6	

23. MAT1

Frequency	Percentage	Lower Class Limit	
12	0.4	190.770	
50	1.8	250.148	
140	5.0	309.526	
441	15.9	368.904	
721	25.9	428.282	
750	27.0	487.660	
494	17.8	547.038	
155	5.6	606.416	
14	0.5	665.794	
4	0.1	725.172	

24. MAT2

Frequency	Percentage	Lower Class Limit
16	0.6	192.990
63	2.3	257.500
233	8.4	322.010
580	20.9	386.520
806	29.0	451.030
735	26.4	515.540
285	10.2	580.050
58	2.1	644.560
4	0.1	709.070
1	0.0	773.580

25. MAT3

Frequency	Percentage	Lower Class Limit
6	0.2	157.190
37	1.3	228.924
194	7.0	300.658
559	20.1	372.392
931	33.5	444.126
737	26.5	515.860
273	9.8	587.594
42	1.5	659.328
1	0.0	731.062
1	0.0	802.796

26. MAT4

Frequency	Percentage	Lower Class Limit
24	0.9	195.040
92	3.3	264.633
344	12.4	334.226
681	24.5	403.819
909	32.7	473.412
564	20.3	543.005
148	5.3	612.598
17	0.6	682.191
1	0.0	751.784
1	0.0	821.377

27. MAT5

Frequency	Percentage	Lower Class Limit
6	0.2	178.360
39	1.4	243.793
209	7.5	309.226
488	17.5	374.659
844	30.3	440.092
757	27.2	505.525
356	12.8	570.958
73	2.6	636.391
7	0.3	701.824
2	0.1	767.257

APPENDIX G

SYNTAX OF THE MATHEMATICS MODEL OF TURKEY

```
Turkey
Observed Variables
WATCHTV PLAYING SPORTS EDUMOT EDUFAT BOOKS MOTIMPT FRIENDIM
SELFIMPT LIKEMORE
DIFF NOTALENT NEVER NOSTRENG NEGLECT ORDERLY DOASTOLD TEASHOW
COPYNOTE
TEAEXPRU PROJECTS PAIRSMGR DISCUSSP SMLGRP ASKSTU MAT1 MAT2 MAT3
MAT4 MAT5
Covariance Matrix
1.00
0.26 1.00
0.10 0.32 1.00
0.05 -0.00 0.04 1.00
0.03 -0.04 0.01 0.62 1.00
0.04 -0.03 0.07 0.33 0.41 1.00
-0.01 -0.02 -0.02 0.13 0.07 0.10 1.00
-0.05 -0.04 -0.06 0.03 0.01 0.02 0.54 1.00
0.03 -0.06 -0.06 0.09 0.06 0.08 0.65 0.61 1.00
0.08 0.04 -0.01 -0.03 -0.08 -0.07 -0.09 -0.00 -0.08 1.00
0.05 0.06 0.00 -0.07 -0.10 -0.10 -0.10 -0.01 -0.12 0.66
1.00
0.03 0.05 -0.03 -0.09 -0.12 -0.09 -0.15 -0.07 -0.17 0.55
0.66 1.00
0.05 0.03 0.00 -0.10 -0.10 -0.11 -0.14 -0.07 -0.14 0.41
0.49 0.50 1.00
0.09 0.06 -0.03 -0.06 -0.09 -0.10 -0.15 -0.09 -0.13 0.54
0.57 0.65 0.51 1.00
-0.02 0.00 0.03 0.02 0.05 0.07 0.04 0.07 0.05 -0.14
-0.15 -0.14 -0.15 -0.12 1.00
-0.08 -0.00 0.05 -0.03 -0.04 -0.03 0.14 0.18 0.13 -0.01
0.02 -0.00 -0.01 -0.03 0.23 1.00
-0.09 -0.01 0.04 -0.04 -0.06 -0.07 0.16 0.22 0.16 -0.00
-0.00 -0.02 -0.02 -0.04 0.21 0.61 1.00
0.00 0.02 0.01 0.01 0.02 0.02 0.12 0.13 0.15 -0.04
-0.06 -0.07 -0.04 -0.06 0.03 0.08 0.09 1.00
0.03 -0.02 -0.06 0.03 0.01 -0.01 0.08 0.11 0.15 -0.02
-0.02 -0.06 -0.05 -0.04 0.02 -0.01 0.02 0.29 1.00
0.01 -0.03 -0.05 0.06 0.07 0.08 0.17 0.19 0.23 -0.04
-0.07 -0.11 -0.10 -0.09 0.03 0.04 0.06 0.34 0.33
1.00
```

-0.05 0.02 0.13 -0.05 -0.10 -0.03 0.02 0.06 -0.00 0.01
0.05 0.05 0.06 0.01 -0.02 0.15 0.15 0.20 0.02
0.08 1.00
-0.07 0.03 0.08 -0.06 -0.07 -0.01 0.04 0.11 0.04 -0.02
-0.00 -0.02 -0.03 -0.06 0.03 0.14 0.16 0.17 0.01
0.09 0.28 1.00
0.02 0.04 0.09 0.02 -0.02 0.03 0.01 0.03 0.01 -0.01
0.01 0.01 0.02 -0.02 0.02 0.11 0.10 0.17 0.08
0.21 0.30 0.25 1.00
-0.06 0.03 0.12 -0.09 -0.09 -0.01 -0.03 0.04 -0.05 0.01
0.03 0.01 0.02 -0.00 -0.02 0.14 0.15 0.12 -0.01
0.08 0.43 0.51 0.42 1.00
-0.04 0.01 0.08 -0.02 -0.02 0.01 0.06 0.06 0.05 -0.04
-0.00 -0.01 -0.00 -0.05 0.01 0.12 0.12 0.21 0.11
0.19 0.25 0.25 0.34 0.36 1.00
0.04 -0.10 -0.07 0.21 0.22 0.19 0.15 0.07 0.23 -0.28
-0.37 -0.38 -0.31 -0.30 0.08 -0.08 -0.11 -0.03 0.07
0.09 -0.21 -0.08 -0.05 -0.19 -0.12 1.00
0.07 -0.08 -0.06 0.24 0.24 0.21 0.14 0.02 0.20 -0.28
-0.36 -0.38 -0.30 -0.29 0.11 -0.08 -0.10 -0.00 0.08
0.08 -0.19 -0.06 -0.06 -0.19 -0.09 0.82 1.00
0.07 -0.07 -0.05 0.26 0.28 0.23 0.15 0.04 0.21 -0.27
-0.33 -0.36 -0.31 -0.28 0.07 -0.11 -0.14 0.01 0.09
0.06 -0.20 -0.10 -0.07 -0.18 -0.10 0.83 0.82 1.00
0.05 -0.08 -0.06 0.24 0.25 0.21 0.15 0.06 0.24 -0.27
-0.35 -0.37 -0.32 -0.28 0.08 -0.08 -0.10 0.01 0.10
0.10 -0.20 -0.08 -0.07 -0.21 -0.10 0.83 0.82 0.82
1.00
0.05 -0.09 -0.05 0.25 0.25 0.21 0.15 0.05 0.22 -0.26
-0.33 -0.35 -0.30 -0.27 0.07 -0.12 -0.13 -0.03 0.06
0.12 -0.18 -0.09 -0.05 -0.19 -0.13 0.82 0.82 0.82
0.83 1.00
Sample Size = 4772
Latent Variables OUTOFSCH SES IMPT PERFAIL CLIMATE TEACACT STUACT ACHV
Relationships
WATCHTV PLAYING SPORTS = OUTOFSCH
EDUMOT EDUFAT BOOKS = SES
MOTIMPT FRIENDIM SELFIMPT = IMPT
LIKEMORE DIFF NOTALENT NEVER NOSTRENG = PERFAIL
NEGLECT ORDERLY DOASTOLD = CLIMATE
TEASHOW COPYNOTE TEAEXPRU = TEACACT
PROJECTS PAIRSMGR DISCUSSP SMLGRP ASKSTU = STUACT
MAT1 MAT2 MAT3 MAT4 MAT5 = ACHV
ACHV = OUTOFSCH SES IMPT PERFAIL CLIMATE TEACACT STUACT
PERFAIL = OUTOFSCH SES IMPT TEACACT
CLIMATE = SES IMPT TEACACT STUACT
LET THE ERROR COVARIANCES BETWEEN DIFF AND LIKEMORE CORRELATE
LET THE ERROR COVARIANCES BETWEEN NOSTRENG AND DIFF CORRELATE
LET THE ERROR COVARIANCES BETWEEN SMLGRP AND PAIRSMGR CORRELATE
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem

APPENDIX H

THE BASIC MODEL OF TURKEY WITH ESTIMATES

APPENDIX I

BASIC MODEL OF TURKEY WITH T-VALUES

APPENDIX J

SYNTAX OF THE MATHEMATICS MODEL OF THE NETHERLANDS

```
Netherlands
Observed Variables
WATCHTV PLAYING SPORTS MOTIMPT FRIENDIM SELFIMPT LIKEMORE DIFF
NOTALENT NEVER
NOSTRENG NEGLECT ORDERLY DOASTOLD TEASHOW COPYNOTE TEAEXPRU
MAT1 MAT2
MAT3 MAT4 MAT5
Covariance Matrix
1.00
0.30 1.00
0.08 0.23 1.00
-0.03 0.00 -0.01 1.00
-0.04 -0.04 -0.00 0.47 1.00
-0.06 -0.03 0.03 0.66 0.53 1.00
0.08 0.10 0.00 0.01 0.06 -0.03 1.00
0.03 0.08 -0.01 -0.08 0.01 -0.11 0.62 1.00
0.05 0.11 0.00 -0.10 -0.02 -0.18 0.59 0.69 1.00
0.09 0.09 -0.00 -0.10 -0.05 -0.10 0.49 0.51 0.49 1.00
0.05 0.10 -0.02 -0.07 0.04 -0.12 0.60 0.64 0.72 0.49
1.00
-0.08 -0.05 0.01 0.09 0.10 0.05 -0.09 -0.08 -0.11 -0.11
-0.07 1.00
-0.04 -0.00 0.01 0.11 0.14 0.10 0.01 -0.00 -0.03 -0.05
-0.03 0.48 1.00
-0.02 -0.05 0.01 0.10 0.15 0.12 -0.01 -0.02 -0.05 -0.04
-0.03 0.44 0.57 1.00
-0.04 -0.03 -0.03 0.08 0.10 0.10 -0.00 0.02 -0.01 -0.03
0.00 0.16 0.08 0.05 1.00
-0.02 0.02 0.02 0.08 0.12 0.10 0.09 0.10 0.06 0.02
0.06 0.20 0.15 0.15 0.38 1.00
-0.04 0.02 0.04 0.16 0.11 0.16 0.07 0.02 0.04 0.03
0.05 0.14 0.07 0.10 0.33 0.36 1.00
-0.14 -0.22 -0.04 -0.18 -0.13 -0.14 -0.27 -0.29 -0.26 -0.25
-0.24 0.05 -0.05 -0.03 0.04 -0.09 -0.10 1.00
-0.16 -0.25 -0.04 -0.14 -0.10 -0.09 -0.29 -0.31 -0.29 -0.28
-0.27 0.04 -0.03 -0.02 0.06 -0.04 -0.05 0.86 1.00
-0.13 -0.24 -0.05 -0.17 -0.14 -0.12 -0.28 -0.30 -0.27 -0.27
-0.24 0.07 -0.03 -0.04 0.07 -0.04 -0.05 0.86 0.86
1.00
-0.11 -0.25 -0.04 -0.15 -0.12 -0.12 -0.26 -0.29 -0.25 -0.26
```

-0.23 0.07 -0.02 -0.04 0.06 -0.03 -0.06 0.86 0.86
0.87 1.00
-0.12 -0.25 -0.04 -0.15 -0.10 -0.11 -0.29 -0.30 -0.28 -0.29
-0.26 0.08 -0.03 -0.03 0.06 -0.04 -0.07 0.85 0.85
0.86 0.86 1.00
Sample Size = 2728
Latent Variables OUTOFSCH IMPT PERFAIL CLIMATE TEACACT ACHV
Relationships
WATCHTV PLAYING SPORTS = OUTOFSCH
MOTIMPT FRIENDIM SELFIMPT = IMPT
LIKEMORE DIFF NOTALENT NEVER NOSTRENG = PERFAIL
NEGLECT ORDERLY DOASTOLD = CLIMATE
TEASHOW COPYNOTE TEAEXPRU = TEACACT
MAT1 MAT2 MAT3 MAT4 MAT5 = ACHV
ACHV = OUTOFSCH IMPT PERFAIL TEACACT
PERFAIL = OUTOFSCH IMPT CLIMATE TEACACT
CLIMATE = IMPT TEACACT
LET THE ERROR COVARIANCES NOSTRENG AND NOTALENT CORRELATE
LET THE ERROR COVARIANCES DOASTOLD AND ORDERLY CORRELATE
Path Diagram
Iterations = 250
Method of Estimation: Maximum Likelihood
End of Problem

APPENDIX K

THE BASIC MODEL OF THE NETHERLANDS WITH ESTIMATES

APPENDIX L

BASIC MODEL OF THE NETHERLANDS WITH T-VALUES

APPENDIX M

SYNTAX OF THE MATHEMATICS MODEL OF ITALY

Italy
Observed Variables
EDUMOT EDUFAT BOOKS MOTIMPT FRIENDIM SELFIMPT LIKEMORE DIFF
NOTALENT NEVER
NOSTRENG NEGLECT ORDERLY DOASTOLD TEASHOW COPYNOTE TEAEXPRU
PROJECTS PAIRSMGR
DISCUSSP SMLGRP ASKSTU MAT1 MAT2 MAT3 MAT4 MAT5
Covariance Matrix
1.00
0.63 1.00
0.36 0.38 1.00
0.07 0.05 0.10 1.00
-0.04 -0.00 -0.03 0.34 1.00
0.03 0.05 0.06 0.67 0.45 1.00
-0.13 -0.10 -0.11 -0.05 0.06 -0.10 1.00
-0.21 -0.20 -0.19 -0.16 0.04 -0.20 0.59 1.00
-0.15 -0.17 -0.15 -0.20 0.01 -0.29 0.51 0.73 1.00
-0.19 -0.19 -0.14 -0.21 0.02 -0.26 0.40 0.60 0.62 1.00
-0.10 -0.11 -0.08 -0.16 0.02 -0.28 0.50 0.69 0.80 0.58
1.00
0.01 0.04 0.00 -0.01 0.16 0.01 -0.09 -0.09 -0.09 -0.09
-0.10 1.00
-0.06 -0.03 -0.06 0.11 0.31 0.14 0.01 0.08 0.03 0.06
-0.01 0.38 1.00
-0.07 -0.03 -0.09 0.05 0.35 0.14 0.02 0.07 0.03 0.05
-0.01 0.40 0.62 1.00
-0.05 -0.01 -0.03 0.05 0.01 0.05 0.10 0.10 0.04 0.05
0.06 -0.04 0.01 0.00 1.00
-0.05 -0.03 -0.04 0.03 0.05 0.08 0.09 0.12 0.07 0.10
0.07 -0.03 0.04 0.05 0.33 1.00
-0.04 -0.00 -0.00 0.09 0.08 0.12 0.03 -0.01 -0.02 -0.03
-0.03 -0.02 0.09 0.05 0.19 0.14 1.00
-0.04 0.00 0.00 0.09 0.12 0.12 -0.02 0.05 0.01 0.03
-0.06 0.06 0.13 0.16 0.12 0.14 0.07 1.00
-0.08 -0.07 -0.05 -0.02 0.05 0.01 0.02 0.06 0.03 0.04
-0.02 0.01 0.05 0.09 0.03 0.07 -0.04 0.29 1.00
-0.00 -0.01 -0.01 0.06 0.05 0.11 0.00 0.04 0.01 0.04
-0.02 0.05 0.13 0.07 0.11 0.09 -0.01 0.32 0.20
1.00
-0.13 -0.10 -0.08 0.02 0.11 0.03 0.07 0.16 0.13 0.12

0.04 0.03 0.12 0.14 0.09 0.09 0.02 0.41 0.58
0.38 1.00
-0.09 -0.08 -0.09 0.01 0.12 0.07 0.08 0.16 0.10 0.13
0.06 0.01 0.12 0.14 0.10 0.11 0.09 0.29 0.23
0.29 0.39 1.00
0.30 0.26 0.23 0.15 -0.12 0.12 -0.33 -0.50 -0.45 -0.41
-0.42 0.08 -0.12 -0.14 -0.07 -0.10 0.00 -0.11 -0.14
-0.05 -0.29 -0.23 1.00
0.29 0.25 0.23 0.14 -0.09 0.10 -0.31 -0.48 -0.44 -0.39
-0.41 0.05 -0.12 -0.15 -0.02 -0.10 -0.01 -0.11 -0.12
-0.04 -0.26 -0.23 0.88 1.00
0.30 0.26 0.25 0.16 -0.08 0.13 -0.33 -0.48 -0.45 -0.41
-0.41 0.08 -0.09 -0.13 -0.06 -0.09 -0.01 -0.11 -0.13
-0.04 -0.27 -0.21 0.89 0.88 1.00
0.28 0.26 0.26 0.15 -0.11 0.12 -0.33 -0.50 -0.47 -0.42
-0.43 0.09 -0.11 -0.14 -0.05 -0.11 -0.02 -0.10 -0.12
-0.06 -0.29 -0.23 0.88 0.89 0.88 1.00
0.28 0.25 0.25 0.15 -0.12 0.11 -0.34 -0.50 -0.46 -0.41
-0.44 0.09 -0.12 -0.15 -0.05 -0.10 -0.02 -0.10 -0.13
-0.06 -0.28 -0.25 0.88 0.89 0.88 0.88 1.00
Sample Size = 2781
Latent Variables SES IMPT PERFAIL CLIMATE TEACACT STUACT ACHV
Relationships
EDUMOT EDUFAT BOOKS = SES
MOTIMPT FRIENDIM SELFIMPT = IMPT
LIKEMORE DIFF NOTALENT NEVER NOSTRENG NEGLECT = PERFAIL
NEGLECT ORDERLY DOASTOLD = CLIMATE
TEASHOW COPYNOTE TEAEXPRU = TEACACT
PROJECTS PAIRSMGR DISCUSSP SMLGRP ASKSTU = STUACT
MAT1 MAT2 MAT3 MAT4 MAT5 = ACHV
ACHV = SES PERFAIL CLIMATE STUACT
PERFAIL = SES IMPT TEACACT STUACT
CLIMATE = SES IMPT STUACT
SET ERROR COVARIANCE OF DIFF AND LIKEMORE FREE
SET ERROR COVARIANCE OF NOSTRENG AND NOTALENT FREE
SET ERROR COVARIANCE OF SMLGRP AND PAIRSMGR FREE
SET ERROR COVARIANCE OF FRIENDIMP AND DOASTOLD FREE
SET ERROR COVARIANCE OF FRIENDIMP AND ORDERLY FREE
Path Diagram
Admissibility Check = Off
Iterations = 5000
Method of Estimation: Maximum Likelihood
End of Problem

APPENDIX N

THE BASIC MODEL OF ITALY WITH ESTIMATES

APPENDIX O

BASIC MODEL OF ITALY WITH T-VALUES

APPENDIX P

FREQUENCY TABLES OF OBSERVED VARIABLES OF TEACHER-CENTERED ACTIVITIES

Turkey

mat\teacher show how to do problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	3926	50,1	51,6	51,6
	pretty often	2448	31,2	32,2	83,7
	once in a while	1135	14,5	14,9	98,7
	never	102	1,3	1,3	100,0
	Total	7611	97,1	100,0	
Missing	not admin.	10	,1		
	System	220	2,8		
	Total	230	2,9		
Total		7841	100,0		

mat\copy notes from the board

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	4873	62,1	64,4	64,4
	pretty often	2242	28,6	29,6	94,0
	once in a while	390	5,0	5,2	99,1
	never	66	,8	,9	100,0
	Total	7571	96,6	100,0	
Missing	not admin.	10	,1		
	System	260	3,3		
	Total	270	3,4		
Total		7841	100,0		

mat\new topic\teacher explains rules

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	4654	59,4	61,0	61,0
	pretty often	2055	26,2	26,9	87,9
	once in a while	764	9,7	10,0	97,9
	never	161	2,1	2,1	100,0
	Total	7634	97,4	100,0	
Missing	not admin.	18	,2		
	System	189	2,4		
	Total	207	2,6		
Total		7841	100,0		

Italy

mat\teacher show how to do problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	1632	49,0	49,4	49,4
	pretty often	1030	30,9	31,2	80,5
	once in a while	591	17,8	17,9	98,4
	never	52	1,6	1,6	100,0
	Total	3305	99,3	100,0	
Missing	System	23	,7		
Total		3328	100,0		

mat\copy notes from the board

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	1374	41,3	41,6	41,6
	pretty often	972	29,2	29,4	71,0
	once in a while	780	23,4	23,6	94,6
	never	178	5,3	5,4	100,0
	Total	3304	99,3	100,0	
Missing	System	24	,7		
Total		3328	100,0		

mat\new topic\teacher explains rules

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	2309	69,4	69,8	69,8
	pretty often	685	20,6	20,7	90,5
	once in a while	226	6,8	6,8	97,3
	never	89	2,7	2,7	100,0
	Total	3309	99,4	100,0	
Missing	System	19	,6		
Total		3328	100,0		

The Netherlands

mat\teacher show how to do problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	940	31,7	33,0	33,0
	pretty often	1076	36,3	37,8	70,7
	once in a while	707	23,9	24,8	95,5
	never	127	4,3	4,5	100,0
	Total	2850	96,2	100,0	
Missing	not admin.	96	3,2		
	System	16	,5		
	Total	112	3,8		
Total		2962	100,0		

mat\copy notes from the board

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	438	14,8	15,4	15,4
	pretty often	687	23,2	24,1	39,4
	once in a while	1226	41,4	43,0	82,4
	never	501	16,9	17,6	100,0
	Total	2852	96,3	100,0	
Missing	not admin.	97	3,3		
	System	13	,4		
	Total	110	3,7		
Total		2962	100,0		

mat\new topic\teacher explains rules

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	865	29,2	30,4	30,4
	pretty often	935	31,6	32,9	63,4
	once in a while	767	25,9	27,0	90,4
	never	274	9,3	9,6	100,0
	Total	2841	95,9	100,0	
Missing	not admin.	102	3,4		
	System	19	,6		
	Total	121	4,1		
Total		2962	100,0		

APPENDIX R

FREQUENCY TABLES OF OBSERVED VARIABLES OF STUDENT-CENTERED ACTIVITIES

Turkey

mat\work on projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	780	9,9	10,6	10,6
	pretty often	847	10,8	11,6	22,2
	once in a while	2251	28,7	30,7	52,9
	never	3455	44,1	47,1	100,0
	Total	7333	93,5	100,0	
Missing	not admin.	10	,1		
	System	498	6,4		
	Total	508	6,5		
Total		7841	100,0		

mat\work in pairs or small groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	751	9,6	10,2	10,2
	pretty often	911	11,6	12,4	22,6
	once in a while	2954	37,7	40,1	62,7
	never	2750	35,1	37,3	100,0
	Total	7366	93,9	100,0	
Missing	not admin.	11	,1		
	System	464	5,9		
	Total	475	6,1		
Total		7841	100,0		

mat\new topic\discuss proctical prob

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	1056	13,5	14,3	14,3
	pretty often	1321	16,8	17,9	32,3
	once in a while	3087	39,4	41,9	74,2
	never	1903	24,3	25,8	100,0
	Total	7367	94,0	100,0	
Missing	not admin.	16	,2		
	System	458	5,8		
	Total	474	6,0		
Total		7841	100,0		

mat\new topic\work in small groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	660	8,4	9,0	9,0
	pretty often	849	10,8	11,6	20,5
	once in a while	2639	33,7	35,9	56,4
	never	3202	40,8	43,6	100,0
	Total	7350	93,7	100,0	
Missing	not admin.	16	,2		
	System	475	6,1		
	Total	491	6,3		
Total		7841	100,0		

mat\new topic\ask what students know

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	1650	21,0	22,4	22,4
	pretty often	1911	24,4	25,9	48,3
	once in a while	2919	37,2	39,6	87,8
	never	900	11,5	12,2	100,0
	Total	7380	94,1	100,0	
Missing	not admin.	18	,2		
	System	443	5,6		
	Total	461	5,9		
Total		7841	100,0		

Italy

mat\work on projects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	198	5,9	6,1	6,1
	pretty often	516	15,5	15,8	21,8
	once in a while	1193	35,8	36,5	58,3
	never	1364	41,0	41,7	100,0
	Total	3271	98,3	100,0	
Missing	System	57	1,7		
Total		3328	100,0		

mat\work in pairs or small groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	331	9,9	10,1	10,1
	pretty often	550	16,5	16,7	26,8
	once in a while	1308	39,3	39,8	66,6
	never	1097	33,0	33,4	100,0
	Total	3286	98,7	100,0	
Missing	System	42	1,3		
Total		3328	100,0		

mat\new topic\discuss practical prob

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	394	11,8	12,0	12,0
	pretty often	679	20,4	20,7	32,7
	once in a while	1305	39,2	39,8	72,5
	never	904	27,2	27,5	100,0
	Total	3282	98,6	100,0	
Missing	System	46	1,4		
Total		3328	100,0		

mat\new topic\work in small groups

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	197	5,9	6,0	6,0
	pretty often	330	9,9	10,0	16,0
	once in a while	1042	31,3	31,7	47,7
	never	1721	51,7	52,3	100,0
	Total	3290	98,9	100,0	
Missing	System	38	1,1		
Total		3328	100,0		

mat\new topic\ask what students know

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	almost always	535	16,1	16,3	16,3
	pretty often	792	23,8	24,1	40,4
	once in a while	1240	37,3	37,8	78,2
	never	717	21,5	21,8	100,0
	Total	3284	98,7	100,0	
Missing	System	44	1,3		
Total		3328	100,0		