THE ROLES OF AFFECTIVE, SOCIOECONOMIC STATUS AND SCHOOL FACTORS ON MATHEMATICS ACHIEVEMENT: A STRUCTURAL EQUATION MODELING STUDY

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ABSTRACT

THE ROLES OF AFFECTIVE, SOCIOECONOMIC STATUS AND SCHOOL FACTORS ON MATHEMATICS ACHIEVEMENT: A STRUCTURAL EQUATION MODELING STUDY

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The purpose of the present study was to investigate the effects of socioeconomic status, school factors (classroom climate, classroom activities) and affective variables (motivation, self-efficacy, mathematics anxiety, beliefs about the nature of mathematics and teaching of mathematics, students' perceptions of their teachers and parents' attitudes toward them) on mathematics achievement with 9^{th} grade students in Ankara.

For this purpose, structural equation modeling techniques were used. In the study, there were two research problems: "What was the general model explaining the effects of socioeconomic status, affective and school factors on students' mathematics achievement?" and "how the proposed model explained mathematics achievement in three school types (Anatolian, general and vocational high schools)?"

Some of the results of the analyses conducted in the study are the followings: In the main study, socioeconomic status had strong effect on mathematics achievement. In addition, while student-centered activities generally affected students' mathematics achievement in a positive way but indirectly, teacher-centered activities had negative effects on affective variables. But for Anatolian and vocational high schools, this negative effect turned positive on mathematics achievement. In the main study, classroom climate had positive direct effects on self-efficacy and motivation toward mathematics as well as on mathematics achievement. Generally, affective variables had positive effects on mathematics achievement. But mathematics anxiety had no significant effect on it except general high school. The results of present study indicated that students' perceptions of their parents and teachers' attitudes and expectations toward them had positive indirect effects on mathematics achievement.

Keywords: Affective variables, structural equation modeling, mathematics achievement, school factors, socioeconomic status

ÖZ

DUYUŞSAL, SOSYOEKONOMİK DURUM VE OKUL FAKTÖRLERİNİN MATEMATİK BAŞARISI ÜZERİNDEKİ ROLÜ: BİR YAPISAL EŞİTLİK MODELLEMESİ ÇALIŞMASI

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Bu çalışmanın amacı sosyoekonomik durum, okul faktörleri (sınıf ortamı ve sınıf içi etkinlikler) ve duyuşsal değişkenlerin (motivasyon, öz-yeterlilik, matematik kaygısı, matematik ve matematik öğretiminin doğası hakkındaki inançlar, öğrencilerin, öğretmen ve ebeveynlerinin kendilerine karşı tutumları hakkındaki algıları) Ankara'daki 9. sınıf öğrencileri ile matematik başarısı üzerindeki etkilerini incelemektir.

Bu amaçla, yapısal eşitlik modellemesi yöntemleri kullanılmıştır. Çalışmanın iki araştırma problemi vardır: "Sosyoekonomik durum, duyuşsal ve okul faktörlerinin öğrencilerin matematik başarıları üzerindeki etkisini açıklayan genel model nedir?" ve "Önerilen model matematik başarısını üç okul türünde (Anadolu, genel ve meslek lisesi) nasıl açıklamaktadır?"

Çalışmanın sonuçlarından bazıları şöyledir: Ana çalışmada, sosyoekonomik durum matematik başarısı üzerinde güçlü bir etkiye sahiptir. Ek olarak, öğrenci-merkezli etkinlikler genellikle öğrencilerin matematik başarılarını olumlu yönde fakat dolaylı biçimde etkilerken, öğretmen-merkezli etkinlikler duyuşsal değişkenler üzerinde negatif yönde etkilere sahiptir. Fakat Anadolu ve meslek liseleri için bu negatif etki matematik başarısı üzerinde olumluya dönüşmüştür. Ana çalışmada, sınıf ortamı, öz-yeterlilik ve matematiğe karşı motivasyona etkisinin yanında matematik başarısına pozitif olarak doğrudan etkiye sahiptir. Genel olarak, duyuşsal değişkenler matematik başarısı üzerinde pozitif etkilere sahiptirler. Fakat matematik kaygısı genel liseler dışında matematik başarısı üzerinde anlamlı bir etkiye sahip değildir. Çalışmanın sonuçları, öğrencilerin, öğretmen ve ebeveynlerinin kendilerine karşı tutumları ve beklentileri hakkındaki algıları matematik başarısı üzerinde dolaylı olarak olumlu etkisi olduğuna işaret etmektedir.

Anahtar Kelimeler: Duyuşsal değişkenler, yapısal eşitlik modellemesi, matematik başarısı, okul faktörleri, sosyoekonomik durum

To my family

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LIST OF ABBREVIATIONS

SES	Socioeconomic Status of the Family
TEAC_CEN	Teacher-Centered Classroom Activities
STUD_CEN	Student-Centered Classroom Activities
CLIMATE	Classroom Climate
SP_MOTH	Students' perceptions of their mothers' attitudes and expectations toward them as learners of mathematics
SP_FATH	Students' perceptions of their fathers' attitudes and expectations toward them as learners of mathematics
SP_TEAC	Students' perceptions of their mathematics teachers' attitudes and expectations toward them as learners of mathematics
MAT_ANX	Mathematics Anxiety
MOT	Motivation to Mathematics
BELIEF	Beliefs about the Nature of Mathematics
BEL_TEAC	Beliefs about the Teaching of Mathematics
EFFICACY	Self-Efficacy toward Mathematics
MAT_ACH	Mathematics Achievement
SEM	Structural Equation Modeling
CFA	Confirmatory Factor Analysis
RMSEA	Root Mean Square Error of Approximation
AGFI	Adjusted Goodness of Fit Index
GFI	Goodness of Fit Index
S-RMR	Standardized Root Mean Square Residual

CHAPTER 1

INTRODUCTION

Many research studies have been trying to find out the variables that are considered to affect mathematics achievement and whether there exist the relationships among these variables (Abu-Hilal, 2000; Hammouri, 2004; Ma, 1999; Papanastasiou, 2002; Volet, 1997; Zhang & Post, 2000). Affective variables are also seen extremely important factors to determine the number of taking math courses, to influence motivation toward the subject and so their achievement (Ma, 1999). It is highlighted that affective dimensions are closely related to cognitive development (Aksu, Demir & Sümer, 2002; Austin & Wadlington, 1992; Corte & Eynde, 2003; Fleener, 1996; Gonske, 2002; Vanayan, White, Yuen & Teper, 1994). Parallel to these trends in the world, Turkish Ministry of National Education has also emphasized that issue in the new mathematics and science curricula developed.

One of the factors that is considered to affect mathematics achievement is self efficacy toward mathematics (Lent, Lopez & Bieschke, 1991; Ural, Umay & Argün, 2008). Individual's self efficacy can affect personal academic expectations that predict future performance (Bandura, 1997). Bandura (1977) defined self-efficacy as an individual's belief of how well he or she can behave successfully required to accomplish some task. Lent, Lopez and Bieschke (1991) found that self-efficacy mediates the effects of prior performance on motivation and, in turn, motivation mediates the effects of self-efficacy. Theories related to self-efficacy commonly provide information about social behaviors and development of these behaviors by increasing people beliefs in their efficacy. According to social cognitive theory, to set goals and expectations are important determinants of learning. According to

Bandura (1997), people's beliefs in their efficacy influence "the courses of action people choose to pursue, how much effort they put forth in given endeavors, how long they will persevere in the face of obstacles and failures, and level of accomplishments they realize" (p. 3).

Like self-efficacy, motivation also plays an important role in engaging activities, setting goals and learning (Atkinson, 1957; Pintrich & Schunk, 2002). There are some theories that contribute to understanding of motivation. Atkinson (1957) explains achievement motivation theory as individual's perform that motivates his or her to arrive best final conclusion. Another theory that focuses on motivation is goal theory. Setting goals are important to determine the purpose and steps of actions. In addition, attribution theory focuses on personal's judgments about one's success or failure with respect to how much effort one expends. According to Bandura (1997), attributions of success to ability are related to personal efficacy. Person who thinks that one fails because of insufficient effort may be more aware of one's capabilities. On the other hand, person who thinks that one fails because of lack of the ability may become discouraged easily. According to Pintrich and Schunk (2002), the attributions that people hold about can come from two sources: external or internal. External sources such as teacher feedback can influence individual's perceptions of one's ability and internal sources such as prior knowledge can influence present event. In addition, attribution theory presents teachers information about how students' expectancies for success, their self-efficacy and achievement behaviors are influenced by their success or failure attributions (Pintrich & Schunk, 2002). In the present study, the effects of self-efficay and beliefs about mathematics on motivation are investigated. People also motivate themselves by their expectancies through the outcomes. Expectancy-value theory focuses on desired outcomes and this leads to motivation. In the present study, the effect of motivation on mathematics achievement is investigated.

Another important affective factor is mathematics anxiety in which it is an important issue to both students and teachers (Gonske, 2002). The effects of anxiety on mathematics achievement have been widely investigated by various researchers (Bandalos et al, 1995; Hembree, 1990). Largely, the results of these studies show that students with high anxiety levels toward mathematics are expected to get low level of performance in mathematics courses. Richardson and Suinn (1972) defined mathematics anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p. 51). Bessant (1995) pointed out that mathematics anxiety can be associated with test stress, low self efficacy, negative attitudes towards mathematics learning and fear of failure. Gourgey (1992) stated that students who have high level of anxiety also held misconceptions about what mathematics is and what abilities are necessary to learn mathematics. In addition, Ma (1999) stated that there is a relationship between mathematics anxiety and mathematics achievement in such a way that "the relationship between mathematics anxiety and mathematics achievement can change dramatically for students with different social and academic backgrounds of the characteristics" (p. 536).

In addition, Hembree (1990) stated that mathematics anxiety could be learned condition more behavioral than cognitive in nature. In addition, Ashcraft and Faust (1994) stated that

> "Feelings of tension, apprehension, or even dread that interferes with the ordinary manipulation of number and the solving of mathematical problems" (Ashcraft & Faust, 1994).

In the present study, mathematics anxiety was related to students' negative feelings while trying to solve math problems and toward mathematics itself.

In addition, another variables that are considered to influence student's motivation and achievement are beliefs about the nature of mathematics and teaching of mathematics (Kloosterman, 1999; Schoenfeld, 1989). Researchers have also investigated how individuals' beliefs are about mathematics and how these beliefs affect learning process. Brown and Cooney (1982) explained that beliefs are major determinants of the behavior.

The general agreement among the researchers is that students' beliefs have important influences on mathematical learning and problem solving (Kloosterman, 1999; Schoenfeld, 1989). According to Schoenfeld (1989), students' experiences with mathematics constitute expectations about a mathematical view. Kloosterman (1999) noted that beliefs are important with respect to motivation to learn and understand mathematical topics. In addition, Gonske (2002) found that beliefs are primarily negatively related to math anxiety. In the present study, the effects of students' beliefs about the nature of mathematics and teaching of mathematics on mathematics achievement are investigated.

Besides affective variables, socioeconomic status and school factors are also important that are considered to affect success and persistence learning in mathematics (Zhang & Post, 2000). One of them is family background characteristics of the students. Most of the studies show that parental involvement is a strong effect for student cognitive and personal development (Martinez & Pons, 1996; Taylor, 1996). Gonzales-Pienda et al (2002) stated that, generally, there are two kinds of studies that are related to parental involvement in educational research: (i) the effects of parental behaviors to students' affective variables such as motivation, self-concept, and attitude; (ii) how parents become involved in the learning process of the students.

Moreover, teacher-student interaction and teacher's behavior toward the student can affect student's achievement (Aiken, 1972; Bulach, 2001). Teachers' expectations toward their students' achievement, parents' support for their children's learning and their cultural and socioeconomic backgrounds can influence their psychological as well as cognitive development (Hayes, 2003). Beliefs and effectiveness of the teacher in mathematics influence students' attitudes and performance (Aiken, 1972). Bulach (2001) showed that teacher experience has a positive effect on student's performance.

In addition, characteristics of the classroom environment may influence students' goals that can affect their cognitive processes (Anderman & Maehr, 1994; Berberoglu et al, 2003). Anderman and Maehr (1994) stated that

> *"If the activities in a particular class emphasize relative ability, grades and performance, then students are likely to adopt ability ability-focused goals. In contrast, in classrooms where task-mastery effort and improved are stressed, students are more likely to adopt task-focused goals."* (p. 296).

Moreover, according to Bandura (1997), if we want to manage classroom successfully, we should promote and praise to behaviors with productive activities rather than punish disruptive behavior. Safe and respect learning environment brings to academic achievement automatically.

Finally, socioeconomic status is another influence on achievement (Alwin & Thornton, 1984; Entwisle & Alexander, 1996; Khmelkov & Wang, 2002). Lack of supports at home and school needs can influence students' academic performances. According to Alwin and Thornton (1984), parents with higher socioeconomic status are more accurate in their recall of the child's scores, and expectations of parents whose knowledge is more accurate have more effect on the child's performance.

Papanastasiou (2002) emphasized that the problem of mathematics achievement is multidimensional, that is, whether affective variables or environmental variables can not be used to predict student outcomes in mathematics only. They should be taken into account altogether. In addition, examining the relationships among variables provides a deep understanding of indirect and direct effects of factors on each other and on mathematics achievement. In the present study, the effects of socioeconomic status, school factors (classroom climate, classroom activities and affective variables (motivation, self-efficacy, mathematics anxiety, beliefs about the nature of the mathematics and teaching of mathematics, students' perceptions toward their parents and teachers' attitudes and expectations about their learnings of mathematics) on mathematics achievement are investigated.

1.1 Purpose of the Study

The purpose of the present study is to investigate the effects of socioeconomic status, school factors (classroom climate, classroom activities) and affective variables (motivation, self-efficacy, mathematics anxiety, beliefs about the nature of the mathematics and teaching of mathematics, students' perceptions toward their parents and teachers' attitudes and expectations about their learning of mathematics) on mathematics achievement with respect to different kinds of high schools by using structural equation modeling techniques.

In this study there are three primary objectives:

- To examine the effects of socioeconomic status, school factors (classroom climate, classroom activities and affective variables (motivation, self-efficacy, mathematics anxiety, beliefs about the nature of the mathematics and teaching of mathematics, students' perceptions toward their parents and teachers' attitudes and expectations about their learning of mathematics) on mathematics achievement,

- To investigate the relationships among the dimensions of these variables by using structural equation modeling (SEM) techniques,

- To investigate how these relationships differ among students at different kinds of high schools (Anatolian, general and vocational).

1.2 Research Problems of the Study

The purpose of the study is to investigate the effects of socioeconomic status, school factors and affective variables on mathematics achievement with respect to different kinds of high schools by using structural equation modeling techniques.

Thus, the research problems of the study will be as follows:

(1) What is the general model explaining socioeconomic status, affective and school factors affecting directly and indirectly to students' mathematics achievement?
(2) How the proposed model explains the mathematics achievement in three school types -Anatolian, general and vocational high schools?

1.3 Variables of the Study

In the study, there are seven exogenous latent variables which are expected to affect mathematics achievement directly or indirectly. These variables are given below:

<u>Exogenous Latent Variables</u>

1. Socioeconomic status of the family (SES)
2. Students' perceptions of their mothers' attitudes and expectations toward them as learners of mathematics (SP_MOTH)
3. Students' perceptions of their fathers' attitudes and expectations toward them as learners of mathematics (SP_FATH)
4. Students' perceptions of their teachers' attitudes and expectations toward them as learners of mathematics (SP_TEAC)
5. Teacher-centered classroom activities (TEAC_CEN)
6. Student-centered classroom activities (STUD_CEN)
7. Classroom climate (CLIMATE)

In addition, six endogenous latent variables defined which are expected to be affected by other variables and they are also expected to affect mathematics achievement. Moreover, some affective variables are mediator variables in which they are expected to mediate between some other variables and mathematics achievement.

Endogenous Latent Variables:

8. Mathematics anxiety (MAT_ANX)
9. Motivation to mathematics (MOT)
10. Beliefs about the nature of mathematics (BELIEF)
11. Beliefs about the teaching of mathematics (BEL_TEAC)
12. Self-efficacy toward mathematics (EFFICACY)
13. Mathematics achievement (MAT_ACH)

1.4 Definitions of the Terms

The definitions of the variables and the terms used in the analysis are given below to explain and clarify the meanings.

1.4.1 Definitions of the Variables

The definitions of the variables used in this study are given below to reveal the meanings and avoid possible misconceptions.

Anxiety: It is a subjective feeling of tension, apprehension, and worry, set off by a particular combination of cognitive, emotional, physiological, and behavioral cues (Hart, 1989, p 43).

Mathematics Anxiety: "Feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (Richardson & Suinn, 1972, p 51).

In the study, this variable is based on the students' responses to the "Mathematics Anxiety Scale" which was adapted from Fennema- Sherman Attitude Scale (1986).

Belief: It refers to the individuals' conceptions, values, ideologies, dispositions and philosophies of life (Ernest, 1989).

Beliefs about the Nature of Mathematics: Individual's conceptions, values, ideologies, dispositions (Ernest, 1989) and philosophies related to the nature of mathematics. To measure students' beliefs about the nature of mathematics, "Beliefs about Mathematics Scale" was adapted for the present study. This scale was developed by Mert (2004) for high school students.

Beliefs about the Teaching of Mathematics: Individual's conceptions, values, ideologies, dispositions, and philosophies related to teaching of mathematics (Ernest, 1989). To measure students' beliefs about the teaching of mathematics, "Beliefs about the Teaching of Mathematics Scale" was adapted for the present study. This scale was developed by Mert (2004) for high school students.

Motivation to Mathematics: It refers to students' involvement in mathematics, active enjoyment of seeking of challenge, interest or enjoyment of mathematics. This variable is based on the students' responses to "Motivation Scale".

Self-efficacy: Individual's belief of how well he or she can successfully enact behavior required to accomplish some task (Bandura, 1977).

Socioeconomic Status of the Family: It includes number of siblings, family income, father education and mother education.

Sp_Fath: It refers to students responses to "Father Scale" which was adapted by Tag (2000) from Fennema- Sherman Attitude Scale (1976) to measure students' perceptions of their fathers' interests, encouragements and confidence in their abilities about mathematics (Fennema & Sherman, 1976).

Sp_Moth: It refers to students responses to "Mother Scale" which was adapted by Tag (2000) from Fennema- Sherman Attitude Scale (1976) to measure students' perceptions of their mothers' interests, encouragements and confidence in their abilities about mathematics (Fennema & Sherman, 1976).

Sp_Teac: It refers to students' responses to "Teacher Scale" which was adapted by Tag (2000) from Fennema- Sherman Attitude Scale (1976) to measure students' perceptions of their teachers' attitudes toward them as learners of mathematics (Fennema & Sherman, 1976).

Teacher-Centered Activities: Teacher-centered activities include those in which teachers are dominant and students are passive listeners. To measure this variable, students' responses to "Classroom Activity Scale" was used. This scale consists of items related to teacher-centered activities such as 'I copy the notes from the blackboard', 'mathematics teacher shows how to solve problems him/ herself'.

Student-Centered Activities: Student-centered activities include those in which students participate to actively in the class such as group work, solving problems with different teaching methods, using concrete materials, and discussions. To measure this variable, students' responses to "Classroom Activity Scale" was used.

Classroom Climate: Students' perceptions related to classroom environment during teaching-learning process in mathematics. "Classroom Climate Scale" was used to measure this variable.

Mathematics Achievement: It refers to the students' performances on mathematics achievement test developed by Oztürk (2003).

1.4.2 Definitions of the Terms related to Modeling

In the study, the definitions of the terms that will be used in analyzing the data are given below to explain and clarify their meanings.

Structural Equation Modeling: Structural Equation Modeling techniques (SEM) uses various types of models to depict relationships among observed variables, with the same basic goal of providing a quantitative test of a theoretical model hypothesized by a researcher (Schumacker & Lomax, 2004, p.2).

SEM can test various types of theoretical models: regression, path analysis and confirmatory factor analysis.

Confirmatory Factor Analysis (CFA): Confirmatory factor analysis is a theory-testing model. That is, in this analysis, the researcher begins with a hypothesis prior to the analysis (Jöreskog & Sörbom, 1993). In the study, CFA was used to test the factor structures of the scales.

Fit Statistics: It refers to determine criteria a priori to access model fit and confirm the factor structure. Some of the criteria indicate acceptable model fit while others are close to meeting values for acceptable fit. In the study, root mean square error of approximation (RMSEA), adjusted goodness of fit index (AGFI), goodness of fit index (GFI) and standardized root mean square residual (S-RMR) are used to confirm fit of the proposed model.

Chi-square (χ^2): It describes similarity of the observed and expected matrices. A non-significant χ^2 indicates the model fits the data. But χ^2 is very sensitive to sample size. Generally, it can be searched for χ^2 / df ratios that the ratio less than 5 indicates a good fit to the data and the ratio less than 2 indicates overfit to the data (Kelloway, 1998).

RMSEA: It indicates the amount of unexplained variance or residual.

Goodness-of-fit Index (GFI): The goodness of fit index "is a measure of the relative amount of variances and covariances jointly accounted for by the model" (Jöreskog & Sörbom, 1986, p. 41).

Adjusted Goodness-of-fit Index (AGFI): It adjusts the GFI because of degrees of freedom in the model, in that, a discrepancy between the AGFI and GFI indicates the trivial and nonsignificant parameters (Kelloway, 1998).

Root Mean Square Residual (RMR): "It is the square root of the mean of the squared discrepancies between the implied and observed covariance matrices" (Kelloway, 1998, p. 27).

Standardized Root Mean Square Residual (S-RMR): RMR "is sensitive to the scale of measurement of the model variables. As a result, it is difficult to determine what low value actual is. LISREL also provides the standardized RMR, which has a lower bound of 0 and upper bound of 1" (Kelloway, 1998, p.27).

Observed Variables: Variables that can be manipulated by the researchers and their effects can be observed.

Latent Variables: Variables that can only be measured indirectly and effects of observed variables are used to represent the latent variables effects.

Endogenous Latent Variables: Any latent variable that is predicted by other latent variables in a structural equation model.

Exogenous Latent Variables: Any latent variable that is not influenced by any other variables in a model.

Direct Effect: In a model, it depicts casual effects that are presumed to flow from one latent variable to another.

Indirect Effect: It means that one variable causes a second, which in turn causes a third.

Covariance and Correlation Matrix: The covariance or correlation matrix of the variables “is a symmetric matrix, of which on the elements below and including the diagonal need to be given” (Jöreskog & Sörbom, 1993, p. 166). Kelloway (1998) pointed out that in spite of the similarity of the matrices, the standardization of variables in constructing a correlation matrix removes important information about the scale of measurement from the data. On the other hand, analyzing a covariance matrix which is an assumption for the hyphothesis tests in SEM is strongly recommended (Kelloway, 1998).

Lambda X (λ_x) and Lambda Y (λ_y): It shows “loadings of variables on common factors ” (Kelloway, 1998, p.43).

Gamma (γ) and Beta (β): They are the structural coefficients relating between latent variables (Kelloway, 1998).

1.5 Hypothesized Mathematics Achievement Model

The hypothesized model is established by taking both practical and theoretical considerations. In the model, direct and indirect effects of the latent variables on mathematics achievement are presented (Fig. 1.1).

In the study, the effects of MAT_ANX, MOT, BELIEF, EFFICACY, BEL_TEAC, SP_FATH, SP_MOTH, SES, SP_TEAC, TEAC_CEN, STUD_CEN and CLIMATE on MAT_ACH are supposed to be significant. In addition, SP_FATH, SP_MOTH, CLIMATE, STUD_CEN, TEAC_CEN, SP_TEAC, BELIEF and EFFICACY are supposed to have indirect effects on MAT_ACH. Thus, hypothesis of the study can be expressed as the following:

Hypothesis: There are no significant effects of Mathematics Anxiety (MAT_ANX), Motivation to mathematics (MOT), Beliefs about the nature of mathematics (BELIEF), Beliefs about the teaching of mathematics (BEL_TEAC), Self-efficacy toward mathematics (EFFICACY), Socioeconomic status of the family (SES), SP_FATH, SP_MOTH, SP_TEAC, Teacher-centered classroom activities (TEAC_CEN), Student-centered classroom activities (STUD_CEN), Classroom Climate (CLIMATE) on mathematics achievement (MAT_ACH). Significance level is set to 0.05 (t = 1.96) for all relationships in the study.

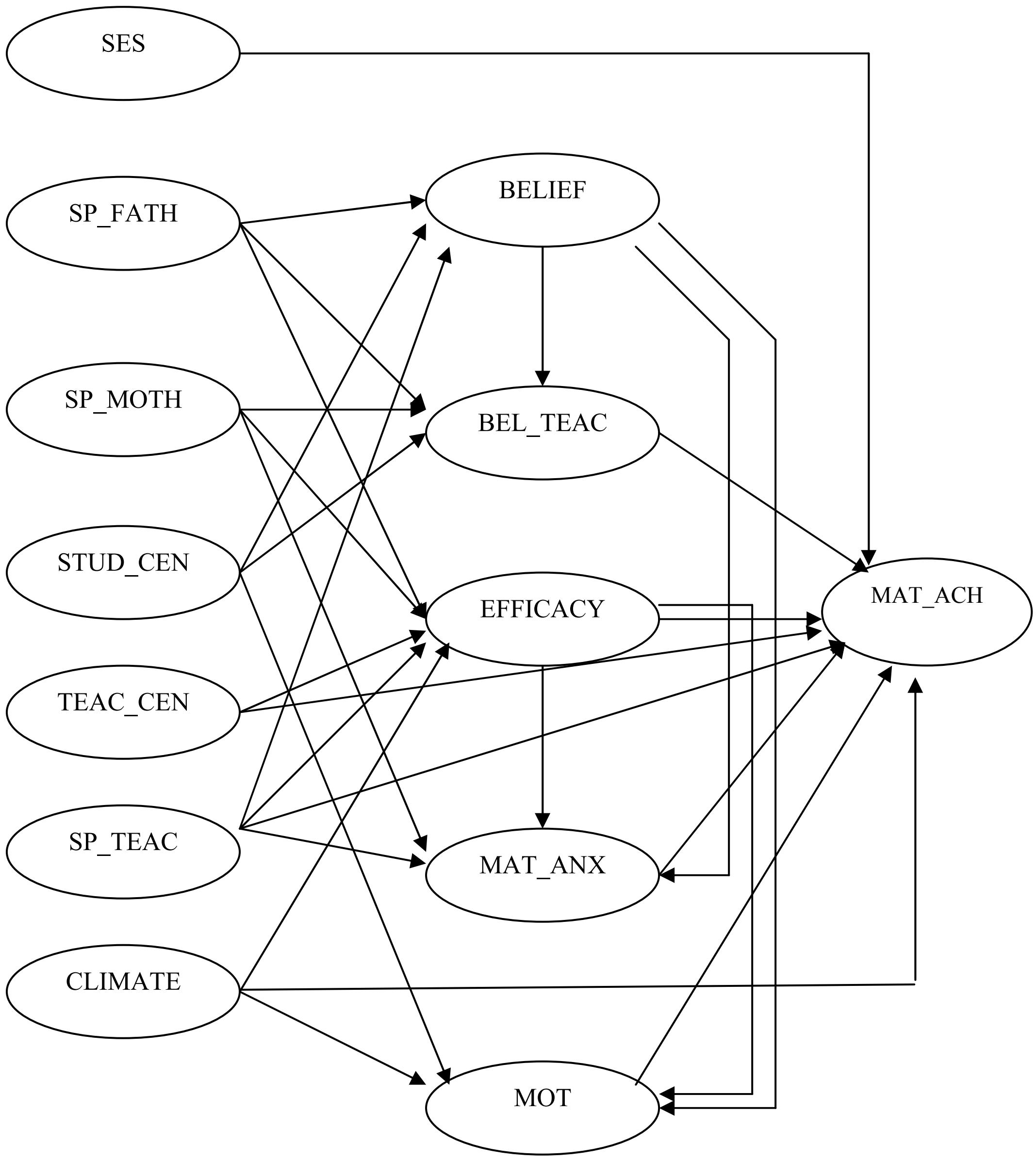

Figure 1.1 Hypothesized Mathematics Achievement Model

1.6 Significance of the Study

Structural equation modeling is one of the techniques that is used to estimate and tests the hypothesized relationships of the factors in mathematics achievement. There are many studies that investigate the influence of socioeconomic status, school factors and affective variables on mathematics performance and develop a model to show direct and indirect effects of the selected factors on each other and on mathematics achievement (Hammouri, 2004; Nasser & Birenbaum, 2005; Singh, Granville & Dika, 2002; Papanastasiou, 2002).

In the study, SEM techniques were used because of the following reasons:

- It shows “not only how well the predictors explain the criterion variable but also which specific predictors are most important in predicting” (Maruyama, 1998, p. 21)
- SEM software programs are easy to conduct and analyze.
- “SEM can test various types of theoretical models” (Schumacker & Lomax, 2004, p.3).
- SEM techniques take measurement error into account when statistically analyzing data (Schumacker & Lomax, 2004).

Many of the research studies investigate the variables that are considered to affect mathematics achievement (Berberoglu et al, 2003; Broeck, Opdenakker & Damme, 2005; Hammouri, 2004; Papanastasiou, 2002; Papanastasiou, 2000).

In addition, Bloom (1976), in his theory, tried to explain learning process in schools with some of the variables. The theory of school learning includes student characteristics, instruction, and learning outcomes. In this model, he noted that the rate of learning and achievement are strongly influenced by cognitive and affective constructs as well as quality of instruction. Thus, we can not explain achievement with one or two factors. We should explain the reasons with the composition of instruction, family and affective constructs.

The present study is important because of the following reasons:

- In Turkey, there are few research studies related to the investigation of influential factors in mathematics achievement through the use of modeling (Berberoglu, 2003; Tag, 2000; Yayan & Berberoglu, 2004).
- This study is the first one in the studies in Turkey where both affective and school factors are examined to understand their effects on mathematics achievement and on each other at the same time with high school level of students.
- It gives the information about how the proposed model explains the mathematics achievement in three school types (Anatolian, general, and vocational high schools).
- This study can present an idea about how teacher education programs and mathematics curriculum should be in teaching and learning of mathematics. In addition, results of the present study can be expected to be used to improve the quality of mathematics instruction in schools.
- Results of the present study can be expected to provide information that are related to implementation of new curricula of Turkish Ministry of National Education including affective and cognitive development of students. Also results may make contributions that can be helpful for possible revisions on the mathematics curricula.

In summary, the factors that are considered to influence mathematics achievement should be taken into account as a whole. For example, teacher can affect achievement by influencing students' self-efficacy, in turn; learning activities in class can affect achievement because of influencing students' motivation toward the subject. We can say all these conjectures if we conduct the studies including school factors and affective variables together by using modeling techniques. In the present study, the influences of affective and school factors on mathematics achievement are investigated by using structural equation modeling techniques.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the literature related to the present study was reviewed. Based on the content and the main objectives of the study, the literature was classified into four sections: theoretical background of the study, studies on the relationship between affective variables and mathematics achievement, studies on the relationship between school factors and mathematics achievement, and studies about modeling.

2.1 Theoretical Background of the Study

In this section, theoretical background of the variables included in the present study was summarized.

2.1.1 Self-efficacy

Hackett and Betz (1989) reported that mathematics self-efficacy is an important predictor variable for the future mathematics performance.

Pajares (1996) noted that self-efficacy beliefs can influence individuals' emotional reactions when confronting obstacles. He concluded that self-efficacy beliefs can be predictors and determinants of the level of accomplishments.

Based on the research studies, Adeyemo (2005) stated that self-efficacy has an important role in the process of cognitive development and it influences school activities and academic performance.

According to Bandura (1997), there are positive relationships between expectancies and efficacy beliefs. In Figure 2.1, efficacy beliefs coming before behaviors with level, strength, generality and outcome expectancies cause positive or negative physical, social and self-evaluative effects.

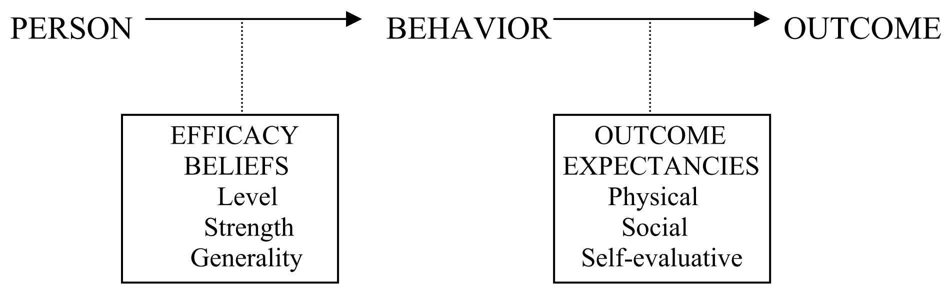

Figure 2.1 The Conditional Relationships Between Efficacy Beliefs and Outcome Expectancies (Bandura, 1997, p.22)

Person with low self-efficacy can be more unwilling to learn, which in turn, this can lead to decrease motivation and increase mathematics anxiety.

In the present study, the effects of mathematics self-efficacy on motivation, mathematics anxiety and achievement are investigated.

2.1.2 Motivation to Mathematics

Haladyna et al (1983) stated that attitude toward mathematics is a part of the student motivation. In light of these concerns, the researchers developed a model to represent the relationship between attitude and other classroom variables (see fig. 2.2). In this model, attitude is seen to be influenced by a number of factors such as teacher quality, climate in learning environment or gender. The researchers valued the positive attitude toward mathematics for the following reasons:

1. A positive attitude is an important school outcome in and of itself.

2. Attitude is often positively, although slightly, related to achievement.

3. A positive attitude toward mathematics may increase one's tendency to select mathematics courses in high school and college and possibly one's tendency to select careers in mathematics or mathematics-related fields (Haladyna et al, 1983, p. 20)

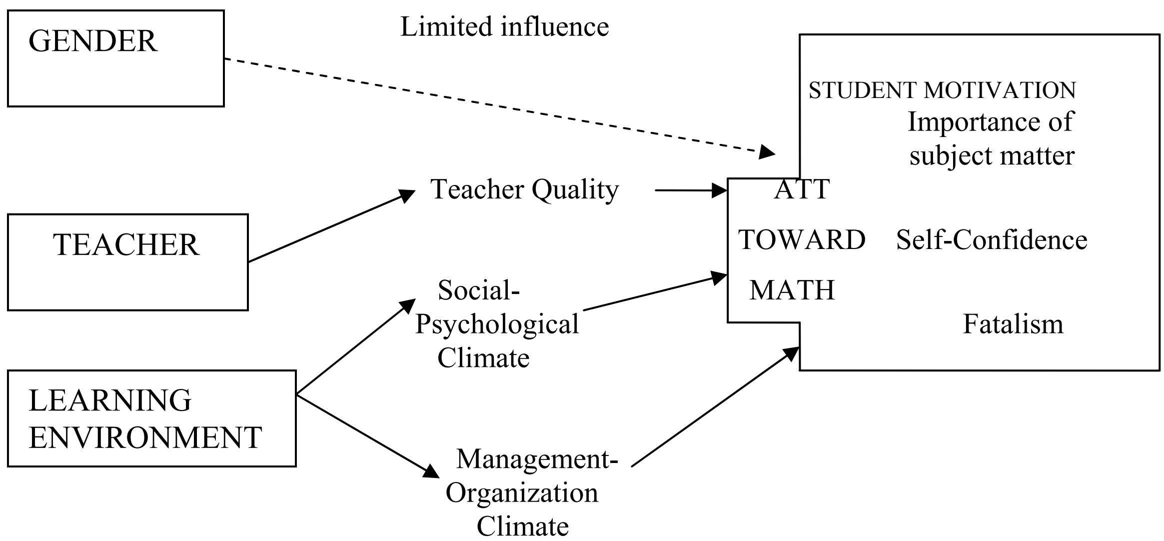

Figure 2.2 Model of Determinants of Attitudes Toward Mathematics (Haladyna et al, 1983)

Many researchers have been trying to explain motivation and achievement theoretically (Atkinson, 1957; Bandura, 1986; Bandura, 1997). There are some theories related to motivation.

2.1.2.1 Goal Theory

Goal theory has emerged in the last decades for analyzing motivational problems of adolescence. It is concerned with the role of goal, action and effect (Anderman & Maehr, 1994).

The basic statement of goal theory, as stated by Covington (2000), is that students' achievement at school is affected by their achievement goals by qualitative changes in cognitive self-regulation processes. The term cognitive self-regulation can be defined as active engagement of students in learning. Analysis of school assignments, planning sources for assignments, and following process of completion of the assignments can be listed some of the elements of student learning (Pintrich, 1999; Zimmerman, 1990).

Some researchers have divided goals into two distinct categories that can be named as learning goals (Anderman & Midgley, 1997) and performance goals (Thorkildsen & Nicholls, 1998). Learning goals are about understanding, appreciation for learning. On the other hand, performance goals involve showing individuals' abilities over others.

Covington (2000) stated that there are two main hypotheses as to how is the relationship between goals and achievement: (i) learning goals result in highly qualified information processing, and this, in turn, results in a increase in student, (ii) on the other hand, performance goals exerts an opposite effect on information processes and student achievement. Though goal theory can be offended from the perspective including how individuals choose among goals, it provides a surrogate for the concept motivation (Covington, 2000).

2.1.2.2 Reinforcement Theory

Skinner (1935) who developed reinforcement theory stated that there was a relationship between behavior and reinforcement. In learners are exerted positive reinforcement, desired behavior will follow.

Reinforcement can be defined as operant conditioning of stimulus. Examples of reinforcement can be differentiated from different perspectives. Verbal statements such as "great", "wonderful", "very good" or more concrete ones including promotion or certificates can be used as positive reinforcements. Likewise, negative reinforcement can also be used to strengthen a behavior by stopping a negative condition.

The use of reinforcement is widely accepted and adopted that students have been given grades, praises, privileges, etc after their "correct" behaviors (Biehler & Snowman, 1997).

Another importance of reinforcement comes from that it helps to identify differences in reactions of students to particular subjects, not to others. For example, about students who may have negative feelings about mathematics courses it can be argued that in the past these students were exerted negative reinforcement or experiences, purposeful or not.

Albert Bandura also calls attention to importance of observation, imitation, and vicarious reinforcement. Some students may develop expectations after observing other students who get praise after certain behavior, and behave in the same way of these students (Biehler & Snowman, 1997). Both direct and vicarious reinforcement can be used for students' self-efficacy and motivation.

2.1.2.3 Attribution Theory

Attribution theory emphasizes the attributions that affect individual beliefs and behaviors. According to Weiner (1985), individuals can attribute their success or failure to personal capabilities which can lead to become discouraged when they fail.

Bandura (1997) represents the cognitive motivation that is based on cognized goals, outcome expectancies and casual attributions (see fig. 2.3)

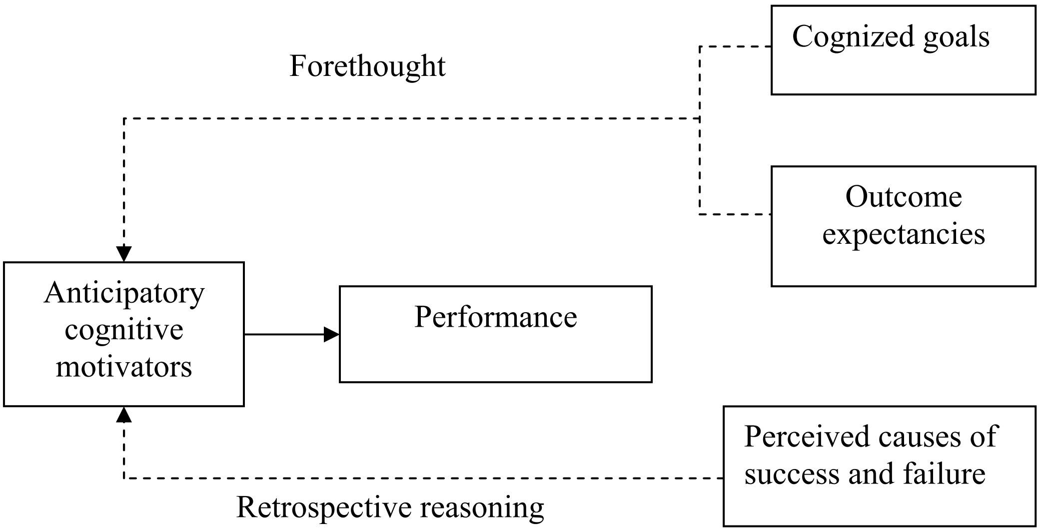

Figure 2.3 Schematic Representation of Alternative Conceptions of Cognitive Motivation (Bandura, 1997, p. 123)

2.1.2.4 Achievement Motivation Theory

Atkinson (1957)'s achievement motivation theory implies that individuals perform their best in order to achieve.

Eccles et al (1983) developed an expectancy-value model to interpret child's achievement-related choices (see Figure 2.4). In this model, choices are affected by child's perceptions, experiences and expectations. They emphasized that children's interpretations of their past experiences, and their perceptions of socializers' attitudes and expectations influence their goals and task-specific beliefs.

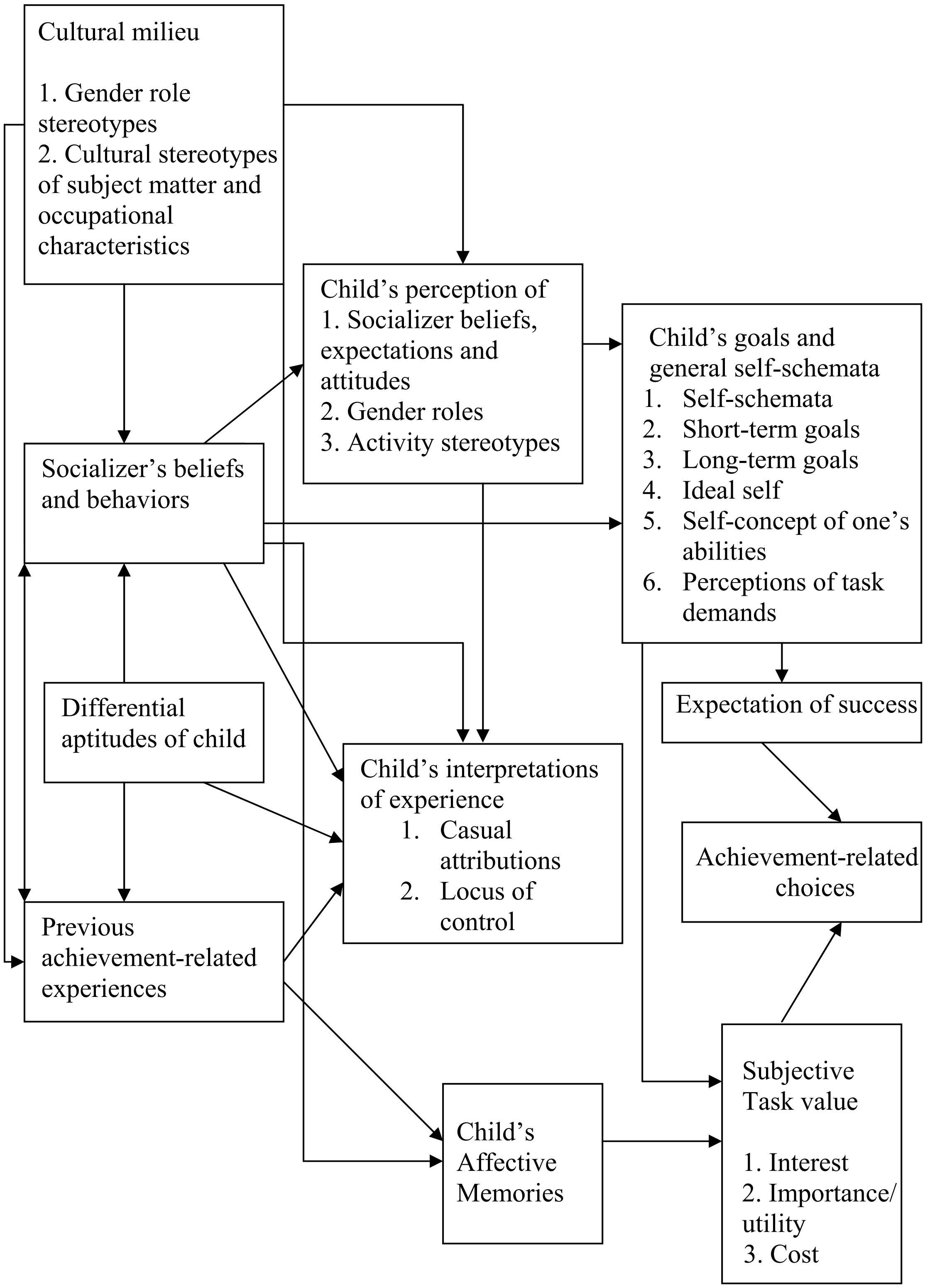

Figure 2.4 Expectancy-Value Model of Achievement-related Choices
(Eccles et all, 1983)

In the present study, the effects of motivation on mathematics achievement are investigated. In addition, the influential variables on students' motivation toward mathematics are examined.

2.1.3 Mathematics Anxiety

Mathematics anxiety has been widely investigated by several researchers (Aiken, 1976; Wither & Sherman, 2003).

A various definitions of term *anxiety* made by several researchers can be found in the literature. It can be defined, in general terms, as negative changes in body, emotions, and mental states.

The term *mathematics anxiety* can be defined as the feelings of anxiety and tension that are related to mathematical concepts and problem solving situations. Hackett and Betz (1989) stated that mathematics self-efficacy is related to mathematics anxiety in that it is more important predictor variable than math anxiety.

There can be found different causes for mathematics anxiety. Jackson et al (1999) pointed overt behaviors and covert behaviors of instructors may cause mathematics anxiety.

Student avoidance as defined by Ashcraft (2002) is regarded as another source of mathematics anxiety. The researcher stated the importance of student involvement in learning.

It is known that regular educational practices in schools such as problem solving in a limited time, feeling of embarrassment, etc. are direct sources of mathematics anxiety. This is supported by researchers who indicated that mathematics anxiety is not an uncommon fact.

In the present study, the effects of mathematics anxiety on mathematics achievement are investigated. In addition, some influential factors on mathematics anxiety are examined (self-efficacy, beliefs about mathematics, classroom activities, students' perceptions about their teachers' expectations and attitudes toward them).

2.1.4 Beliefs about Mathematics

The study of the nature of beliefs and their influence on people's action has been widely investigated by several researchers (Brown & Cooney, 1982; Thompson, 1992; Pajares, 1992). Brown and Cooney (1982) explained that beliefs are dispositions to action and major determinants of behavior.

There are many definitions of beliefs. Some of them were stated as follows: Scheffler (1965) defined belief as:

> *"A belief is a cluster of dispositions to do various things under various associated circumstances. The things done include responses and actions of many sorts and are not restricted to verbal affirmations." (p.85)*

Fleener (1996) states that beliefs help individuals when they face conflict, resolve contradiction, and cope with uncertainty. That is, beliefs help individuals to adapt their environment. In addition, Ernest (1989) stated that beliefs are personal views, assumptions and values.

Harvey (1986) defined belief as "an individual's representation of reality that has enough validity, truth, or credibility to guide thought and behavior" (p 152). Sigel (1985) defined belief as "mental constructions of experience-often condensed and integrated into schemata or concepts that guide behavior" (p 351).

According to Pehkonen and Törner (1999), beliefs are important for learning mathematics because of powerful impact on how children learn and use mathematics. In order to get effective learning, beliefs that students hold about mathematics should be turned to positive.

Pajares (1992) stated that it is difficult to alter the earlier belief structure. These earlier beliefs can influence the processing of getting new information. He also stated that acquired earlier beliefs are more permanent even after significantly correct explanations are presented to them. Pajares (1992) also stated that students are generally unaware of their negative beliefs and if conceptual change takes place, newly acquired beliefs must be tested.

Schoenfeld (1985) found that some students seemed to believe in quick, all-or-none learning. That is, they believe that if they don't get it the answer in 10-12 minutes, they assume they never will solve it.

Epistemological beliefs play an important role for interpretation and achievement. Schommer (1990) conducted two experiments to explore students' beliefs about the nature of knowledge and their effect on comprehension. The researcher concluded that epistemological beliefs affected students' interpretation of knowledge, their efforts and information processing strategies.

In the present study, beliefs are defined as an individual's conceptions, values, ideologies, dispositions (Ernest,1989), and philosophies of the nature of mathematics and the teaching of mathematics. In the study, the effects of beliefs about the nature of mathematics and the teaching of mathematics on mathematics achievement are investigated.

2.1.5 Teachers' Expectations and Beliefs

Teachers' expectations and beliefs toward the subject and students' achievement can influence students' perceptions about their teachers and subject being taught. Teacher-student interaction and teacher's behavior toward the student can effect students' academic achievement.

According to some researchers, teachers' beliefs play an important role for students' perceptions toward them and achievement in mathematics (Fennema, Carpenter & Peterson, 1989). Fennema, Carpenter and Peterson (1989) have developed a model that shows how to influence teachers' knowledge and beliefs on students' learning (see Figure2.5). In this model, teachers' beliefs and knowledge as well as students' behaviors affect teachers' decisions about how to implement classroom instruction that provides students' learning.

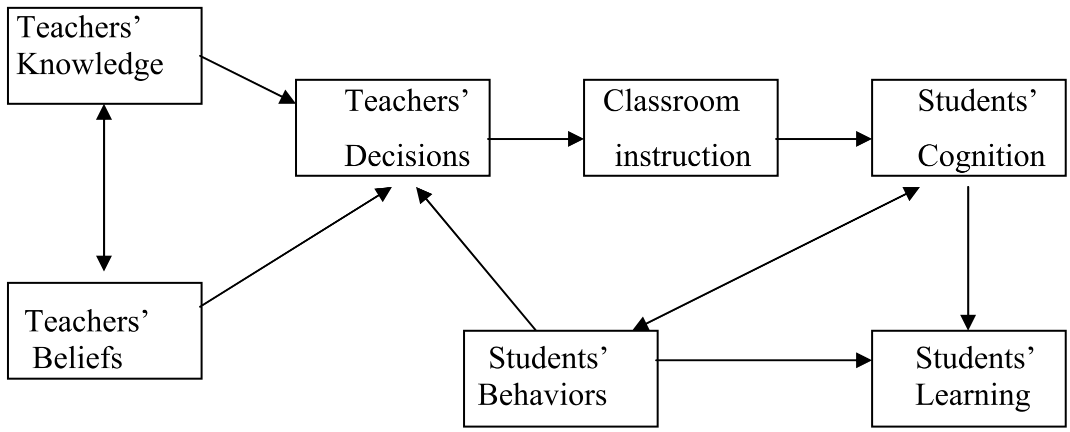

Figure 2.5 The Model of Teachers' Influences on Students' Learning
(Fennema, Carpenter & Peterson, 1989)

Ernest (1989) has developed a model that includes knowledge, beliefs and attitudes of mathematics teacher. According to the researcher, to able to know how to teach mathematics effectively, teacher should know their students, school context (other teachers, resources, school facilities, assessment systems,..ect.) and educational psychology.

Teacher expectations can be one of the influences on students' achievement. Braun (1976) has developed a model to explain students' behavior and self-evaluation. In this model, teachers' expectations influence their behaviors that shape instruction this leads to students' behavior and self-evaluation (see Fig. 2.6).

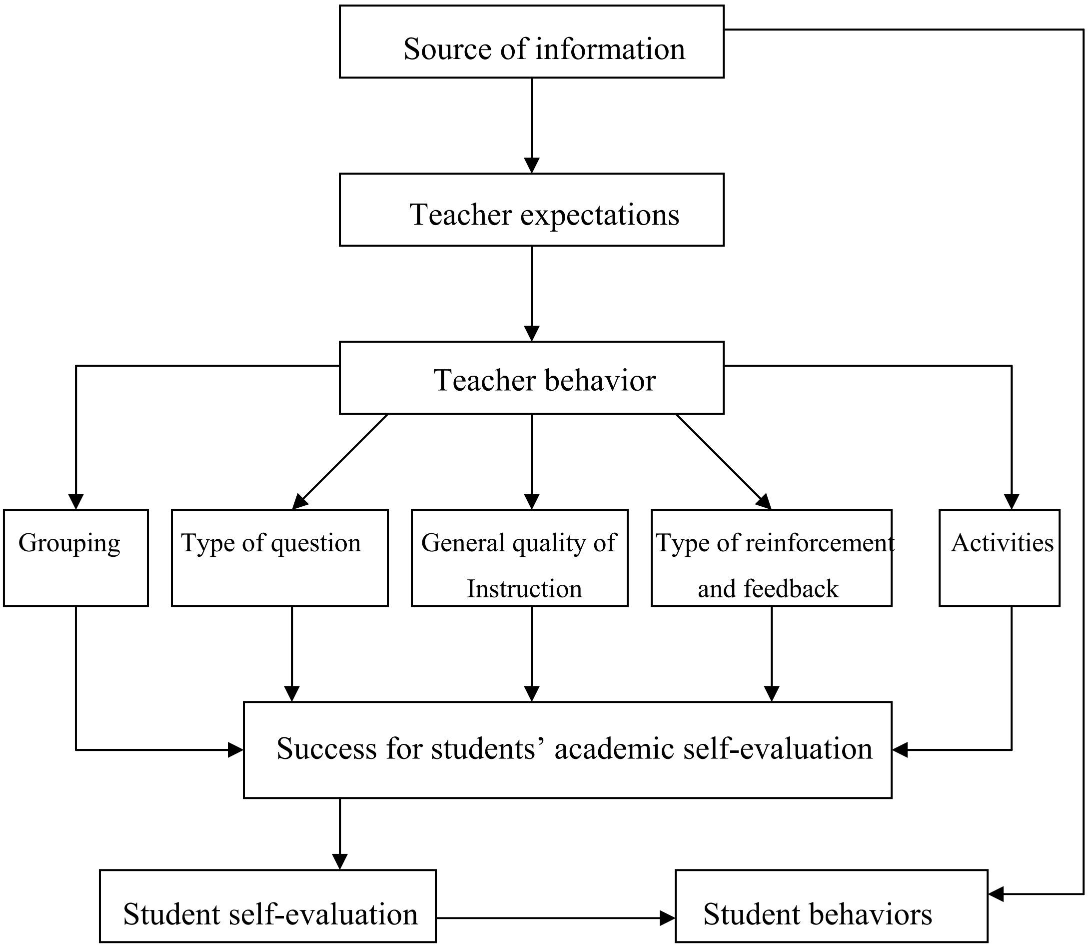

Figure 2.6 Effects of Teacher's Expectations on Instruction, Students' Behaviors and Their Self-evaluation (Braun, 1976)

Fennema and Franke (1992), in their study, discussed the teachers' mathematical knowledge and its impact on students' learning. According to them, if a teacher has inadequate knowledge in content of mathematics, they are not capable of how to plan instruction and they are not aware of students' thinking process. Thompson (1992) investigated the nature of teachers' beliefs about the subject matter and instructional process that influence students' perceptions about their teachers and learning capabilities.

In the present study, the effects of students' perceptions about their teachers' attitudes and expectations toward them and mathematics itself are investigated.

2.1.6 Parents' Involvements

Parents' involvement includes their expectations and beliefs toward their students that influence students' perceptions toward them, and their socio-economic backgrounds.

Generally, fathers are responsible for their students' needs and they are more dominant in home environment. Pintrich and Schunk (2002) summarized types of father involvement (see Table 2.1).

Table 2.1 Types of Father Involvement (Pintrich & Schunk, 2002, p. 394)

Type	Characteristics
Economic provider	Provides economic resources
Presence	Spends times with children; provides some sports
Responsibility	Meets children's needs; provides economic resources; helps plan and organize children's lives
Engagement	Has direct contact and shared interactions with children during leisure time
Accessibility	Present and available to the child

Mother has also influenced her child's development by giving encouragements and valuing child's school achievement.

According to Meece (1997), child whose parents provide warm home environment, encourage to success and give learning materials is more willing to learn and more tendency to achieve.

In the present study, the effects of students' perceptions about their parents attitudes and expectations toward them as learners of mathematics as well as socioeconomic status of the family on mathematics achievement and affective constructs are investigated.

2.1.7 Classroom Climate and Activities

Bloom (1976), in his theory, has tried to explain learning process in schools with student characteristics, instruction and learning outcomes. The theory of school learning includes student cognitive and affective characteristics, learning tasks, and level and type of achievement, rate of learning and affective outcomes. It was showed schematically as follows:

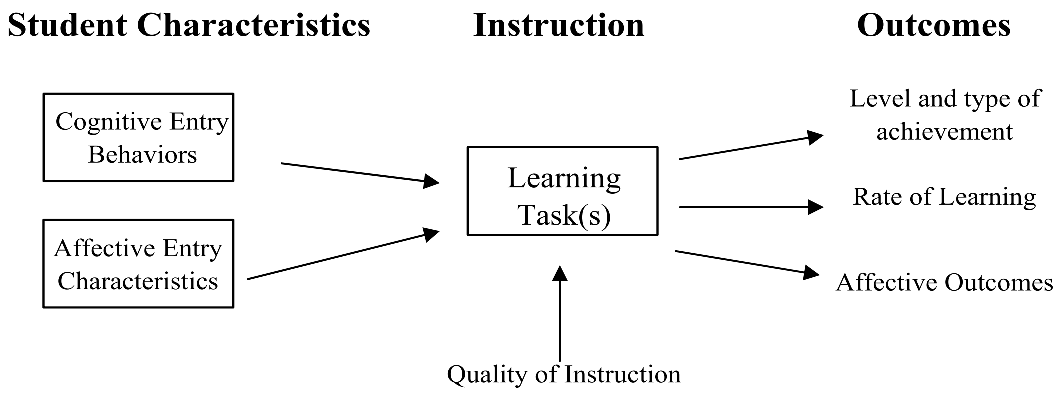

Figure 2.7 The theory of school learning (Bloom, 1976)

According to this theory, if the students have basic prerequisite knowledge, they are motivated well in the learning process and the instruction appropriate for them, then the learning outcomes will be at high level.

Pintrich and Schunk (2002) pointed out three affective aspects of school climate that can influence students' academic outcomes. These three aspects are

(1) a sense of community and belongingness,

(2) warmth and civility in personal relations,

(3) feelings of safety and security (p. 363).

In the present study, the effects of classroom climate on affective variables and mathematics achievement are investigated.

2.2 Studies on the Relationship between Affective Variables and Mathematics Achievement

Generally, there were two common problems that the researchers examine: "Did mathematics anxiety affect student's performance negatively or did students with less competence mathematically have more feelings of tension that might arouse anxiety?". Sherman and Wither (2003) investigated the relationships between mathematics anxiety and mathematics achievement. They proposed three hypotheses: (1) Mathematics anxiety caused an impairment of mathematics achievement; (2) Lack of mathematics achievement caused mathematics anxiety; (3) There was a third underlying cause of the two. The study was a longitudinal study over a period of five years. The result of the study showed that the first hypothesis that mathematics anxiety caused a lack of mathematics achievement rejected. That is, either the second or the third hypothesis was tenable. Of course, this result was not consisted with the most of the findings of the studies (Ashcraft & Kirk, 2001; Hembree, 1990; Nasser & Birenbaum, 2005). But the researchers implied that this study was a single study and the sample size was limited. Nevertheless, this study might be thought as a question that might be asked whether there were programs in schools to reduce mathematics anxiety (Sherman & Wither, 2003).

Meta analyses are important studies to provide summarizing of the findings statistically. Hembree (1990) integrated the findings of the research on mathematics anxiety with respect to its nature, effects and relief. He performed meta analysis with 151 studies related to mathematics anxiety. In the study, he tried to determine the direction in the relationship between mathematics anxiety and mathematics performance, whether test anxiety affected mathematics anxiety and difference between male and female students' behaviors with respect to mathematics anxiety. It was concluded that students with higher mathematics anxiety levels had consistently lower mathematics performance. In addition, mean correlations between mathematics anxiety and attitudinal constructs showed that students who had positive attitudes toward mathematics had lower mathematics anxiety. Moreover, there were strong relations for an enjoyment of mathematics and self-confidence in the subject with mathematics anxiety. The researcher also investigated the treatments effects on mathematics anxiety. He concluded with the findings of the studies that classroom interventions such as tutorial, small-group, self-paced didn't seem effective in reducing mathematics anxiety.

Moreover, Ashcraft and Kirk (2001) examined the influence of mathematics anxiety on mathematical cognition. The hypothesis of the study was that a major contributor to low performance involving working memory was founded for participants with high mathematics anxiety. In the study, the researchers assessed that whether math anxiety disrupted working memory processing when the cognitive task involves arithmetic or related problems. In the study, there were 3 experiments. One of them was done by 66 students participated from the undergraduate psychology classes. In this experiment, to test the working memory capacity, participants listened to a number of simple sentences, one by one, and answered a simple question about the current sentence before listening to the next (e.g., "The children in the car wanted to stop for ice cream. Where were the children?"). And then, they recalled the last word of each sentence (ice cream). Then, participants had the simple arithmetic problems solutions recall one by one (e.g., if 5+2=?, 9-6=?, then the answer was (7,3)). This experiment showed that individuals at higher levels of math anxiety had significantly lower working memory capacity scores than those at lower anxiety levels. According to the researchers, this meant that working memory capacity was negatively associated with math anxiety.

In addition, Yenilmez and Özbey (2006) studied the secondary school students' levels of mathematics anxiety and relations between the level of mathematics anxiety and students' characteristics. The sample of the study included

289 students from one private school and two secondary schools in Inegöl. For statistical analyses, variance analyses and t-test techniques were used. The results of the study indicated that there were differences in students' mathematics anxiety levels with respect to class level, general success, mathematics success and parents' education levels.

Beliefs that students hold about the nature of mathematics and teaching of mathematics have been well documented in the literature (Aksu, Demir & Sümer, 2002; Austin & Wadlington, 1992; Corte & Eynde, 2003; Fleener, 1996; Gonske, 2002; Vanayan, White, Yuen & Teper, 1994). Generally, these findings showed that many students had a lot of beliefs about mathematics that were usually uncorrect.

One of the studies was done by Corte and Eynde (2003). They analyzed the structure of mathematical belief systems of 365 Flemish junior high school students. In this survey study, the researchers tried to identify the different constituting components of students' belief systems in relation to each other. They developed an instrument that asked students about their beliefs related to the self in relation to mathematics, mathematics education, and the social context in their specific class. The results indicated that students who thought mathematics as a social, and dynamic in nature and hold positive beliefs about their teacher, more valued to mathematics and had more confidence in their mathematical performance. According to the researchers, students who were confident about their mathematical ability were mostly also the ones who more interested in mathematics. On the other hand, students with low self-confidence didn't think the importance of mathematics.

In addition, Kloosterman (1999) stated that it was important to study about students' mathematical beliefs to understand students' motivation, mathematical learning and their problem solving strategies. He investigated 56 high school students' responses to the Indiana Mathematics Belief Scale (IMBS-Kloosterman & Stage, 1992) and interview questions. According to the students' responses, the researcher noted that students believed that mathematics involved numbers and these numbers were used to solve variety problems. The researcher also stated that students thought that to success in mathematics, memorization was an important procedure for their learning. On the other hand, he also stated that students believed that if they worked hard enough they could still learn mathematics without memorizing.

Much of the research concerning mathematics anxiety and beliefs about mathematics has been conducted with elementary, secondary and traditional college students (Austin & Wadlington, 1992; Gonske, 2002). Gonske (2002) examined the relationships among math anxiety, beliefs about the nature of learning mathematics, and students' learning approaches with 129 nontraditional students at the college by using both qualitative and quantitative research studies together. For quantitative part, two hypotheses related to beliefs were examined in the study: (1) There were significant correlations between beliefs about the nature of mathematics, beliefs about learning mathematics, and learning approaches with varying levels of mathematics anxiety; (2) There were significant correlations between beliefs about the nature and the learning of mathematics and students' learning approaches. The results of the correlational and hierarchical regression analyses of the survey data indicated that there were few statistically significant correlations among the variables. For the qualitative part of the study, 14 students were asked some open-ended questions to understand their beliefs about the nature of learning mathematics. The results of the study showed that students primarily believed that "mathematics was rigid and rule based", "mathematics was useful in daily life", "memorizing was important to solve math problems" and "to increase ability in mathematics, effort should be put into it".

One of the research studies related to the relationships between the mathematical beliefs and math anxiety was done by Austin and Wadlington (1992). They examined college students' mathematical beliefs toward their effects on math anxiety and math self-concept. There were fifty pre-service and 15 in-service teachers. Three questionnaires 'mathematics anxiety rating scale', 'mathematics self-concept test' and a 'specially developed test' were used. In the study, the relationships between math anxiety and negative math self-concept couldn't be found significant. The results of the study showed that the percentages of mathematical beliefs of high-anxious pre-service teachers, low-anxious pre-service teachers, and in-service teachers were similar. In addition, 73% or more of all three groups believed that “mathematics required a good memory”.

There were various descriptive studies related to beliefs and attitudes toward mathematics in which the study of Vanayan, White, Yuen and Teper (1994) was one of them. They examined third and fifth grade students’ responses to 22 survey items in which they were categorized into three sections: ‘liking mathematics’, ‘perceived mathematics competence’, and ‘beliefs regarding mathematics relevance’. The results of the study indicated that 64% of the students in both grades agreed that memorizing was important for learning mathematics. On the other hand, in both grades, about 85% of the students thought that there were usually various strategies to solve mathematical problems. According to the researchers, recognizing the relation between learning mathematics and learning other subjects, students could believe in integrating view of learning. Moreover, it was found in the study that more students in Grade 5 seemed to be aware of the usefulness and relevance of mathematics outside of school. According to the researchers, it could be useful to provide real life applications more frequently in learning mathematics for making mathematics seem relevant in the early grades.

The value and importance of mathematics, beliefs about mathematical and scientific truths, gender equity and ability with respect to mathematics careers, and the relationship between mathematics and technology were examined by Fleener (1996). The researcher investigated 20 high school students’ beliefs about mathematics and science during for week summer residential mathematics and science program. In the study, the researcher investigated the answers of some questions: ‘what beliefs did high school students have about scientific and mathematical-building and practice?’ and ‘what did the world views of students as suggested by their beliefs about scientific and mathematical knowledge-building?’. To answer these questions, students completed instruments related to mathematics and science beliefs. The results of the study indicated that students believed that learning to mathematics was important to develop ‘reasoning ability’. In addition, according to the researcher, mixed responses to the items “mathematics was changing”, and “there were often many correct solutions to a math problem” indicated that there were not enough agreement about 'mathematics as a dynamic', and 'changing discipline' (Fleener, 1996).

In addition, Schoenfeld (1989) investigated the relationships between students' beliefs about mathematics and students' understandings about the nature of deductive proof in geometry. There were 230 high school students enrolled in mathematics courses. The instrument containing 81 open-ended and closed items were related to attributions of success of failure; students' perceptions of mathematics and school practice; their views of school mathematics, English and social studies; the nature of geometric proofs, reasoning, and constructions, motivation and personal and scholastic performance. The results of the study showed that the students considered mathematics as an objective subject. The results of the study indicated that students believed that mathematics could be mastered, if they worked hard and the reason to take good grades couldn't be luck. In addition, they believed that effective teaching practice included different strategies to solve the problem and showing how to use the rules.

Effects of beliefs on comprehension were investigated by Schommer (1990). The researcher addressed two questions: "What were students' beliefs about the nature of knowledge?" and "How did these beliefs affect comprehension?". 'Epistemological questionnaire' were given to 117 junior college students and 149 university students to assess their epistemological beliefs. The results showed that students who took more classes in higher education were more likely to believe knowledge was tentative. In addition, students who were older than the others were more likely to believe the ability to learn was acquired. An important finding of the study was that epistemological beliefs seemed to affect students' monitoring of their comprehension and processing of information (Schommer, 1990).

There are also some studies on elementary students' beliefs about mathematics teaching. Such a study was done by Pehkonen and Tompa (1994) on an international scale. They compared Finnish and Hungarian seventh grade students' conceptions or beliefs of mathematics teaching. They asked to 200 students from Hungary and Finland for the main question 'what did good mathematics teaching include?'. They found out that the Finnish students were more in favor of working with calculation than their Hungarian students. The Hungarian preferred teaching methods where “students' capabilities and computational aspects of mathematics such as rapid performance, correct answers, the memorization of rules and beliefs in the existence of proper procedures” were emphasized (Pehkonen & Tompa, 1994).

In Turkey, there were few studies related to students' beliefs about mathematics and teaching of mathematics (Aksu, Demir & Sümer, 2002; Baydar, 2000; Mert & Bulut, 2006). Aksu, Demir and Sümer (2002) investigated 563 primary school students' beliefs about mathematics with respect to gender, grade level and level of mathematics. The participants were selected from two primary schools (one private, one public) in Ankara, Turkey. The instrument “Beliefs about Mathematics Survey” was used to understand students' beliefs about ‘the process of learning mathematics’, ‘the use of mathematics’ and ‘the nature of mathematics’. According to the results of the study, students believed that it should be arrived the correct answer and there was an only one correct solution to solve a problem which was taught by the teacher. In addition, they also believed that mathematics was useful in daily life.

Moreover, Mert and Bulut (2004) investigated 425 high school students' beliefs about mathematics with respect to gender, kinds of schools and achievement level. The instrument ‘Beliefs about Mathematics’ scale was used. The results of the study showed that students' beliefs differed according to their mathematics achievement level. That is, students who more succeeded in mathematics were more likely to believe the usefulness of mathematics. In addition, there were statistically significant differences among Anatolian, general and vocational high schools students with respect to beliefs about mathematics.

Self-efficacy was important for understanding the differences in the educational and career choices (Bandura, 1977; Hackett & Betz, 1989; O'Brien, Martinez-Pons & Kopala, 1999). Hackett and Betz (1989) examined the relationship between mathematical performance and mathematical self-efficacy, attitudes toward mathematics, and the choice of mathematics-related majors. There were two hypotheses of the study: (1) Self-efficacy with regard to specific mathematics problems was related to actual performance on an equivalent set of problems. (2) The mathematics self-efficacy/mathematics performance correspondence was stronger for men than for women. The subjects of the study were 262 undergraduate students. The findings of the study indicated that a moderately strong positive relationship existed between self-efficacy and performance (0.44). According to the researchers, these analyses indicated that students with high scores on mathematics self-efficacy and mathematics performance, compared with those with low scores, tended to report lower levels of mathematics anxiety, higher levels of confidence and reflectance motivation, and a greater tendency to see mathematics as an useful subject. There were slightly stronger relationships between attitudes toward mathematics and mathematics self-efficacy expectations than between mathematics attitudes and mathematics performance and achievement measures. These results suggested that gender differences in mathematics self-efficacy expectations were correlated with gender differences in mathematical performance (Hackett & Betz, 1989).

Moreover, O'Brien, Martinez-Pons and Kopala (1999) assessed the students' mathematics self-efficacy, ethnic identity, gender and career interests in mathematics and science. The sample consisted of 415 11^{th} grade students. They hypothesized that gender and ethnic identity influenced student's interest in pursuing a career in mathematics or science and they influenced self-efficacy. In addition, they hypothesized that mathematics and science self-efficacy was influenced by past academic performance in those areas. The results of the study showed that there were statistically significant correlations among career interest with self-efficacy, past academic performance and gender, self-efficacy with past academic performance and ethnic identity and past academic performance with SES. According to the researchers, the research might be required experimental studies to examine causal relations among the variables with respect to the effects of mathematics self-efficacy, SES, and ethnic identity on career interest.

In addition, Pajares and Graham (1999) stated that in self-efficacy research, the area of mathematics had received special attention for many reasons. Some of them could be presented as the importance of mathematics in the academic curriculum, for the level placement, and college administrations. They also agreed that self-efficacy predicted mathematics performance to a greater degree than did mathematics anxiety. In the study of Pajares and Graham (1999), it was investigated the self-efficacy effects on the prediction of mathematics performance when other motivation and previous achievement variables were controlled. Data of the study were collected from the 6^{th} –grade students at the beginning and again at the end of the year. Independent variables of the study were self-efficacy, anxiety, self-concept, self-efficacy for self-regulation, perceived value, engagement, and previous achievement in mathematics. The result of the study showed that mathematics self-efficacy was the only motivation variable to predict mathematics performance both at the beginning and end of year. In addition, according to the results, there were no differences in anxiety, self-concept, self-efficacy for self-regulation between fall and spring semester. On the other hand, the researchers stated that students had perceived mathematics as less valuable and gave lower effort and persistence than at the beginning of the year.

Ural, Umay and Argün (2008) investigated the effects of STAD (Student Teams-Achievement Divisions) and traditional learning on achievement and mathematics self-efficacy. Two ninth classes have been randomly selected for treatment and control groups. Students in both groups were taught about the concepts of relation, function and operation over an eight week-period. Pretest-posttest quantitative research design was performed. In the study, the instruments "Mathematics Achievement Test" and "Scale of Mathematics Self-Efficacy" were utilized in order to measure students' mathematics achievement and self-efficacy levels. The study indicated that there was a statistical significant difference on students' achievement scores ($p<0.001$) and self-efficacy scores ($p<0.05$) in favour of treatment group. In addition, according to individual interviews with some students in treatment group, 42% of the students agreed that this method (STAD) provided to them to learn better and increased their learning capacities.

There are many research studies that investigate the effects of students' attitude toward mathematics on mathematics performance (Haladyna, Shaughnessy & Shaughnessy, 1983; Quinn & Jadav, 1987; Tocci & Engelhard, 199; Utsumi &

Mendes, 2000). Utsumi and Mendes (2000) analyzed the students' attitudes toward mathematics with respect to type of school, gender, age, the frequency in which mathematical problems were understood, the amount of days studying mathematics, school failure, receiving help with their homework and self-perception of mathematical performance. The sample of the study were 209 students with 6, 7 and 8^{th} grades. The results of the study showed that students in public schools had significantly more positive attitudes than students in the private schools. In addition, the findings showed that there was a statistically significant relationship between the frequency in which mathematical problems were understood and students' attitudes toward mathematics. That is, students who understood the mathematical problems had better attitude toward mathematics, or, students who had positive attitudes might understand mathematical problems more easily. On the other hand, being helped to the completion of homework assignments, gender and the number of days dedicated to the study mathematics didn't show statistically significant influences on the attitudes toward mathematics.

In addition, Quinn and Jadav (1987) examined the possible causal relationships attitude and achievement in the areas of mathematics and reading for elementary school children. In this study cross-lagged panel analysis was performed. In the study, student attitude and achievement were measured for three time periods (October, December and May). Despite the often presented the belief that attitude and achievement were meaningfully related, it was concluded from the study that no powerful casual relationships existed between attitude and achievement in mathematics and reading (Quinn & Jadav, 1987).

The study of Peker and Mirasyedioglu (2003) investigated the relationships between the second grade students' attitudes towards mathematics and mathematics achievement. In this research, the instruments (mathematics attitude scale, and achievement test) were administered to 500 students in Ankara. Results of data analysis indicated that more than half of students had positive attitudes towards mathematics. However, more than 68,4% failed to mathematics according to score of mathematics achievement test. In addition, significant differences were found between students' attitudes towards mathematics and mathematics achievement.

In summary, affective variables are important determinants to understand students' mathematical ability and learning. In the present study, the effects of mathematical anxiety, beliefs about the nature of mathematics and teaching of mathematics, motivation toward mathematics and self-efficacy toward mathematics on mathematics achievement were investigated.

2.3 Studies on the Relationship Between School Factors, Socioeconomic Status and Mathematics Achievement

It was commonly noted that parent's socioeconomic status played a strong role for shaping the students' psychological and social characteristics and providing educational opportunities that might positively influence mathematics achievement (Alwin & Thornton, 1984; Entwisle & Alexander, 1996; Khmelkov & Wang, 2002). Entwisle and Alexander (1996) investigated the relationships between family type and student's growth in reading and math with primary grades. In the longitudinal model, the family type, the number of child's siblings, the mother's age, family's economic status and parent expectations were taken into account. The result of the study showed that parent configuration had no significant effect on math scores between the first and third grade. On the other hand, parents' economic status and expectations had great influence on math scores. According to the researchers, parents with higher socioeconomic status were more accurate in their recall of the child's scores, and expectations of parents whose knowledge was more accurate had more effect on the child's performance. In addition, Alwin and Thornton (1984) tried to explore the role of family socioeconomic factors in school achievement at two separate periods: early in childhood and during adolescence. The measures of the variables consisted of mother and father's education, father's occupation, family assets and income, family size and maternal employment. The structural equation model was used to determine whether the schooling experiences of both early in childhood and during adolescence were affected by socioeconomic influences. In the study, the relationships among the socioeconomic variables were quite similar across the major time periods. The result indicated that parental socioeconomic status tended to be positively related to school-achievement variables except family size. Moreover, Khmelkov and Wang (2002) determined the effects of family characteristics on mathematics achievement. In the study, middle school students from 34 nations participated in the TIMSS study. Hierarchical Linear Modeling was used to determine the effects of parents' education and family structure on mathematics achievement. The result of the study suggested that controlling the parents' education and academic ability, the effect of family structure on mathematics achievement varied with among nations. Students with more educated parents tended to get higher scores on the mathematics test. In addition, social background influenced mathematics achievement significantly.

In addition, Adeyemo (2005) investigated the effect of parental involvement, interest in schooling and school environment on academic self-efficacy of secondary school students. The stratified random techniques were used in the study to select 250 secondary school students. The multiple regression analysis, ANOVA and t-test statistical techniques were used to analyze the data. The result of the study showed that each of the independent variables made a significant contribution to the prediction of academic self-efficacy. In fact, parental involvement had the most significant effect ($\beta = 0.26$) and interest in schooling had the least significant effect ($\beta = 0.17$) for the prediction of academic self-efficacy. Thus, the result of the study demonstrated that 22.4% of the variance in the academic self-efficacy was accounted for by the linear combination of three variables (Adeyemo, 2005).

Besides**,** Bergin (1992) investigated the reciprocal relationship between the influence of leisure activities and motivation on mathematics achievement. The researcher presented the reasons of the importance of leisure activities on mathematics achievement and their motivation on the subject: (1) The content of leisure activity might be critical for cognitive development. (2) Activity could benefit for generalizing habits of discipline; self-regulation and problem solving. (3) During wide experience in leisure activities, students could learn content relevant to school. The subjects of the study were 159 high school students. The results of the study showed that students who intensely interested in sports were lower in intrinsic intellectual motivation than students with non-sport interests. In addition, number of leisure activities and hours spent in leisure activities correlated positively but weakly with mathematics achievement. Content of leisure activities was also important for achievement. Moreover, it was found that intrinsic intellectual motivation was a consistently significant predictor in achievement.

Some studies were dealing with the relationships between the attitude toward mathematics and the variables such as learning environment, family background and teacher characteristics (Haladyna, Shaughnessy & Shaughnessy, 1983; Papanastasiou, 2000; Tocci & Engelhard, 1991). One of them was done by Haladyna, Shaughnessy and Shaughnessy (1983). They investigated the effects of teacher quality, social-psychological classroom climate, and management-organization classroom climate on students' attitude toward mathematics and motivation. The path analysis was used to examine the relationships between these variables. The sample was selected by using a stratified random sampling that comprised over 2000 students with 4, 7 and 9th grades. The findings of the study showed that there was a strong association between teacher quality and both attitude toward mathematics and student motivation. In addition, the relationship between the social-psychological dimension and attitude increased with grade level. On the other hand, for 4th grade, attitude toward mathematics was not statistically significant with any variable. The important finding of the study was that the influence of attitude toward mathematics on motivation strengthens with grade level.

The study of Dursun and Dede (2004) investigated the teachers' thoughts about factors that were considered to affect students' success and they were grouped in ten points. The participants were 38 mathematics teachers. Results of the study indicated that mathematics teachers were aware of many factors that influenced students' success. According to the teachers, students who listened effectively to the lesson were more likely success in mathematics. In addition, 71% of mathematics teachers thought that mother's education and father's education had high effects on students' mathematics achievement.

Moreover, Tocci and Engelhard (1991) investigated the relationships of attitudes toward mathematics with mathematics achievement, parental support and gender. The data were analyzed by using a multivariate general linear model for two countries: US and Thailand. In both countries, mathematics achievement, parental support and gender were found to be statistically significant predictors of attitudes toward mathematics. In addition, gender differences in attitudes toward mathematics were significant even after controlling for achievement and parental support. In addition, Papanastasiou (2000) examined the predictors of mathematics outcomes focusing on attitudes and beliefs for three countries: US, South Cyprus and Japan. The variables of the study were students' views and attitudes on mathematics, parents' opinions on the importance of mathematics, socioeconomic status, educational background of the family, activities using in class, and general school climate. Structural equation model was used to identify the relationships among the variables. The result of the study showed that the path from beliefs to attitude was significant only in the South Cyprus model. The strongest direct effect on attitudes toward mathematics was *teaching* in South Cyprus and Japan, and *reinforcement* in the US. The strongest direct effect on student beliefs related to mathematics was reinforcement given by mothers and friends for South Cyprus and US students. However, attitudes and beliefs were not found to be predictors of student achievement in mathematics for all countries. Moreover, Papanastasiou (2002) found that teaching directly affected students' attitudes toward mathematics.

In summary, teachers' expectations toward their students' achievement, parents' support for their children's learning and their cultural and socioeconomic backgrounds, classroom climate and activities can influence students' affective characteristics as well as their mathematical performance. In the present study, the effects of socioeconomic status of the family, students' perceptions of their parents and teachers' attitudes toward them as learners of mathematics, classroom climate and learning activities in math class on mathematics achievement and on affective constructs were investigated for high school students.

2.4 Modeling Studies on Mathematics Achievement

Many research studies have been conducted in the recent years that addressed mathematics achievement with the affective and environmental variables that were considered to affect it (Bandura, 1997; Hayes, 2003; Ma, 1999; Martinez & Pons, 1996; Nasser & Birenbaum, 2005; Taylor, 1996). Some of the researchers have been trying to find out these relationships by using modeling techniques (Berberoglu et al, 2003; Broeck, Opdenakker & Damme, 2005; Hammouri, 2004; Papanastasiou, 2002). Generally, these studies showed that mathematics achievement could be explained by considering some factors related to students' affective constructs such as attitude, self-efficacy, anxiety, motivation, interest (Abu-Hilal, 2000; Nasser & Birenbaum, 2005) or environmental variables such as family and teacher characteristics, classroom climate, activities used in math classes (Papanastasiou, 2002; Zhang & Post, 2000).

One of the study was done by Broeck, Opdenakker and Damme (2005) who investigated the effects of students' characteristics on mathematics achievement. In this study, intake characteristics which were defined as numerical and spatial intelligence, educational level of the parents, language at home and possessions at home with the other characteristics-the attitude toward mathematics, the constructivist learning environment as perceived by the students and the optional program the students take were considered. The dataset contained the data of 4,168 Flemish students, 261 classes and 133 schools. The study revealed that the correlations between the mathematics scores and the variables were between 0.00 and 0.61. A strong correlation was found between "math score" and "intelligence score". In addition, a moderate correlation was found between the variables "intelligence score" and "attitude towards math" ($r=0.38$), "educational level of the parents" and "math score" ($r=0.30$), and "attitude towards math" and "math score" ($r=0.41$). In the study, with respect to the background characteristics of the students, the numerical and spatial intelligence scores appeared to be the most important variable to mathematics achievement. On the other hand, there was no indication of the importance of a constructivist learning environment as perceived by the student for mathematics achievement (Broeck, Opdenakker & Damme, 2005).

Moreover, Papanastasiou (2002) investigated the mathematics achievement of 8th grade students by using a structural equation model. The model contained 2 exogenous constructs: the educational background of the family and the reinforcement from mother, friends and individual himself; 5 endogenous constructs: Socioeconomic status (SES), students' attitudes toward mathematics, teaching, school climate and beliefs related to success in mathematics.

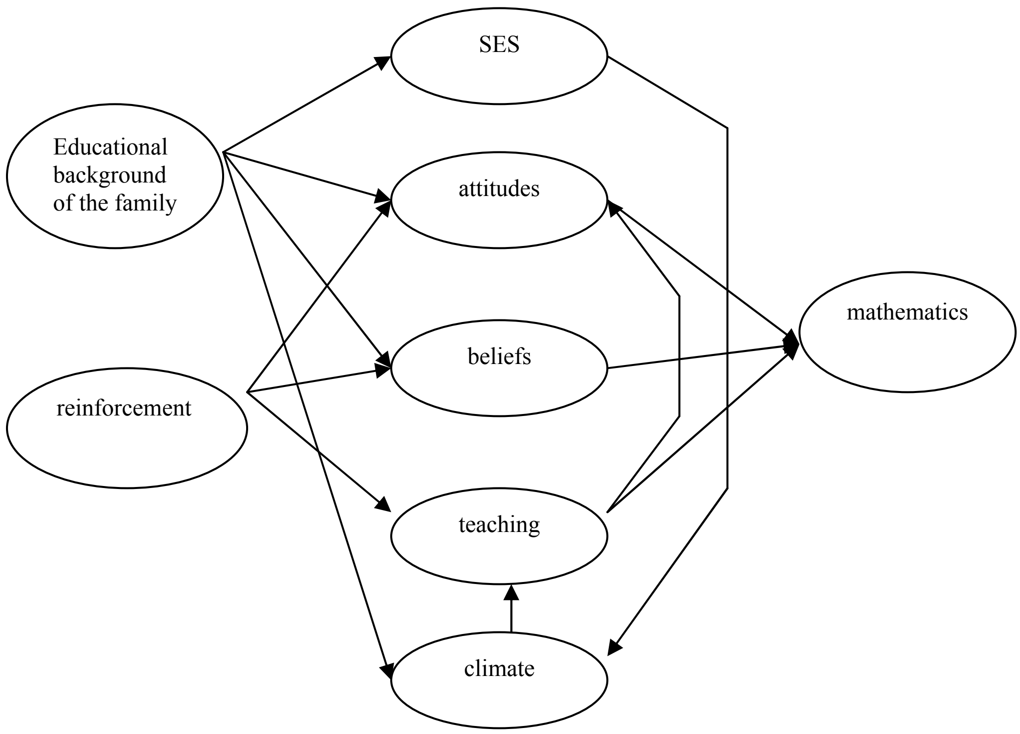

Figure 2.8 Model of Mathematics Outcomes Process (Papanastasiou, 2002)

The model of the study indicated that although attitudes, beliefs, and teaching had direct effects on mathematics outcomes, they were not statistically significant (see Fig. 2.8). This could mean that attitudes, teaching, and beliefs couldn't be used to estimate student outcomes in mathematics (Papanastasiou, 2002). Another important finding of the study was that the family educational background directly affected SES, attitudes toward mathematics, school climate and beliefs related to success in mathematics. This might mean that family characteristics had important roles for student emotional and cognitive development. In addition, teaching directly affected students' attitudes toward mathematics.

In addition, Zhang and Post (2000) examined fourth grade students' mathematics achievement by exploring the direct and indirect effects of students' school location, family background, and the teacher qualification. The researchers proposed a general model with related variables (Fig. 2.9). They had six hypotheses: (1) There was marked inequalities in family resources between urban and rural areas, (2) Greater family resources led to children to study in schools with more highly qualified teachers, (3) Children in urban areas attended schools with more highly qualified teachers than children in rural areas, controlling for the effect of family resources (4) Children from families with greater resources had higher test scores, controlling for the effect of the child's location and the teacher qualifications, (5) Students whose teachers were high qualified had higher test scores, regardless of the students' family resources or location, (6) Students in urban schools had higher test scores than students in rural schools, controlling for the effect of family resources and teacher quality (Zhang & Post, 2000).

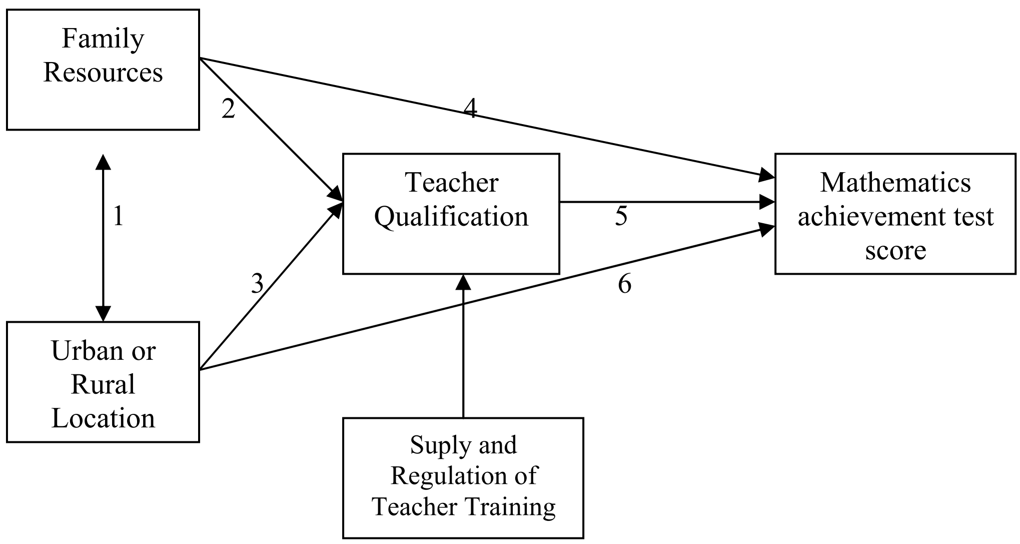

Figure 2.9 Relationship between Family resources, Location, Teacher Quality and Achievement (Zang & Post, 2000)

According to the results of the study of Zhang and Post (2000), a school level of teacher training had a large effect on students' knowledge of mathematics. However, there was no any direct effect of family resources on fourth grade mathematics achievement. That is, the fourth hypothesis was only rejected. But there was an indirect effect of this variable on achievement through the intervening the role of the teacher. According to the researchers, this was because of the fact that children in urban schools had highly qualified teachers than those in rural schools.

Another modeling study was done by Hammouri (2004). The purpose of this study was to examine the effects of student-related variables on achievement in mathematics. The subjects were 3736 8th-grade students. In the model, there were nine variables: mother's and friend's perception of mathematics importance , self perception of mathematics importance, success attribution to hard work, success attribution to luck, educational aspiration, confidence in mathematics ability, attitudes towards mathematics and mathematics achievement. The result of the study showed that first eight factors explained 31% of the variance in math scores. But the strongest positive total effect on math achievement was from the mother's perception of math importance (β=0.47). The second strongest total effect on math achievement was from success attribution to hard work (β=0.27). On the other hand, success attribution to luck had the strongest negative direct effect on achievement (β=-0.21). In addition, mother's perception of math importance had direct effects on attitude towards math (β=0.56) and self-perception of math importance (β=0.55). According to the researchers, this could mean that students who perceived great pressure from his/her mother to do well in mathematics could be more likely to like it and thought that it was important for life. Another important result of the study was that attitudes toward math had direct effects on math achievement (β=0.21) and self-perception of math importance (β=0.38). These findings showed that the 'closely related persons' had a significant effect on students' beliefs, attitudes and future aspirations (Hammouri, 2004).

Moreover, Abu-Hilal (2000) tested the casual relationship between attitudes, level of aspiration and achievement including mathematics, English and reading subjects by using a structural equation model. In the study, 280 (121 boys, 159 girls) high school students who were randomly selected form high schools in the state of California participated in the study. The hypothetical model consisted of eight exogenous variables. Level of aspiration was specified as dependent on attitude toward subject matter, while achievement was latent endogenous variable which was dependent on attitudes toward school subjects and level of aspiration (Fig. 2.10)

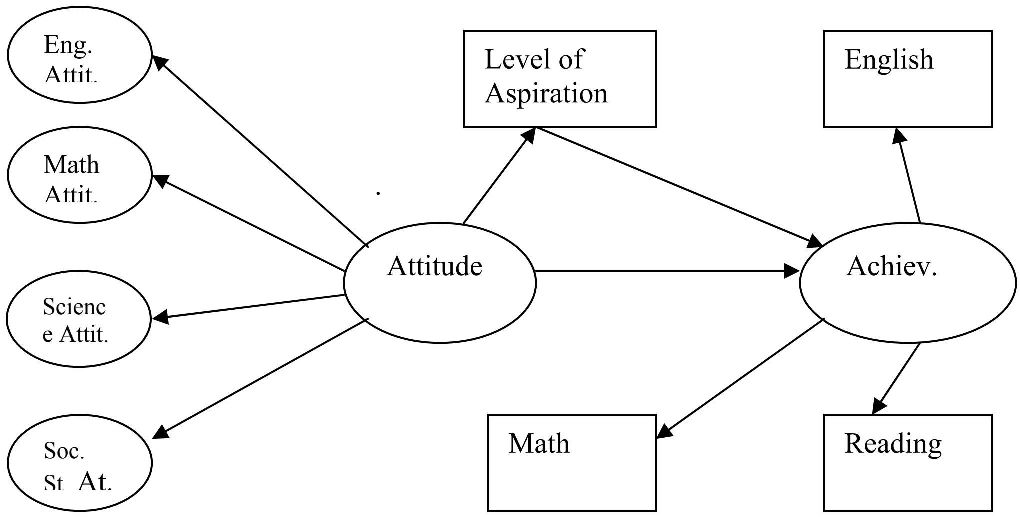

Figure 2.10 The Path Model of Academic Attitudes, Level of Aspiration and Achievement (Abu-Hilal, 2000)

In the study, the structural analysis revealed that attitudes to school influenced achievement indirectly (β=0.44). On the other hand, level of aspiration had significant direct effect on achievement (β=0.48) and it mediated between attitudes and achievement. Abu-Hilal (2000), in his study, noted that student's attitude was an important factor if he or she had goals and intentions on mathematics achievement.

Nasser and Birenbaum (2005) examined the relationships among gender, epistemological beliefs about the nature of mathematics, mathematics self-efficacy, attitudes toward mathematics, mathematics anxiety and achievement in mathematics with a structural model for two culturally different groups: 195 Jewish and 283 Arab eighth-grade students. The researchers investigated whether the structural model of mathematics achievement in terms of the learner-related variables was comparable across the two groups and the effects of these learner-related variables on mathematics achievement differ in both groups. In the study, gender was an exogenous variable while epistemological beliefs, mathematics anxiety, attitudes toward mathematics, mathematics self-efficacy, and achievement in mathematics were endogenous latent variables.

The result of the study showed that the hypothesized structural model of mathematics achievement indicated good fit in both groups (Fig. 2.11).

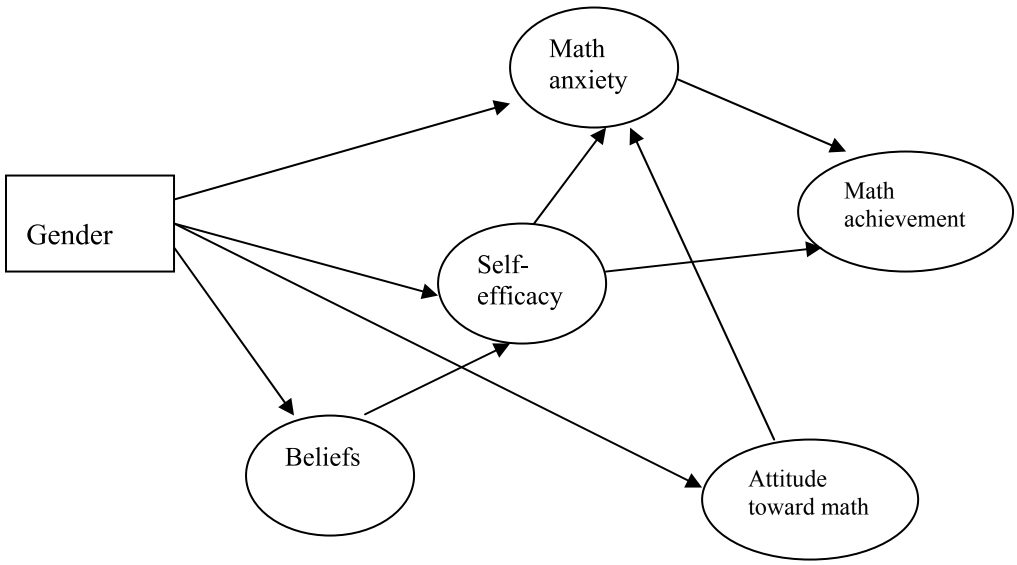

Figure 2.11 The Hypothesized Structural Model of Mathematics Achievement (Nasser & Birenbaum, 2005)

For the Jewish group, the effect of mathematics self-efficacy was significant directly and the effect of epistemological beliefs about mathematics on mathematics achievement was significant indirectly. In addition, for both groups, mathematics self-efficacy had the strongest effect on mathematics achievement. Moreover, epistemological beliefs about mathematics had second largest effect on mathematics achievement for Jewish students and third largest effect in Arab groups. On the other hand, for the Arab groups, gender, attitudes, and anxiety had insignificant effects on mathematics achievement. In addition, they reported that these five variables accounted for 31% of the variance in mathematics achievement for Arab groups whereas they accounted for only 14% of the variance in mathematics achievement for Jewish groups. This study showed that culture had an important role for determining affecting factors on mathematics achievement (Nasser & Birenbaum, 2005).

In addition, Gonzalez-Pienda et al (2002) investigated the influence of the parental involvement on students' academic aptitudes, self-concept, casual attributions and academic achievement. 503 students with different of grades were participated. In the study, parental involvement criteria involved parents' expectations about their children's achievement and capacity to achieve important goals, their reinforcement behaviors when they did homework. The researchers hypothesized the following model. In this model, parental involvement, casual attribution and academic aptitudes were supposed to affect students' academic achievement indirectly (Fig. 2.12).

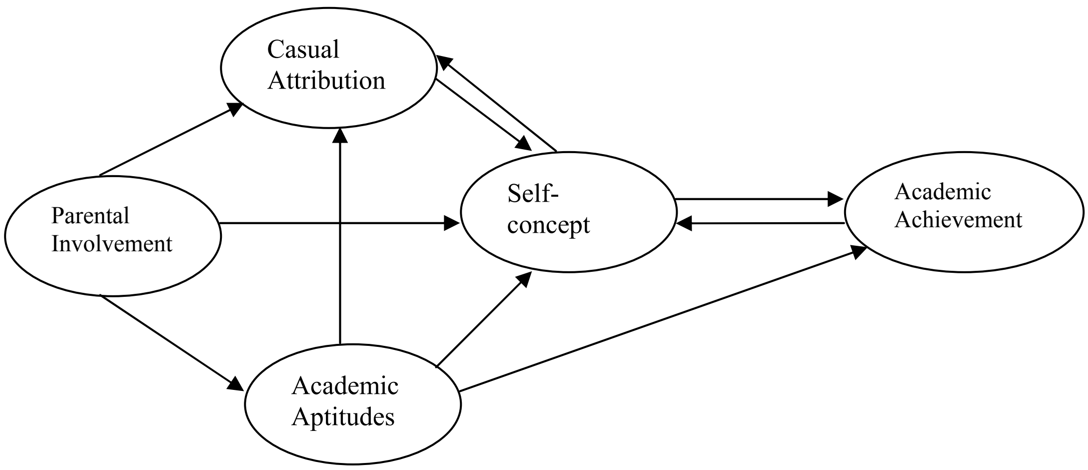

Figure 2.12 The Path Model for Latent Variables (Gonzales-Pienda et al, 2002)

In the result of the study, parental involvement behaviors significantly affected children's academic achievement but this influence was indirect.

Another modeling study was done by Is-Guzel and Berberoglu (2005) on data set from Program for International Student Assessment (PISA 2000) with respect to mathematical literacy. In this study, the factors studied were attitudes towards reading, student-teacher relations, classroom climate, communication with parents, use of technology, attitudes towards mathematics and reading literacy. The participants of the study were Brazilian, Japanese and Norwegian students. The results of the study showed that in all the three countries, reading literacy had the strongest effect on students' mathematical literacy skills. In addition, communication with parents was another important factor that made contribution to high performance in both reading and mathematical literacy across the three countries. On the other hand, the use of technology had a positive influence on reading and mathematical literacy for only Brazilian students. In addition, attitudes toward reading affected students' mathematical literacy skills negatively for all three countries.

Besides, Kabiri and Kiamanesh (2004) investigated the role of some personal variables, i.e., mathematics self-efficacy, mathematics anxiety, math attitudes and prior math achievement on students' math achievement. The participants of the study were 366 Iranian eighth graders. The collected data were analyzed using Path Analysis.

The obtained results indicated that prior math achievement and mathematics self-efficacy played the most important role in students' mathematics achievement. The results also showed that the relation between math attitude and math self-efficacy was 0.50, the relation between math attitude and math anxiety was 0.63. Another important finding of the study was that math attitude had positive indirect effects on mathematics anxiety and self-efficacy.

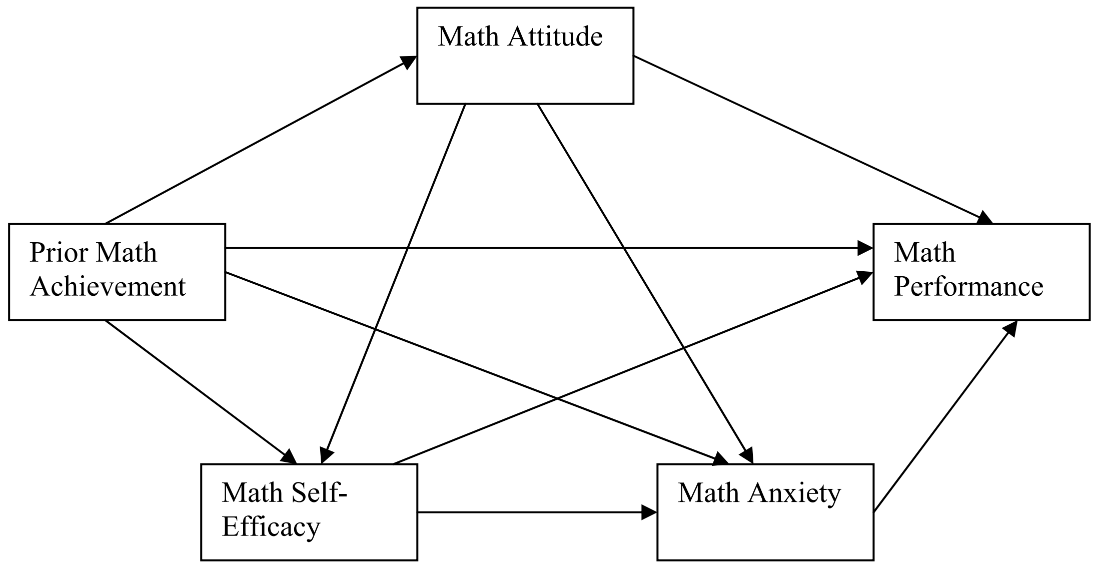

Figure 2.13 Final Path Model of the Study of Kabiri and Kiamanesh (2004)

In addition, Singh, Granville and Dika (2002) examined the effects of motivation, attitude, interest and academic engagement on 8th grade students' achievement in mathematics and science by using structural equation modeling. In the study, there were two types of items in the questionnaire related to motivation. Mot 1 was related to attendance of school and Mot 2 was related to participation and preparedness for classrooms. The final model of the study for mathematics achievement was shown in Figure 2.14.

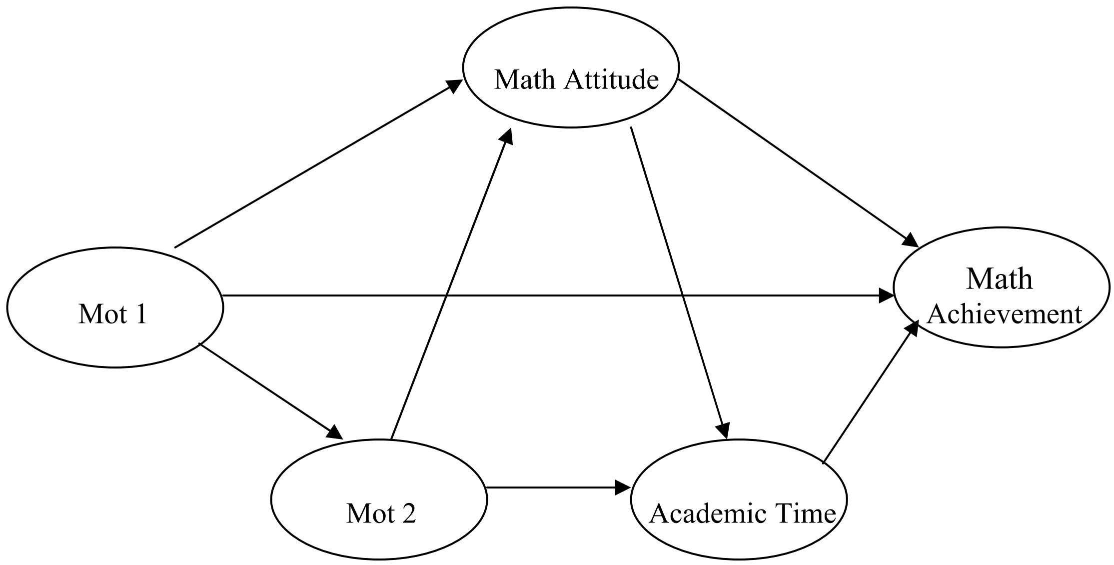

Figure 2.14 Final Model of Mathematics Achievement of Eight Graders
(Singh, Granville & Dika, 2002)

The model overall explained 46% of variance in mathematics achievement. In this model, academic time was the strongest direct effect on math achievement (β= 0.50). In addition, mathematics attitude (β= 0.23) and Mot 1 (β= 0.11) had directs effects on it. On the other hand, Mot 2 had no direct effect on math achievement, but indirect effect through math attitude and academic time. According to the researchers, this could mean that students who were participated in the activities and prepared before coming to the class were more likely to interest the subject and were more likely to success in it. Thus, the study showed that attitudinal and motivational variables were effective in explaining the variability in mathematics achievement (Singh, Granville & Dika, 2002).

Another study related to the effects of student-related variables on mathematics achievement was done by Köller et al (1999). They used structural equation modeling for predicting mathematics achievement of eight grade students. The variables of the study were home environment, sex, intelligence, academic leisure-time behavior, non academic leisure-time behavior, subjective norm (parents and peers), extrinsic motivation, mass media, fear of failure, mathematics achievement at the end of the 7^{th} grade, and mathematics achievement at the end of the 8th grade. Figure 2.15 showed the final model of the study. In the model, all paths displayed were significant at 0.05 and broken lines indicated negative paths.

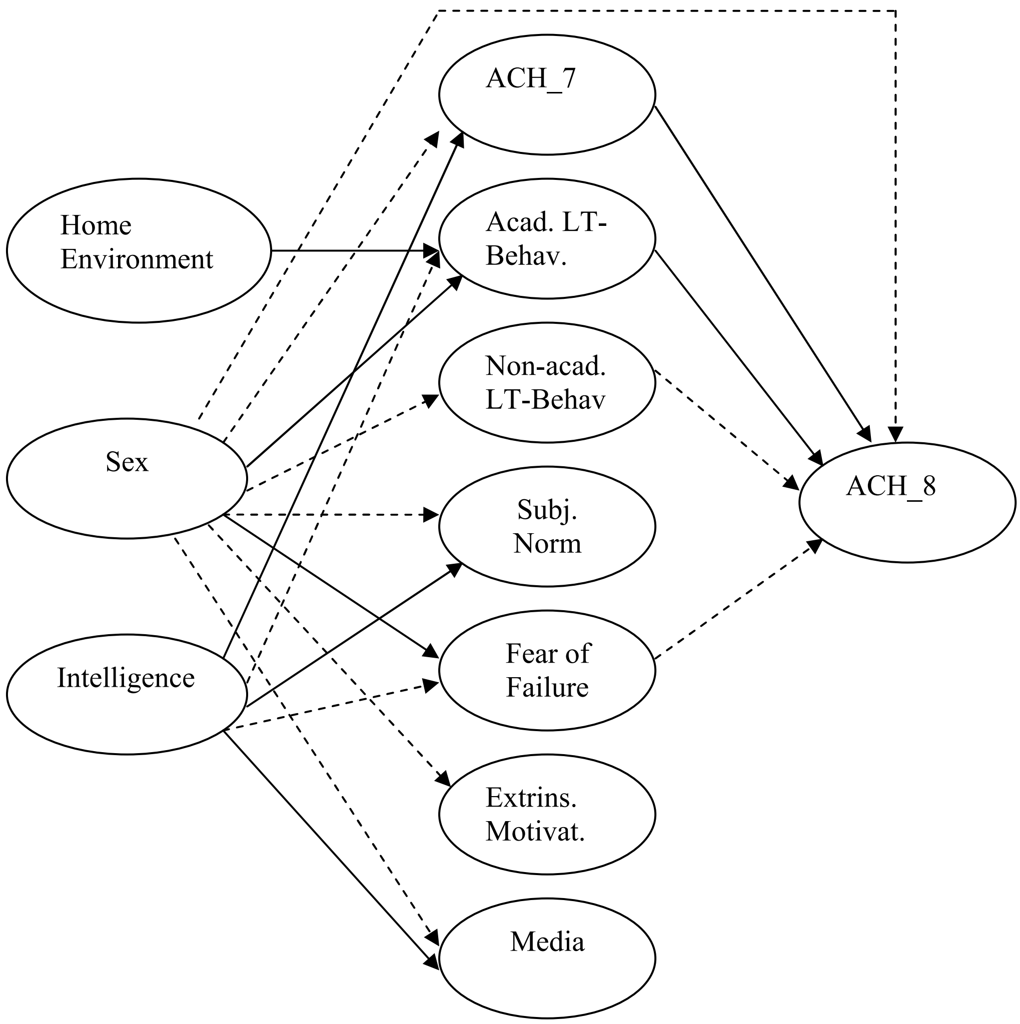

Figure 2.15 The Model of Mathematics Achievement
(Köller et al, 1999)

The model showed that sex and students' intelligence were important variables that influenced mathematics achievement as well as some endogenous latent variables. In fact, SES had significant paths on academic leisure-time behavior and fear of failure. Also, intelligence had significant paths on subjective norm and mass media. In addition, home environment had a significant path on academic leisure time behavior, that is, students with a relatively higher educational background spent more time on academic out-of-school activities (Köller et al, 1999). On the other hand, non-academic out-of-school activities as well as fear of failure had negative effects on achievement.

Creemers (1994) developed a conceptual framework for educational effectiveness. Cramer's model could be expressed as a summary of the empirical research on effective instruction (Bos & Kuiper, 1999) and the way of success in math. In this model, instruction, teacher and student background characteristics were the main factors on achievement (see fig. 2.16).

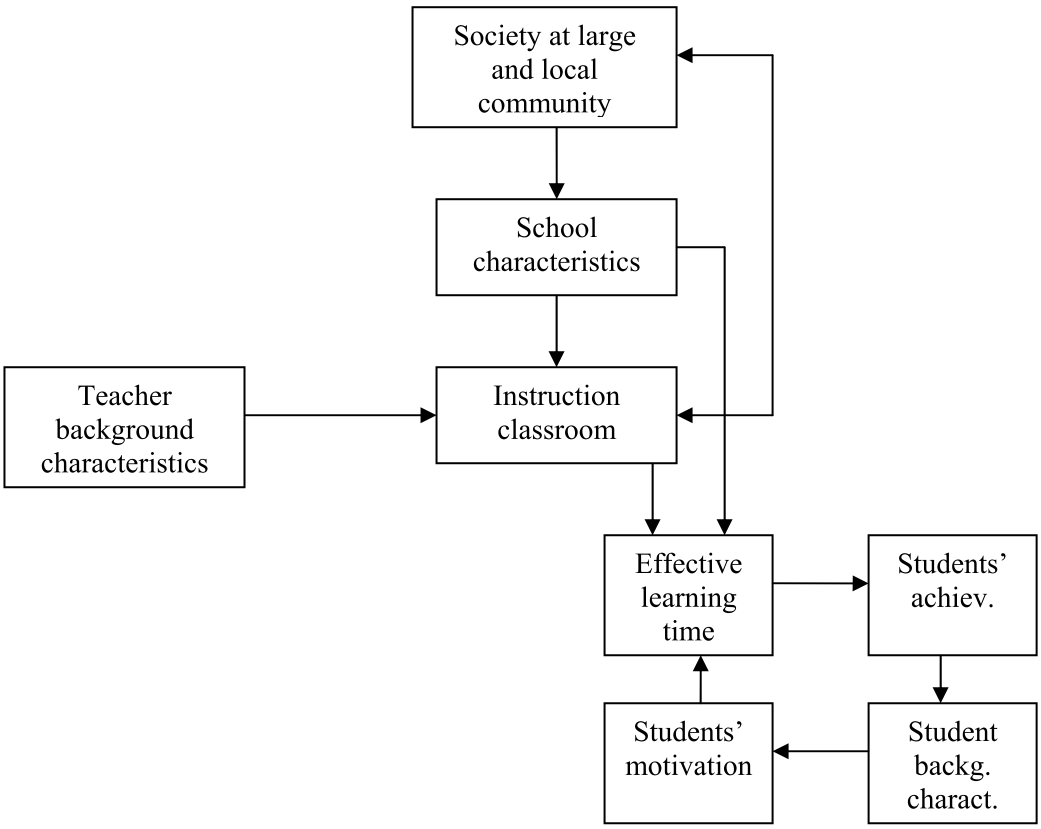

Figure 2.16 Model for Educational Effectiveness (Creemers, 1994)

Moreover, Wilkins and Ma (2003) investigated students' rate of change with variables associated with student characteristics, instructional experiences and environment by using hierarchical linear modeling techniques. In addition, they identified whether there were variables that differentially influenced change in middle school and high school. The data were collected from 3116 students from 7 to 12th grades in each year. Affective variables of the study were attitude toward mathematics, beliefs about the social importance of mathematics and the nature of mathematics. The results of the study showed that peer influence and teacher push were significantly and positively related to attitude toward mathematics and beliefs about social importance. The another important finding of the study was that students in secondary school became increasingly less positive with regard to their attitude toward mathematics and their beliefs about the social importance. On the other hand, there was no relationship between prior achievement and change in affective components. In this study, the findings showed that environmental variables were important role for students to like mathematics and identify its usefulness.

In a comparative perspective, Gruehn and Roeder (1995) tried to explore attitudinal variables of school achievement. Data of the study were collected from three countries: France, Japan and the United States. In the study, there were five factors: “parental support”, “self concept of mathematical ability”, “gender stereotyping”, “importance of mathematics”, and “mathematics achievement”.

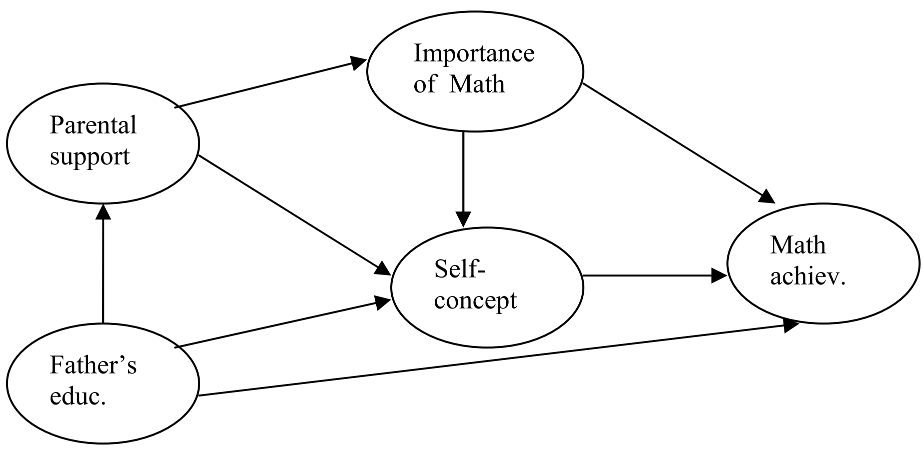

Figure 2.17 Path Analysis of the Relationship Between Motivational, Family Background Variables and Achievement for France, Japan and USA (Gruehn & Roeder, 1995)

The results of the study showed that the variables of the study explained 36% of the variance in math scores for students in France, 23% of the variance for those in Japan and 33% of the variance for those in USA. In addition, self-concept and importance of mathematics were important mediators between family background variables and achievement. Moreover, father's education had the strongest direct effect on mathematics achievement in the US sample (β=0.23). Another finding of the study was that the path from parental support to the self concept was negative for Japanese students. This might occur because of the fact that supporting from parents could be threatening for students that might be already working hard (Gruehn & Roeder, 1995).

Another conceptual framework was done by Bos and Kuiper (1999). They examined influencing factors on mathematics achievement in grade 8. The main question of the study was that "what could be learned about mathematics achievement for 8th grade students and the factors at student and classroom levels that might be associated with that achievement across 10 education systems?". To answer this question, the TIMSS instruments were used. The basic conceptual framework of educational effectiveness was shown in Figure 2.18.

In this model, the possible paths between the different variables at classroom and student levels were presented. The latent variables of the study were shown in Figure 2.18. The results of the study showed that the path coefficients between variables were not high. In fact, the percentage of the variance in students' mathematics scores explained by the latent variables of the model was not higher than 19%. In addition, home educational backgrounds, out of school activities, and attitude towards mathematics had significant direct effects on achievement. On the other hand, out of school activities had negative effect on achievement which meant that students who spent more time on jobs, playing games, and watching television were less successful in mathematics (Bos & Kuiper, 1999). In addition, the effects of the factors (class climate, assessment usage, instructional formats and effective learning time) that were supposed to influence achievement directly were not significant in the large of the educational systems.

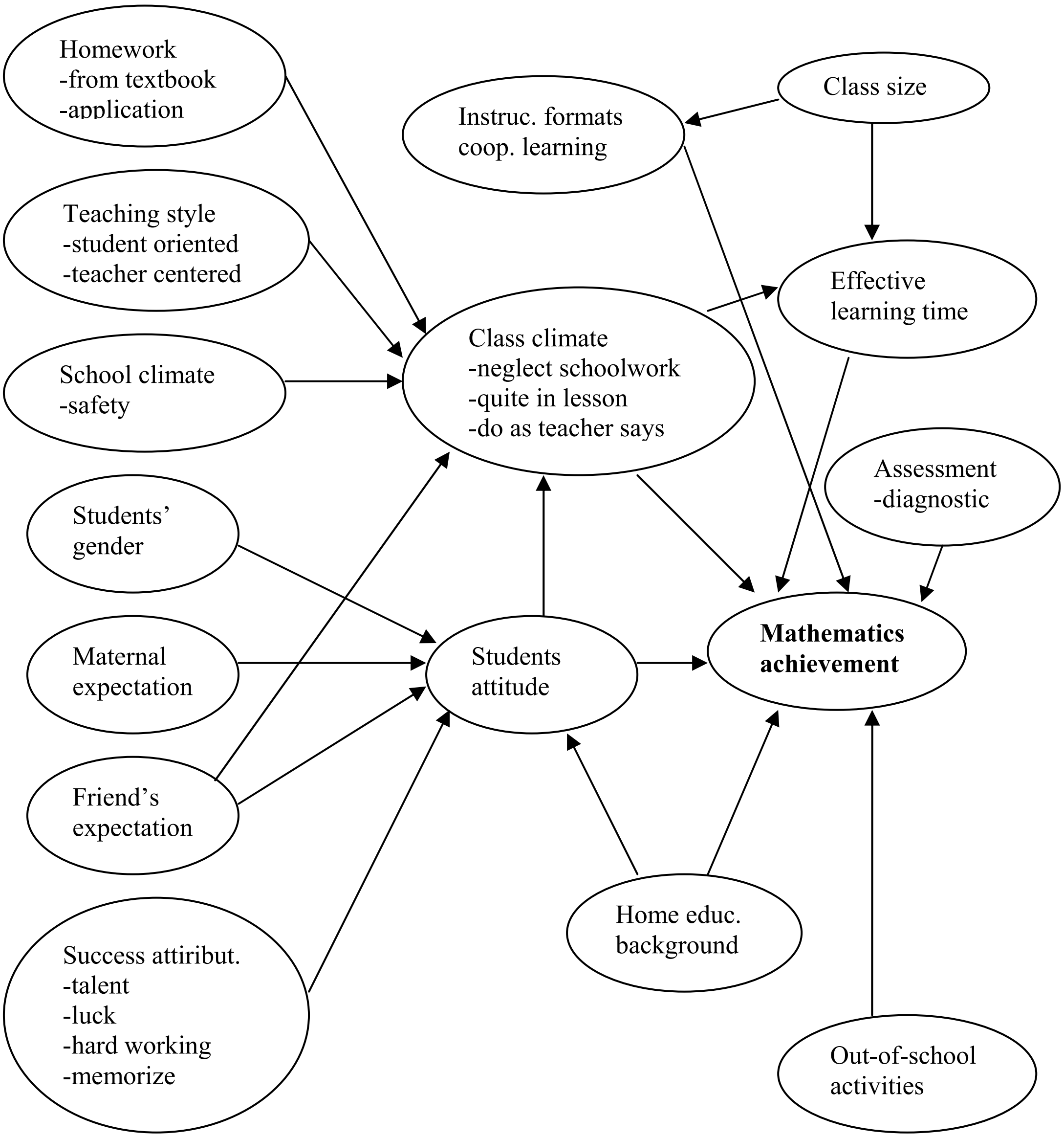

Figure 2.18 Recursive Student and Classroom Model (Bos & Kuiper, 1999)

In Turkey, there were few modeling studies to explain the effects of some factors on mathematics achievement for Turkish students (Akyüz, 2006; Berberoglu et al, 2003; Tag 2000; Yayan & Berberoglu, 2004). Akyüz (2006) examined the effects of mathematics teacher characteristics on students' mathematics achievement across Turkey, European Union countries by analyzing the data collected from student and teacher background questionnaires and mathematics achievement test from TIMSS-R. In the study, the hierarchical linear modeling study was used to build explanatory models. In Turkish model, teacher experience, time spent on tests and quizzes, disciplined class climate, use of text book and class mean of home educational resources were found to have positive significant effects on student achievement. On the other hand, for some countries, these variables had negative effects on mathematics achievement. For example, in Slovenia, it was found that the teacher experience had a negative effect on mathematics achievement. In addition, time spent on tests and quizzes had negative effects in Hungary, Lithuania and Netherlands. On the other hand, the result of the study also showed that class mean of home educational resources was the only the factor that had positive significant effect on students' mathematics performance in all the countries.

Moreover, Berberoglu et al (2003) investigated 7841 eight grade Turkish students' mathematics and science achievement based on the data from Third International Mathematics and Science Study (TIMSS) to explain the factors affecting students achievements in science and mathematics which were analyzed by Structural Equation Modeling (SEM). In this study, perception of success and socioeconomic status were identified as two important latent variables to predict achievement in mathematics and science. In addition, the results of the study showed that socioeconomic status (SES) had a strong impact on students' mathematics achievement (Fig. 2.19). This result also showed the importance of parental involvement in school. However, there was a negative relationship between student-centered classroom activities and mathematics achievement. By the researchers, this result could be explained with some of the reasons. One of them was that the Turkish students might not be familiar with some student-centered activities such as project works, classroom discussions or group work. According to them, this might occur because of the fact that, in many classrooms in Turkey the teacher was used the lecture method that the teacher gave the knowledge and students only took it. The second reason was that the difficulty of the application of the student-centered activities in classrooms which led to non effective activities (Berberoglu et al, 2003).

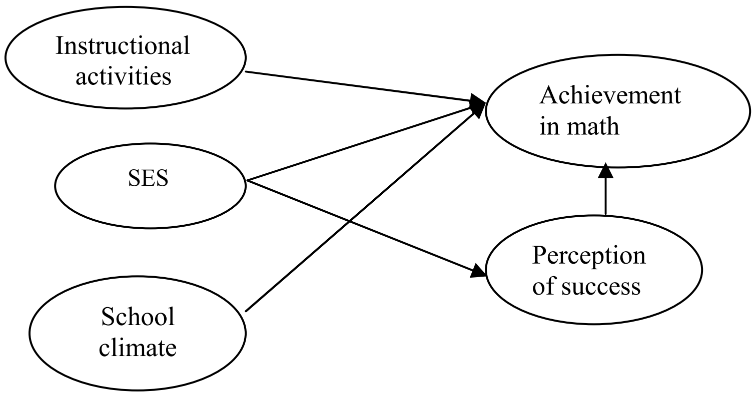

Figure 2.19 A Linear Structural Model for Mathematics (Berberoglu et al, 2003)

Another study which explored factors that were considered to be influential students' mathematics achievement was done by Yayan and Berberoglu (2004) where they assessed the TIMSS data for Turkish students. These influential factors were family background characteristics, student-related affective variables and instructional practices. The sample of the study was 7841 students including 4540 male and 3301 female students. In the study, the greatest effects on mathematics achievement of the students were perception of failure in mathematics, classroom climate, student-centered classroom activities, home family background and importance given to mathematics. In addition, perception of failure in mathematics was found to be the most important latent variable in estimating mathematics achievement. On the other hand, student-centered classroom activities and classroom climate had the negative relationships with mathematics achievement. In addition, importance given to mathematics and teacher-centered classroom activities had positive impact on achievement.

In summary, there are many research studies that investigate the effects of socioeconomic status, affective and school factors on mathematics achievement to explore students' persistence and success in mathematics. In the present study, the aim is to examine the relationships among these dimensions with respect to mathematics achievement and to investigate how this relationship differs among students at different kinds of high schools.

CHAPTER 3

METHOD

This chapter includes population and sample of the study, procedure, analysis of data, steps in SEM, sample size, missing data analysis, instruments, internal and external validity of the study.

3.1 Population and Sample of the Study

All 9^{th} grade students in Turkey were defined as the target population of the study. However, since it was not easy to come into contact with this target population, the accessible population was determined as all 9^{th} grade students in Ankara. For the study, convenience-sampling was used to select the subjects: subjects of the present study were chosen based on their relative ease of access.

Accordingly, the sample of the study was 3100 9^{th} grade students enrolled in different kinds of 22 high schools (9 of Anatolian, 7 of general and 6 of vocational) in Ankara, Turkey. The names of the schools were given in APPENDIX J. The distribution of the subjects with respect to school types was given in Table 3.1.

In vocational high schools, students are taught vocational skills to prepare them for future particular jobs. This school type is sometimes referred as technical high schools in which students are prepared for jobs with manual or practical activities. Students enter Anatolian high schools with a selection test conducted by Ministry of National Education. General high schools have no entrance criteria.

The study was carried out during the spring semester of 2007–2008 academic year.

Table 3.1 The Distribution of the Subjects with Respect to School Types and Gender

High School			Gender		Total
			Male	Female	
School type	**Anatolian**	Count	461	499	960
		% within school type	48%	52%	100%
		% of Total	14.9%	16.1%	31%
	General	Count	570	660	1230
		% within school type	46.3%	53.7%	100%
		% of Total	18.4%	21.3%	39.7%
	Vocational	Count	559	351	910
		% within school type	61.4%	38.6%	100%
		% of Total	18%	11.3%	29.4%
Total		Count	1590	1510	3100
		% of Total	51.3%	48.7%	100%

3.2 Procedure

A comprehensive literature review was conducted on journals and libraries located in Ankara by using the key words: ‘structural equation modeling’, ‘affective variables’, ‘school factors’ and ‘mathematics achievement’. In addition, search was extended by specifying the ‘affective variables’ and ‘schol factors’ with ‘anxiety’, ‘beliefs about mathematics’, ‘motivation to math’, ‘mathematics anxiety’, ‘classroom activities’, ‘family background characteristics’, ‘teachers’ expectations and beliefs’, and ‘classroom climate’.

Before the administrations of the scales and mathematics achievement test, the necessasary permissions were gotten from Turkish Ministry of National Education.

The instruments that were used in the study were administered to students in their classrooms and each class the purpose of the study and the directions were explained. They were informed that there was no right or wrong answer to the items, the correct answer was his or her answer on the survey, and that their answers might be different from their classmates. The scales and mathematics achievement test were administered by the teachers and it was expected to complete these scales and test about 45+45 minutes.

In addition, it was assumed during the study that

- There was no interaction between the subjects to affect the results of the study.
- The subjects understood and interpreted the items truly.
- No outside event occurred during the study.
- The administrations of the scales were completed under standard conditions.

The way of selection of the subjects was convenience-sampling. Thus, the survey didn't comprise a random sampling. Therefore, the sample might not be fully representative of the population and so generalizability could be limited.

3.3 Analysis of Data

Data analysis of the study was conducted by the following statistical techniques:

- Data of the present study were analyzed by using the SPSS and LISREL package programs.
- Data were coded, collected from the subjects by the following techniques:
    - students' responses to the survey items: strongly agree, agree, undecided, disagree and strongly disagree were coded from 5 to

1 respectively, then transfer them into computer environment with SPSS.

  - Anatolian high school, general high school and vocational high school were coded from 1 to 3 respectively.
  - mot_educ and fat_educ were coded from 1 to 7 as illiterate, literate, primary, middle, high school, university, and master respectively into SPSS program.
  - Family income was coded less than 500 as 1, 500-900 as 2, 900-1500 as 3, and more than 1500 as 4 for the analyses.
  - Number of sibling was coded 0-1 as 1, 2 as 2, 3 as 3 and more than 3 as 4.
  - Gender was coded as 1 for male and 2 for female.

- Descriptive statistics were used by the following reasons:
  - To detect the outliers and to check the data whether data recording error was made (data cleaning).
  - To get the mean, standard deviations, percentages and frequencies of the responses of each item.
  - To find the distribution and the frequencies of the subjects.
- Reliability analysis was used to test the reliability of the instruments administered in the present study.
- Exploratory and confirmatory factor analyses were performed to analyze the construct validity of the scales.
- The hypothesis of the study was analyzed by using Structural Equation Modeling (SEM). For this purpose, LISREL statistics package program was used.
- The significant level was set to 0.05 (t=1.96) since it was the most used value in educational studies. Effect size was considered to be small if absolute values less than 0.10, medium if absolute values around 0.30 and large if absolute values above 0.50 (Kline, 1998).

3.4 Steps in SEM

There are five steps that characterize most structural equation modeling applications (Schumacker & Lomax, 2004):

1. Model Specification
2. Model Identification
3. Model Estimation
4. Model Testing
5. Model Modification

Model Specification: At the beginning of the study, the researcher formulates a theoretical model which is hypothesized on the basis of literature. The purpose of the model is to explain the correlations between the variables in a particular shape (Kelloway, 1998).

The power of structural equation modeling derives from assessing the fit of theoretically derived predictions to the data rather than deriving a model that provides a perfect fit to the data (Kelloway, 1998).

Model Identification: It deals with whether a unique solution for the model can be obtained (Bollen, 1989). Models can be under-identified, just-identified or over-identified. If the number of structural equations composing the model exactly equals the number of unknowns, it is said to be this model is *just-identified*. If the number of unknowns exceeds the number of equations, the model is said to be *under-identified.* If the number of equations exceeds the number of unknowns, the model is *over-identified* (Kelloway, 1998, p. 14-15). Kelloway (1998) noted that for the social science, overidentified model is most appropriate one to explain the observed data within some margin of error. In fact, just-identified model which is said to be invalid scientifically is not recommended (Simsek, 2007)

If there are k variables in the model, there are $k \times (k-1) / 2$ unique elements in the covariance matrix. If the researcher wants to predict the value of the parameters with exactly the same number of k x (k-1) / 2, then he performs just-identified model which is not recommended (Simsek, 2007, Figure 3.1).

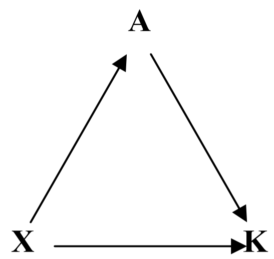

Figure 3.1 Just-identified Model (Simsek, 2007, p. 23)

Generally, it is not possible to estimate an under-identified model because of negative degrees of freedom (Figure 3.2; Simsek, 2007).

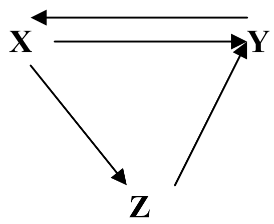

Figure 3.2 Under-identified Model (Simsek, 2007, p. 29)

<u>Model Estimation:</u> The estimation process involves minimizing the difference between implied matrix (∑) and sample covariance matrix (S) by using of a particular fitting function. When elements in the matrix S minus the elements in the matrix ∑ equal zero (S - ∑ = 0) then $\chi^2 = 0$, which means that one has a perfect model fit to the data (Schumacker & Lomax, 2004, p.66). There are different methods for estimating the parameters such as generalized least squares (GLS), unweighted or ordinary least squares (ULS or OLS) and maximum likelihood (Schumacker & Lomax, 2004). In the present study, maximum likelihood estimation method was used since observed variables were interval scaled and multivariate normal.

Model Testing: To test a theory about relationships between theoretical constructs, structural equation models are usually performed in a given context (Jöreskog & Sörbom, 1993). When the parameter estimates are obtained for a specified SEM model, the researcher should determine how well the data fit the model (Schumacker & Lomax, 2004). There are some fit indices used in SEM given in APPENDIX D.

The value of chi-square is very sensitive to sample size (Simsek, 2007). In the present study, GFI, AGFI, RMSEA and S-RMR fit indices were examined to determine how well the data fit the model (Jöreskog & Sörbom, 1993; see Table 3.2). In addition, in the study, standard errors, t-values and standardized residuals were taken into consideration to analyze significance of the relationships of the variables in the model.

Table 3.2 Model Fit Criteria and Acceptable Fit Interpretation
(Kelloway,1998; Jöreskog & Sörbom, 1993; Schumacker & Lomax, 1996)

Model fit 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)	The values exceeding 0.9 indicates a good fit to the data.
AdjustedGFI (AGFI)	0 (no fit) to 1 (perfect fit)	The values exceeding 0.9 indicates a good fit to the data
Standardized RMR (S-RMR)	<0.05	Value less than 0.05 indicates a good model fit.
Root-mean-suare error of approximation (RMSEA)	<0.05	Value less than 0.05 indicates a good model fit. Value up to 0.08 represent reasonable errors of approximation (Browne & Cudeck, 1993)

Model Modification :

Kelloway (1998) stated that researchers sometimes may add paths to the model or delete nonsignificant paths from their models based on the empirical results. But it is important to note that these modifications should be supported by literature.

In the present study, all paths in the model were determined based on the literature review and the theoretical assumptions.

3.5 Sample Size

It is commonly suggested that structural equating modeling technique requires large sample size (Bentler & Chou, 1987). Kelloway (1998) pointed out that both the tests of model fit and the estimation methods are based on the assumption of large samples. Jöreskog and Sörbom (1993) noted that in order to compute the standard errors, goodness of fit measures, t-values of parameter estimates and modification indices the appropriate sample size is needed

In generally, Kelloway (1998) said that at least 200 observations would be an appropriate minimum for the sample size. In fact, sample size which is approximately ten times number of observed variables is considered enough in models with normal distribution and relatively high relationships among variables (Kline, 2005; Schumacker & Lomax, 1996; Simsek, 2007).

3.6 Missing Data Analysis

Missing data values in variables affects the statistical analysis of data (Schumacker & Lomax, 2004). There are different options for replacing missing data values: listwise, pairwise, mean substitution, regression imputation, maximum likelihood and matching response pattern. Options for analyzing missing data are given in Table 3.3.

Table 3.3 Options for Analyzing Missing Data (Schumacker & Lomax, 2004, p. 25)

Options	Definition of the term
Listwise	Delete subjects with missing data on any variable
Pairwise	Delete subjects with missing data on only the two variables used
Mean substitution	Substitute the mean for missing values of a variable
Regression imputation	Substitute a predicted value for the missing value of a variable
Maximum likelihood	Find expected value based on maximum likelihood parameter estimation
Matching response pattern	Match variables with incomplete data to variables with complete data to determine a missing value

In the present study, listwise deletion of cases was used for missing data in all analyses.

3.7 Instruments

In the study, the following measuring instruments were used:

1. Beliefs about the Nature of Mathematics Scale
2. Beliefs about the Teaching of Mathematics Scale
3. Mathematics Self-efficacy Scale
4. Classroom Activities Scale
5. Classroom Climate Scale
6. Motivation Scale
7. Mathematics Anxiety Scale
8. Mother Scale
9. Father Scale
10. Teacher Scale
11. Mathematics Achievement Test

3.7.1 Beliefs about the Nature of Mathematics Scale (BELIEF)

"Beliefs about the Nature of Mathematics Scale" was derived from the Beliefs about Mathematics Scale which were adapted for 10th grade students by Mert (2004) and derived from BaNoM scale developed by Baydar (2000). The items for the present study were selected from the original scale considered measuring dimension of nature of beliefs about mathematics based on the literature. Reliability and validity of the scale were tested before the present study.

Data were analyzed by using the "Statistical Packages for Social Sciences" (SPSS) for the reliability and validity of the scale. In addition, "Linear Structural Relations" (LISREL) was used for confirmatory factor analysis. The scale with 12 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficients of BELIEF with 12 items were found to be 0.77 in the pilot study and 0.78 in the present study. The value of the corrected-item total correlation was appropriate for each item of the BELIEF (see APPENDIX C). The total score of BELIEF was between 12 and 60.

To check whether the selected items constituted a latent variable (BELIEF) Confirmatory Factor Analysis (CFA) was also conducted. The path diagram of the analysis was given in Figure 3.3

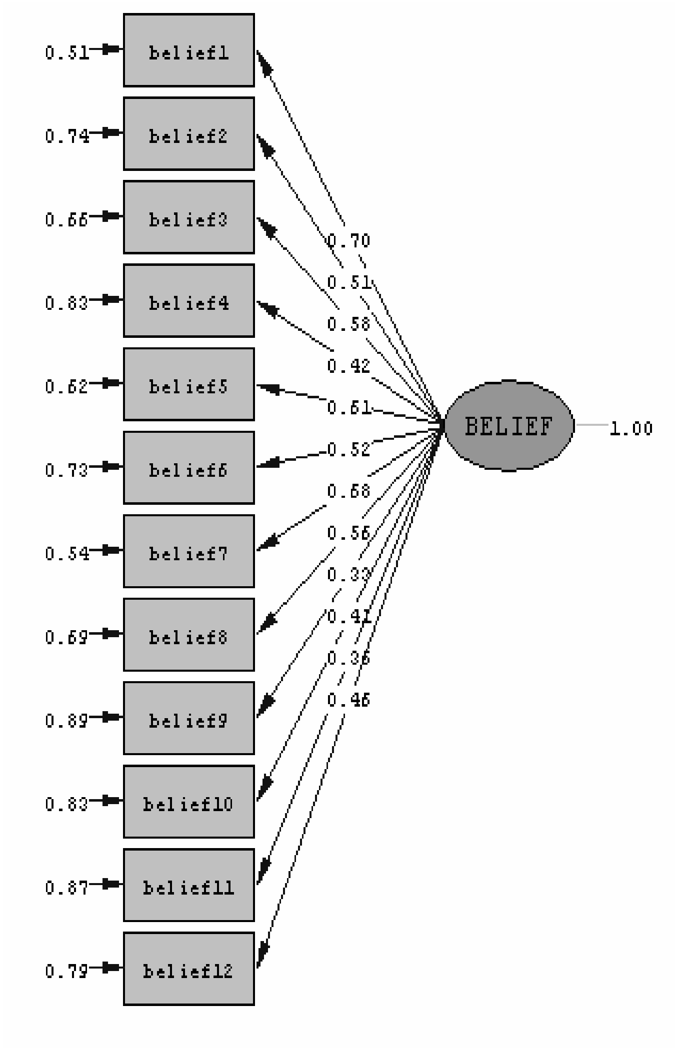

Figure 3.3 Confirmatory Factor Analysis for BELIEF
(Coefficients in Standardized Value)

All the fit indices (see Table 3.4) generated by LISREL indicated the model proposed fitted very well to the data set.

Table 3.4 Fit Indices for the Confirmatory Factor Analysis of BELIEF

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	74.05; df: 52 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.95
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.92
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.043
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.047

BELIEF with 12 items was used for the present study to determine 9th grade students' beliefs about the nature of mathematics.

3.7.2 Beliefs about the Teaching of Mathematics Scale (BEL_TEAC)

"Beliefs about the Teaching of Mathematics Scale" was derived from the Beliefs about the Teaching of Mathematics Scale which were adapted for 10th grade students by Mert (2004) and derived from BaToM scale developed by Baydar (2000). For BEL_TEAC, 13 items were selected. These items were considered representing the same trait measured by the original scale. To check this, analyses on the data collected from the pilot study were conducted.

Data were analyzed by using the "Statistical Packages for Social Sciences" (SPSS) for the reliability and validity of the scale. In addition, "Linear Structural Relations" (LISREL) was used for confirmatory factor analysis. The scale with 13 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficients of BEL_TEAC with 13 items were found as 0.82 in the pilot study and 0.85 in the present study. The value of the corrected-item total correlation was appropriate for each item of BEL_TEAC (see APPENDIX C). The total score of BEL_TEAC was between 13 and 65.

To check whether the selected items constituted a latent variable BEL_TEAC, CFA was conducted. The path diagram of the analysis was given in Figure 3.4.

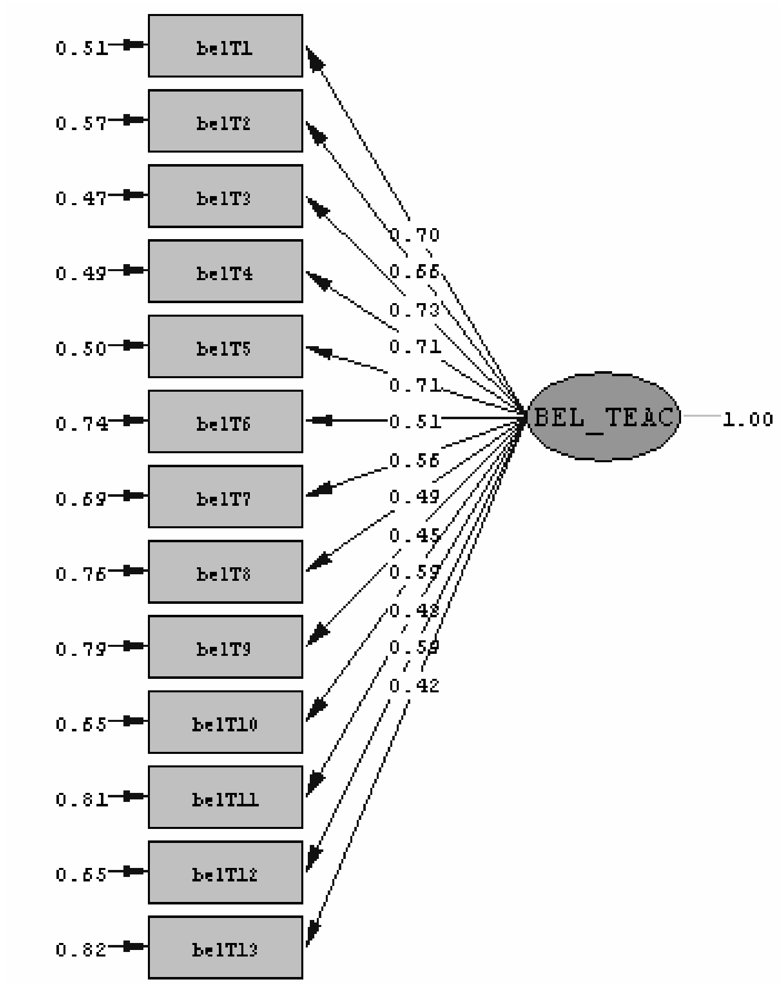

Figure 3.4 Confirmatory Factor Analysis for BEL_TEAC
(Coefficients in Standardized Value)

All the fit indices (see Table 3.5) generated by LISREL indicated the model proposed fitted very well to the data set.

Table 3.5 Fit Indices for the Confirmatory Factor Analysis of BEL_TEAC

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	92.37; df: 58 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.94
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.91
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.05
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.045

BEL_TEAC with 13 items was used for the present study to determine the 9th grade students' beliefs about the teaching of mathematics.

3.7.3 Mathematics Self-efficacy Scale (EFFICACY)

The items of Mathematics Self-efficacy Scale were taken from "Motivated Strategies for Learning Questionnaire" (MSLQ, 1991) which was adapted by Hendricks, Ekici, and Bulut (2000) for Turkish students and literature related to self-efficacy. Reliability and validity of the scale were tested before the present study.

Data were analyzed by using the "Statistical Packages for Social Sciences" (SPSS) for the reliability and validity of the scale. In addition, "Linear Structural Relations" (LISREL) was used for confirmatory factor analysis. The scale with 10 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The Cronbach's alpha reliability coefficients of EFFICACY with 10 items were found as 0.80 in the pilot study and 0.82 in the present study. The total score of EFFICACY was between 10 and 50. Although, the value of the corrected-item total correlation of eff_4 "I am confident that I do my best on homework given and submit it" was not high enough, it was used in the present study because its factor loading was found to be significant based on CFA. Other items of EFFICACY had appropriate value (see APPENDIX C). The total score of EFFICACY was between 10 and 50.

In order to check and confirm whether the selected items constituted a latent variable EFFICACY and to determine the appropriateness of the scale for the structural equation modeling analyses which were conducted for the present study, confirmatory factor analysis was performed. The path diagram of the analysis was given in Figure 3.5.

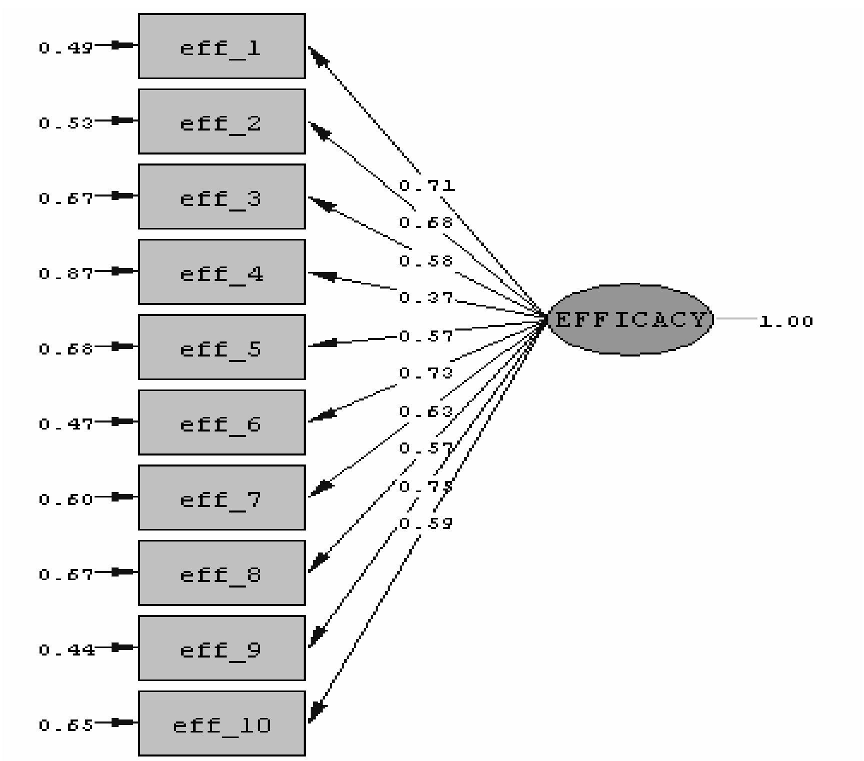

Figure 3.5 Confirmatory Factor Analysis for EFFICACY
(Coefficients in Standardized Value)

All the fit indices generated by LISREL were given at Table 3.6.

Table 3.6 Fit Indices for the Confirmatory Factor Analysis of EFFICACY

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	73.10; df: 32 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.94
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.90
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.06
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.046

The value of RMSEA was 0.06 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). Therefore, fit of the data to the model was considered to be acceptable.

EFFICACY with 10 items was used for the present study to determine the 9th grade student's mathematics self-efficacy.

3.7.4 Classroom Activities Scale (ACTIVITY)

The items of "Classroom Activities Scale" were taken from the literature (Baydar, 2000; Mert, 2004) and TIMSS (Trends in International Mathematics and Science Study) items related to student-centered and teacher-centered activities. Reliability and validity of the scale were tested before the present study.

Data were analyzed by using the "Statistical Packages for Social Sciences" (SPSS) for the reliability and validity of the scale. In addition, "Linear Structural Relations" (LISREL) was used for confirmatory factor analysis. The scale with 10 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree.

The Cronbach's alpha reliability coefficients for ACTIVITY with 10 items were found as 0.70 in the pilot study and 0.72 in the present study. The values of the corrected-item total correlation of act_4 "I copy the notes from blackboard" and act_6 "Group work is conducted in mathematics lesson" were 0.187 and 0.157, respectively. Although these values were very low, the items are frequently used in many studies. Thus, these items were used in the present study. Their parameters were rechecked after the present study. Other items of ACTIVITY had appropriate value (see APPENDIX C). The total score of ACTIVITY was between 10 and 50.

To prove this scale had two factors that constituted the latent variable ACTIVITY, confirmatory factor analysis was performed.

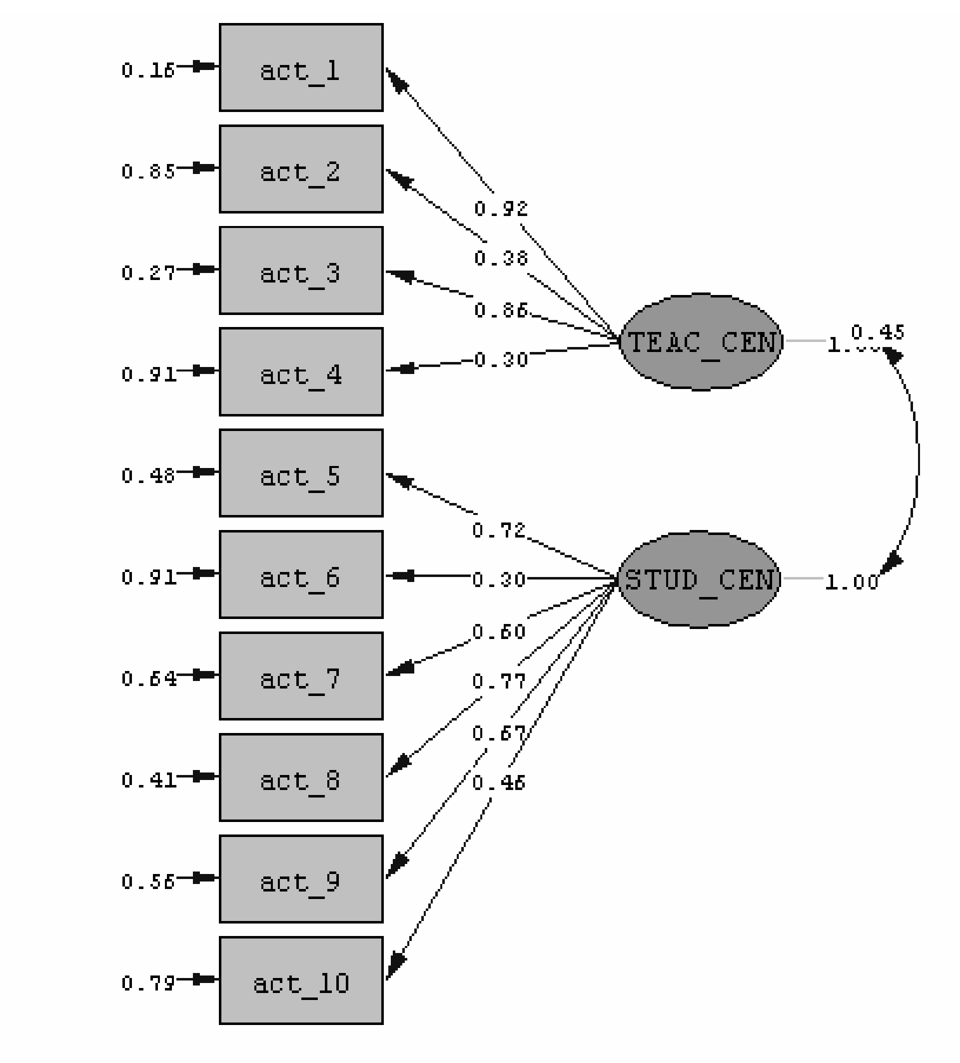

Figure 3.6 Confirmatory Factor Analysis for ACTIVITY

(Coefficients in Standardized Value)

All the fit indices (see Table 3.7) generated by LISREL indicated the model proposed fitted very well to the data set. Thus, ACTIVITY has two factors, namely, students-centered activities (STUD_CEN) and teacher-centered activities (TEAC_CEN). In the pilot study, the alpha reliability coefficients of the first and second factors were 0.716 and 0.589, respectively. In addition, for the present study, these values were 0.66 and 0.55, respectively.

Table 3.7 Fit Indices for the Confirmatory Factor Analysis of ACTIVITY

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	43.69; df: 28 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.96
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.93
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.049
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.049

ACTIVITY with 10 items was used for the present study to determine the 9th grade students' classroom activities.

3.7.5 Classroom Climate Scale (CLIMATE)

The items of Climate Scale were taken from the literature and TIMSS items (Trends in International Mathematics and Science Study) related to classroom climate. Reliability and validity of the scale were tested before the present study.

Data were analyzed by using the "Statistical Packages for Social Sciences" (SPSS) for the reliability and validity of the scale. In addition, "Linear Structural Relations" (LISREL) was used for confirmatory factor analysis. The scale with 6 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficients of CLIMATE with 6 items were found as 0.77 in the pilot study and 0.64 in the present study. The values of the corrected-item total correlation of the items of CLIMATE had appropriate value (see APPENDIX C). The total score of CLIMATE was between 6 and 30.

To check whether the selected items constituted a latent variable CLIMATE, CFA was conducted.

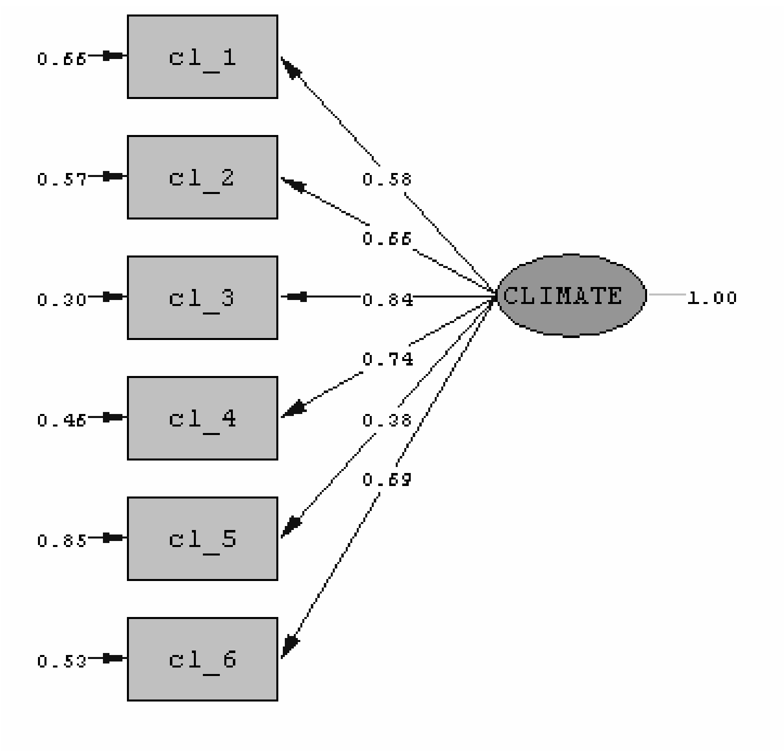

Figure 3.7 Confirmatory Factor Analysis for CLIMATE
(Coefficients in Standardized Value)

All the fit indices (see Table 3.8) generated by LISREL indicated the model proposed fitted very well to the data set.

Table 3.8 Fit Indices for the Confirmatory Factor Analysis of CLIMATE

Fit Index	Criteria	Value
Chi-square	Nonsignificant	8.02; df: 6 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.99
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.96
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.038
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.030

CLIMATE with 6 items was used for the present study to determine the 9^{th} grade students' mathematics classroom climate.

3.7.6 Motivation Scale (MOT)

The items of Motivation Scale were taken from MSLQ (1991) (Motivated Strategies for Learning Questionnaire) which was adapted by Hendricks, Ekici, and Bulut (2000) for Turkish students. 12 items were taken from this scale for the present study. Reliability and validity of the scale were tested before the present study.

Data were analyzed by using the "Statistical Packages for Social Sciences" (SPSS) for the reliability and validity of the scale. In addition, "Linear Structural Relations" (LISREL) was used for confirmatory factor analysis. The scale with 12 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficient of MOT with 12 items was found as 0.665 in the pilot study with 231 students. In addition, for the present study, this value was found as 0.76. The values of the corrected-item total correlation of mot4 "Getting a good grade in this class is the most satisfying thing for me right now" (Extrinsic Mot.), mot6 "I want to do well in mathematics class because it is important to show my ability to people who are in my life." (Extrinsic Mot.) and mot11 "Improving my overall grade point average, getting a good grade in mathematics class is not important thing for me." (Extrinsic Mot.) were 0.074, 0.109 and 0.081, respectively. These values were too low, indicating that three items might not be measuring the same trait with other items. In addition, the value of the corrected-item total correlation of mot5 was 0.181. Since this value was close to 0.2 which was a widely accepted minimum value for item discrimination. These values were rechecked in the analyses of the present study. Other items of MOT had appropriate value (see APPENDIX C). The total score of MOT was between 12 and 60.

In order to prove that this scale was unidimensional, confirmatory factor analysis was performed (see Figure 3.8).

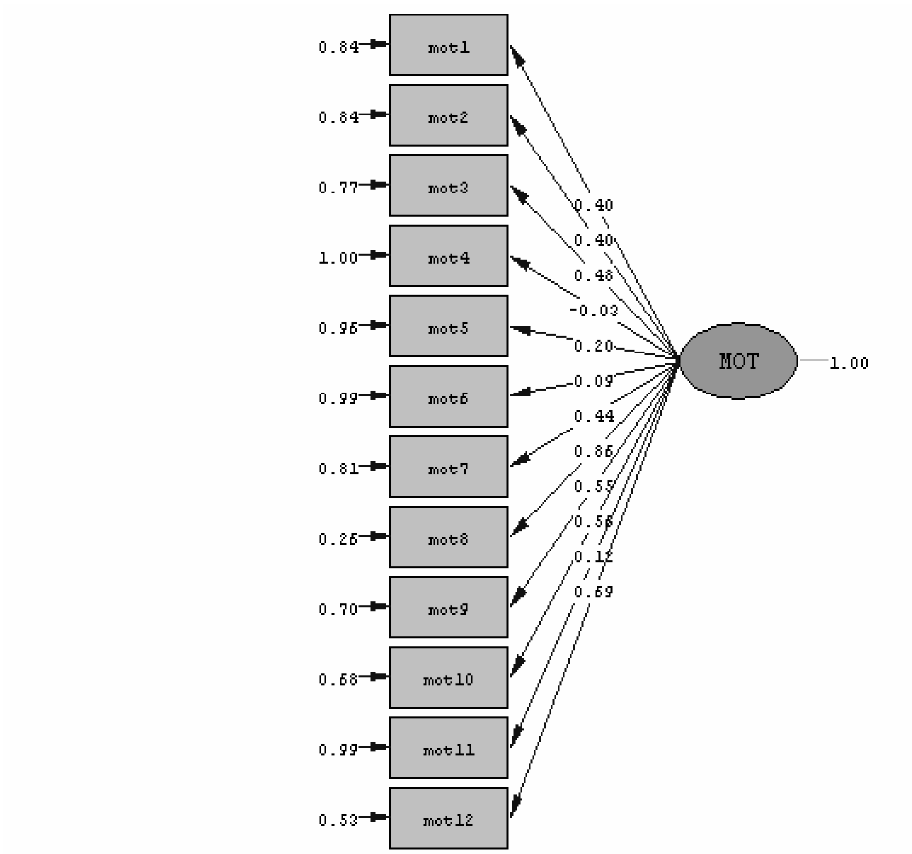

Figure 3.8 Confirmatory Factor Analysis for MOT (Coefficients in Standardized Value)

All the fit indices generated by LISREL are given in Table 3.9.

Table 3.9 Fit Indices for the Confirmatory Factor Analysis of MOT

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	92.99; df: 47 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.94
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.90
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.06
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.05

The value of RMSEA was 0.06 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993).

Therefore, fit of the data to the model was considered to be acceptable. As said before, the items mot4, mot6 and mot11 had nonsignificant t values (p>0.05). These values were rechecked in the present study. MOT with 12 items was used for the present study to determine the 9th grade student's motivation towards mathematics.

3.7.7 Mathematics Anxiety Scale (ANXIETY)

Mathematics Anxiety Scale was adapted from Fennema- Sherman Attitude Scale (1976) to measure feelings of anxiety, dread and nervousness related to doing mathematics. There were 12 items in the scale, 6 of them positively stated and 6 of them negatively stated. The scale with 12 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The negatively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and positively worded items were reversed to a negative direction for scoring purposes.

The alpha reliability coefficients of the ANXIETY with 12 items were found as 0.91 in the pilot study and 0.89 in the present study. The values of the corrected-item total correlation of the items were appropriate value (see APPENDIX C). The total score of ANXIETY was between 12 and 60.

To prove this scale had two factors, confirmatory factor analysis was performed (see figure 3.9)

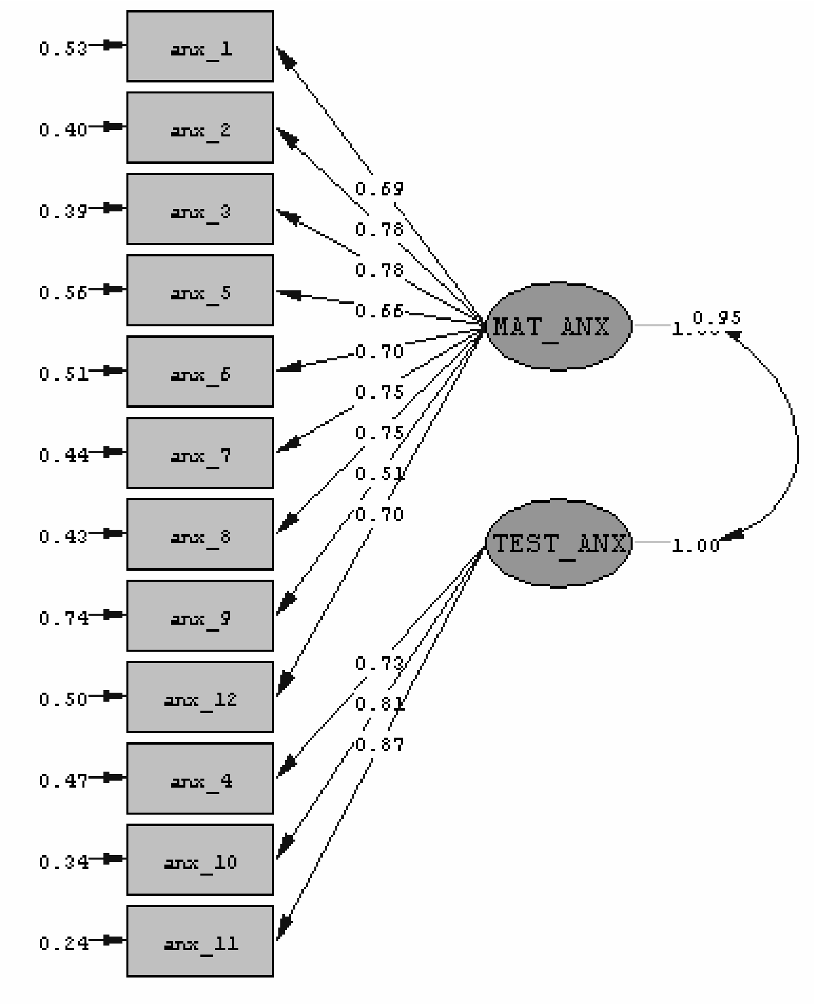

Figure 3.9 Confirmatory Factor Analysis for ANXIETY
(Coefficients in Standardized Value)

The fit indices for the CFA of ANXIETY were given in Table 3.10.

Table 3.10 Fit Indices for the Confirmatory Factor Analysis of ANXIETY

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	136.26; df: 44 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.92
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.85
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.06
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.05

The value of RMSEA was 0.06 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). In addition, the value of AGFI was 0.85 which was very close to the value of 0.90. Because of small sample, this value could be affected by the sample size (Hu & Bentler, 1995). Overall, these fit indices were model fit.

Thus, Mathematics Anxiety Scale was used for the present study to determine the 9th grade student's mathematics anxiety (MAT_ANX). The alpha reliability coefficient of the MAT_ANX with 9 items was found as 0.84 in the present study.

3.7.8 Mother Scale (SP_MOTH)

Mother scale which was adapted by Tag (2000) from Fennema- Sherman Attitude Scale (1976) to measure students' perceptions of their mothers' interests, encouragements and confidence in their abilities about mathematics (Fennema & Sherman, 1976) was used. There were 11 items for the scale where 6 of them positively stated and 5 of them negatively stated. The scale with 11 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficient of SP_MOTH with 11 items was found as 0.79 in the pilot study. Also, relability of the scale was reported by Tag (2000) as 0.82. In addition, the alpha reliability coefficient of SP_MOTH was found to be 0.82 in the present study. The value of the corrected-item total correlation was appropriate for each item of SP_MOTH (see APPENDIX C). The total score of SP_MOTH was between 11 and 55.

To further check whether the selected items constituted a latent variable (SP_MOTH), CFA was also conducted. The path diagram of the analysis was given in Figure 3.10.

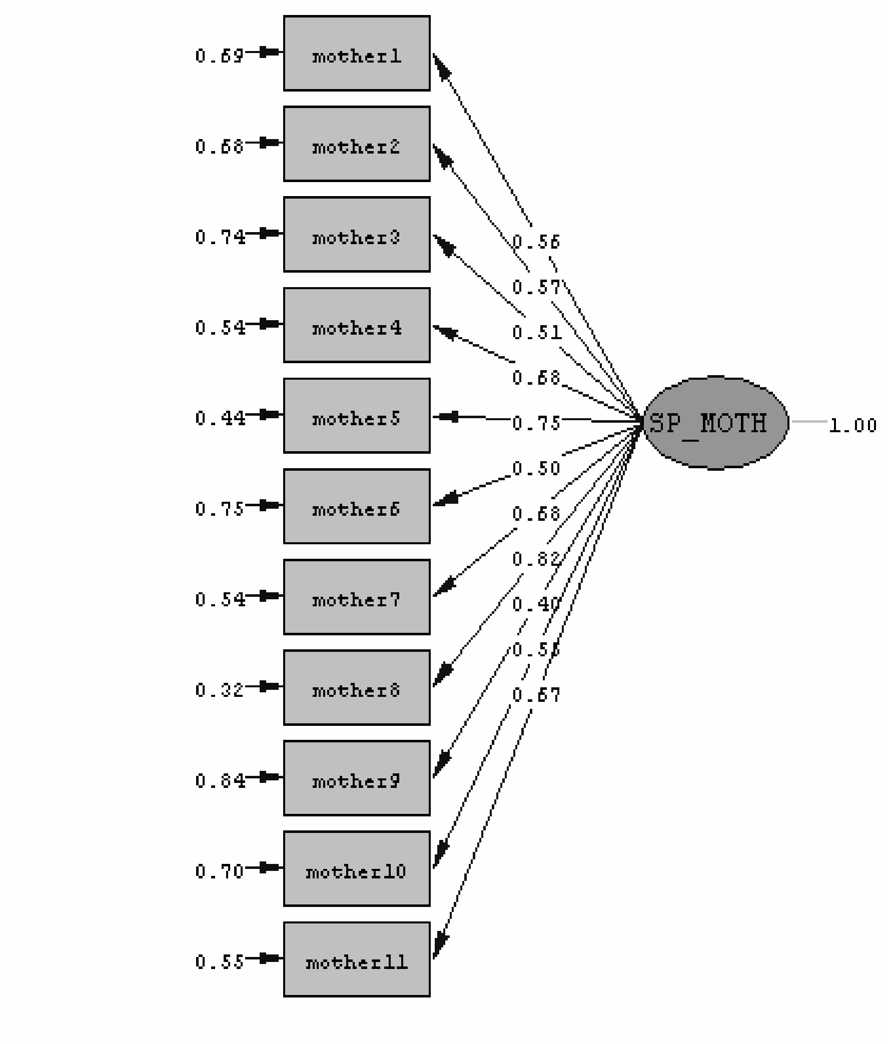

Figure 3.10 Confirmatory Factor Analysis for SP_MOTH
(Coefficients in Standardized Value)

All the fit indices generated by LISREL were given in Table 3.11.

Table 3.11 Fit Indices for the Confirmatory Factor Analysis of SP_MOTH

Fit Index	**Criteria**	**Value**
Chi-square	Non significant	61.41; df: 36 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.96
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.93
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.049
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.04

All the fit indices (see Table 3.26) generated by LISREL indicated the model proposed fitted very well to the data set.

Mother Scale with 11 items was used for the present study to determine the 9th grade students' perceptions of their mothers' attitudes toward them as learners of mathematics.

3.7.9 Father Scale (SP_FATH)

Father scale which was adapted by Tag (2000) from Fennema- Sherman Attitude Scale (1976) to measure students' perceptions of their fathers' interests, encouragements and confidence in their abilities about mathematics (Fennema & Sherman, 1976) was used. There were 11 items for the scale where 6 of them positively stated and 5 of them negatively stated. The scale with 11 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficient of SP_FATH with 11 items was found as 0.87 in the pilot study. Also, relability of the scale was reported by Tag (2000) as

0.85. In addition, the alpha reliability coefficient of SP_FATH was found 0.83 in the present study. The value of the corrected-item total correlation was appropriate for each item of SP_FATH (see APPENDIX C). The total score of SP_FATH was between 11 and 55.

To check whether the selected items constituted a latent variable (SP_FATH), CFA was conducted. The path diagram of the analysis was given in Figure 3.11.

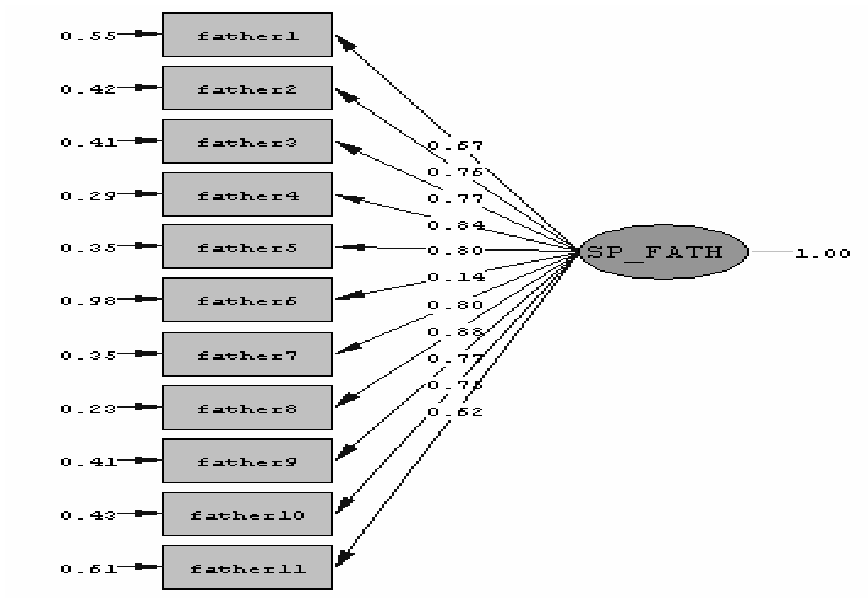

Figure 3.11 Confirmatory Factor Analysis for SP_FATH (Coefficients in Standardized Value)

Table 3.12 Fit Indices for the Confirmatory Factor Analysis of SP_FATH

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	52.61; df: 33 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.95
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.91
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.055
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.03

As seen in Table 3.12, the value of RMSEA was 0.055 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). Therefore, fit of the data to the model was considered to be acceptable. Father Scale with 11 items was used for the present study to determine the 9th grade students' perceptions of their fathers' attitudes toward them as learners of mathematics.

3.7.10 Teacher Scale (SP_TEAC)

Teacher Scale which was adapted by Tag (2000) from Fennema- Sherman Attitude Scale (1976) to measure students' perceptions of their teachers' attitudes toward them as learners of mathematics (Fennema & Sherman, 1976) was used. It included students' perceptions related to their teachers' interests, encouragement and confidence in the students' ability (Tag, 2000). There were 12 items in the scale, 6 of them positively stated and 6 of them negatively stated. The scale with 12 items was scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored starting from strongly agree as 5, to strongly disagree as 1, and negatively worded items were reversed to a positive direction for scoring purposes.

The alpha reliability coefficient of SP_TEAC with 12 items was found as 0.83 in the pilot study with 200 students. Also, reliability of the scale was reported by Tag (2000) as 0.79. In addition, the alpha reliability coefficient of SP_TEAC was found as 0.75 in the present study. The value of the corrected-item total correlation was appropriate for each item of SP_TEAC (see APPENDIX C). The total score of SP_TEAC was between 12 and 60.

To check whether the selected items constituted a latent variable (SP_TEAC), CFA was conducted. The path diagram of the analysis was given in Figure 3.12.

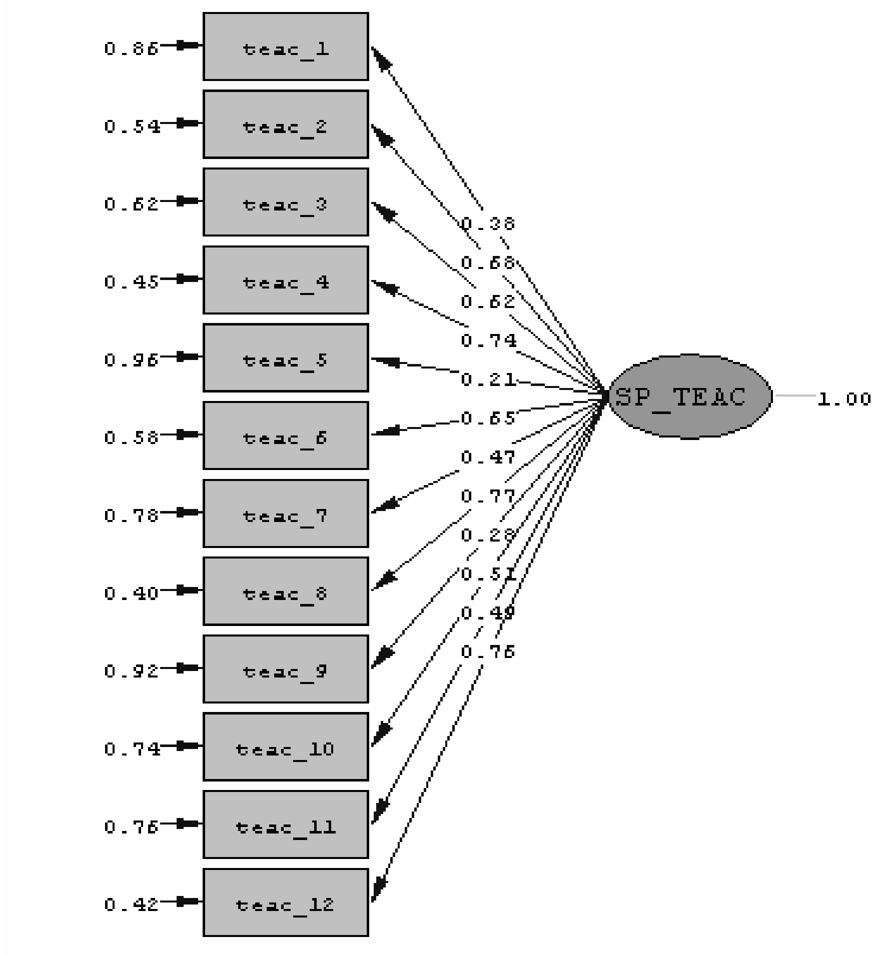

Figure 3.12 Confirmatory Factor Analysis for SP_TEAC
(Coefficients in Standardized Value)

Table 3.13 Fit Indices for the Confirmatory Factor Analysis of SP_TEAC

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	251.28; df: 41 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.92
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.89
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.06
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.05

As seen in Table 3.13, the value of RMSEA was 0.06 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). In addition, the value of AGFI was 0.89 which was very close to the value of 0.90. Because of small sample, this value could be affected by the sample size (Hu & Bentler, 1995).

Therefore, fit of the data to the model was said to be acceptable.

Teacher Scale was used for the present study to determine the 9th grade students' perceptions about their teachers' expectations and attitudes toward them as learners of mathematics.

3.7.11 Mathematics Achievement Test (MAT_ACH)

Mathematics Achievement Test was developed by Ozturk (2003) to determine the students' achievement toward mathematics and to assess the students' degree of attainment of the course objectives. Test content was limited by the researcher according to new curriculum program published by the Turkish Ministry of Education for 9th grade students. So, the pilot study was done before using the test for the present study:

- Pilot study was conducted with 200 students in spring semester of 2007-2008 academic year. In the analysis of the test, if the student's answer was correct then, it was scored as 1 and otherwise, it was scored as 0.
- In the pilot study, the alpha reliability coefficient of the test with 20 items was found as 0.84. In the present study, the alpha reliability coefficient of the test was found as 0.91.
- The ITEMAN program was used to accomplish item analysis. The ITEMAN program indicated item discrimination power as a point biserial coefficient and item difficulty as the percentage of correct responses to each item.
- The criterion is that item discrimination power should be greater than or equal to 0.3 (Hopkins, 1998, p. 260). The criterion for item difficulty is that the coefficient should be between 0.3 and 0.8. According to these criteria, the item discrimination powers and item difficulty of each item were analyzed.

- Both the item discrimination powers and item difficulty of the items were higher than 0.3 (see APPENDIX G).
- Two items related to rational numbers had item difficulty of 0.92 and 0.91. However, these items were not eliminated from the test because of content validity of MAT_ACH. In addition, students knew rational numbers before and so they were expected to have mastered the related concepts and skills.
- The content validity of MAT_ACH was checked by the experts and mathematics teachers in terms of their course objectives and course content. “Table of Specification For Mathematics Achievement Test” was given in APPENDIX F. The table showed the item numbers on levels for each subject matter. All the items on the test were on comprehension and application levels.
- The total score of MAT_ACH was between 0 and 20.

3.8 Internal Validity of the Study

Internal validity of a study means that the dependent variables are directly related to intended independent variables, but not due to some other unintended variables (Fraenkel & Wallen, 1996). In the present study, there can be some possible threats such as subject characteristics, mortality, location, data collector characteristics and data collector bias (Fraenkel & Wallen, 1996).

One possible threat to internal validity of the study was subject characteristics. The subjects of the study were at the same grade level so the ages of the subjects were almost the same. Socioeconomic background of a subject was examined in the study as an exogenous variable, so this variable didn’t affect the research result unintentionally. On the other hand, gender difference wasn’t analyzed. Thus, gender might be a threat for the study.

Administering the questionnaires to 9th grade students of each school at the same time and with similar settings controlled location threat.

In the present study, mortality couldn’t be a threat because subjects were given scales and achievement test in a very short time interval.

Data collector characteristics and data collector bias might constitute threats in the study because data collectors- the teachers or counselors, followed the same procedure, read the same instructions to all participating students.

It was remembered to the students that their answers were not be used any other purposes except the study. Thus, confidentiality was satisfied.

In addition, for all participants, the mathematics achievement test was used to identify their achievement in mathematics in order to avoid different results because of taking different measurements.

3.9 External Validity of the Study

External validity is the extent to which the results of a study can be generalized (Fraenkel & Wallen, 1996).

In the present study, convenience sampling was utilized. Because of this, generalizations of the findings of the study could be limited. However, generalizations could be done on subjects that holded the same characteristics mentioned in the "Population and Sample of the Study" section.

The measuring instruments were used in regular classroom settings. Since the study was on 9th grade high school students, the results of the present study could be generalized to similar settings to this study.

CHAPTER 4

RESULTS

This chapter contains the results of descriptive statistics and factor analyses of the instruments. In addition, it gives the results of different mathematics achievement models for the main study and for each type of the schools.

4.1 Results of Descriptive Analyses

In the present study, the results of the means and standard deviations of the variables with 3100 9th grade students were given in Table 4.1.

Table 4.1 Mean and Standard Deviations

Variable	High School			Main Study
	Anatolian	**General**	**Vocational**	
	Mean (Sd)			
BELIEF	46.97 (7.36)	42.75 (7.11)	42.40 (6.94)	43.95 (7.42)
BEL_TEAC	57.67 (5.75)	53.62 (7.75)	53.28 (7.15)	54.78 (7.27)
EFFICACY	39.78 (6.46)	35.83 (6.67)	36.96 (6.58)	36.80 (6.88)
ACTIVITY	33.35 (5.36)	33.96 (5.30)	33.59 (5.47)	33.67 (5.38)
STUD_CEN	19.89 (4.56)	19.48 (4.36)	19.37 (4.40)	19.57 (4.44)
TEAC_CEN	13.45 (2.96)	14.48 (2.84)	14.22 (3.00)	14.09 (2.95)
CLIMATE	20.63 (4.50)	19.16 (4.32)	18.21 (4.39)	19.34 (4.50)
MOT	46.39 (7.21)	43.85 (7.48)	43.44 (6.91)	44.52 (7.34)

Variable	Mean (Sd)			
ANXIETY	30.12 (9.80)	34.79 (9.76)	35.52 (9.29)	33.57 (9.91)
MAT_ANX	21.66 (7.48)	25.67 (7.48)	26.33 (7.03)	24.63 (7.62)
TEST_ANX	8.46 (3.24)	9.11 (3.19)	9.18 (3.29)	8.93 (3.25)
SP_MOTH	45.74 (7.39)	42.12 (7.80)	40.91 (7.35)	42.89 (7.79)
SP_FATH	46.99 (6.70)	42.26 (7.64)	40.98 (7.30)	43.36 (7.68)
SP_TEAC	42.46 (7.74)	39.30 (7.04)	38.40 (6.56)	40.02 (7.32)
MAT_ACH	15.84 (3.46)	7.61 (4.04)	5.12 (2.41)	9.43 (5.60)

Table 4.1 cont.

4.2 Results of the Factor Analysis

To test the construct validity of each scale, principle components analysis was performed. According to the results, all the scales were one-dimensional like the results of the pilot study. The eigenvalues and factor loadings of each item and total variance of each scale were shown in APPENDIX I.

Table 4.2 presented the variables, items whose factor loadings were higher from the rest, item means, standard deviations, and factor loadings based on the data.

Table 4.2 Variables, Items, Item Means, SD, and Factor Loadings

Variable	Items	Loading	Mean	SD
SES	mot_educ	0.86	4.78	1.18
	fat_educ	0.85	4.28	1.29
	income	0.78	2.98	0.92
	sibling	-0.56	1.75	0.93
TEAC_CEN	act_1	0.74	3.73	1.24
	act_3	0.71	4.08	0.98
	act_4	0.58	3.94	1.12

Variable	Items	Loading	Mean	SD
	act_5	0.70	3.81	1.16
STUD_CEN	act_8	0.69	3.76	1.12
	act_9	0.76	3.87	1.18
	cl_3	0.70	2.71	1.29
CLIMATE	cl_4	0.63	2.90	1.29
	cl_6	0.70	3.25	1.19
	teac_2	0.66	3.48	1.09
SP_TEAC	teac_7	0.68	3.34	1.19
	teac_10	0.69	3.37	1.15
	father4	0.69	4.19	1.01
SP_FATH	father7	0.67	3.82	1.13
	father11	0.70	4.09	1.07
	mother2	0.68	4.04	1.10
SP_MOTH	mother5	0.66	3.79	1.28
	mother10	0.69	3.99	1.15
	belief1	0.73	3.97	1.02
BELIEF	belief2	0.67	3.85	1.00
	belief12	0.65	3.69	1.20
	belt4	0.67	4.37	0.83
BEL_TEAC	belt6	0.65	4.11	0.90
	belt10	0.67	4.28	0.88
	eff_6	0.67	3.38	1.10
EFFICACY	eff_7	0.67	3.28	1.29
	eff_9	0.69	3.56	1.22
	mot2	0.61	3.97	0.98
MOT	mot8	0.69	3.27	1.32
	mot9	0.60	3.64	1.22
	anx_1	0.70	2.64	1.32
MAT_ANX	anx_2	0.74	3.07	1.32
	anx_3	0.67	2.90	1.16
	mat4	0.67	0.42	0.49
	mat5	0.68	0.48	0.50
MAT_ACH	mat10	0.67	0.42	0.49
	mat11	0.71	0.60	0.49
	mat18	0.70	0.56	0.49

Table 4.2 cont.

The literature suggested that at least three observed variables should be used for each latent variable (Hair et al, 1998). Simsek also (2007) stated that using more observed variables caused getting less probability for confirming to the model.

In the present study, for the latent variables, three items whose factor loadings had the highest values from the rest were taken as observed variables from each scale except MAT_ANX (see APENDIX I). The item anx_1 was taken as an observed variable for the latent variable MAT_ANX because of running the model well. In addition, for the latent variable MAT_ACH, five items were used as observed variables for the models of the main study and general high school study. For Anatolian and vocational high schools, the item mat11 was excluded from the model because this item had high relationships some other items of different variables.

By the pilot study, factor structures of the items, reliabilities of the scales and mathematics achievement test, usability of the items and existence of the defective items were investigated. In addition, it was examined that if the items for each scale represented the expected latent variable. In the present study, exploratory factor analysis was performed for each scale again, to notice the factor loadings of each item and constituted a desired latent variable. While analyzing the model for the main study and for each high school type, the same observed variables represented an expected latent variable. In this way, it was avoided different results owing to taking different observed variables.

Moreover, it was remembered that SEM might not prove the casuality. But, it could be said that it had contribution to the literature for the cause and effect relationships and it provided effective information for experimental studies (Simsek, 2007). In the present study, the paths showed the effects of one variable to other variable by supporting the literature and theoretical background.

4.3 The Results of the Structural Equation Modeling Studies

In this section, results of the testing the proposed model (see Figure 1.1) with 3100 9^{th} grade students were given. In addition, three different models were presented with respect to different kinds of high schools (Anatolian, general and vocational). To test the proposed model, LISREL was used. The hypothesis of the present study was that there were no statistically significant effects of Mathematics Anxiety (MAT_ANX), Motivation to mathematics (MOT), Beliefs about the nature of mathematics (BELIEF), Beliefs about the teaching of mathematics (BEL_TEAC), Self-efficacy toward mathematics (EFFICACY), Socioeconomic status of the family (SES), SP_FATH, SP_MOTH, SP_TEAC, Teacher-centered classroom activities (TEAC_CEN), Student-centered classroom activities (STUD_CEN), Classroom Climate (CLIMATE) on mathematics achievement (MAT_ACH). Significance level was set to 0.05 (t = 1.96) for all relationships in the study. Moreover, for each model, standardized coefficients and t values were given.

4.3.1 Mathematics Achievement Model for the Main Study

Proposed model (see Figure 1.1) was tested with 3100 9^{th} grade students firstly without school type discrimination. PRELIS command language syntax for each model was given in APPENDIX L. Path diagrams obtained in terms of standardized coefficients and t values were given with structural models in APPENDIX M.

Mathematics achievement model for the main study with direct effects was given in Figure 4.1. The fit indices for the main study were given in Table 4.3. The values generated by LISREL indicated the model proposed fitted very well to the data set.

Table 4.3 Goodness of Fit Indices for the Main Study

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	6280.65 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.91
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.90
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.04
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.04

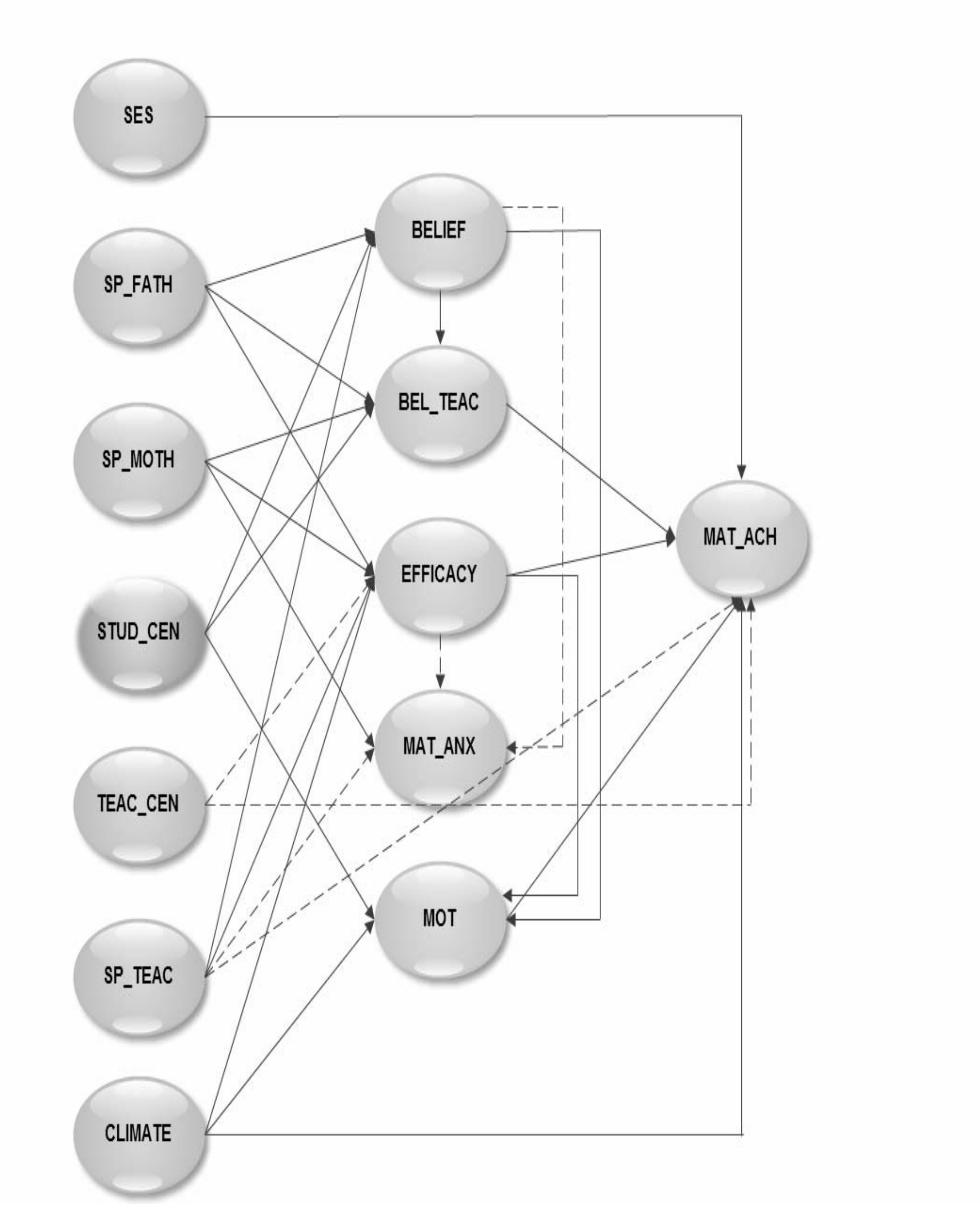

Figure 4.1 Mathematics Achievement Model for the Main Study
(Solid lines indicated positive direct effect, and dash line indicated negative direct effect)

In Table 4.4 and 4.5, λ_x coefficients of exogenous latent variables and λ_y path coefficients of endogenous latent variables were given. In addition, R^2 values were given to indicate how well the observed variables were indicators of latent variables.

Table 4.4 λ_x Coefficients of Exogenous Latent Variables for the Main Study

Latent Variable	**Observed Variables**	**λ_x parameter**	**R^2**
	fat_educ	0.78	0.60
	mot_educ	0.77	0.59
SES	income	0.80	0.64
	sibling	-0.47	0.22
	act_1	0.47	0.22
TEAC_CEN	act_3	0.86	0.73
	act_4	0.49	0.24
	act_5	0.70	0.48
STUD_CEN	act_8	0.63	0.39
	act_9	0.82	0.67
	cl_3	0.85	0.72
CLIMATE	cl_4	0.64	0.40
	cl_6	0.40	0.31
	teac_2	0.74	0.55
SP_TEAC	teac_7	0.71	0.51
	teac_10	0.81	0.66
	father4	0.75	0.56
SP_FATH	father7	0.69	0.48
	father11	0.81	0.66
	mother2	0.77	0.59
SP_MOTH	mother5	0.62	0.38
	mother10	0.72	0.53

Observed variables fat_educ, mot_educ and income of SES had positive loadings (λ_{x} = 0.78, 0.77 and 0.80, respectively), but sibling had a negative loading with SES (λ_x = -0.47). TEAC_CEN had three observed variables that one of them had highest loading (act_3, λ_x= 0.86). The latent variable STUD_CEN had three observed variables (act_5, 8 and 9) whose loadings were high (λ_x=0.70, 0.63 and 0.82, resp.). Cl_3 indicating the silence of the class had highest loading (λ_x=0.85) with CLIMATE. Teac_2, 7 and 10 of SP_TEAC had high loadings (λ_x=0.74, 0.71 and 0.81, resp.). The observed variable father11 had highest loading (λ_x= 0.81) which explain the latent variable SP_FATH with 0.66 variance. SP_MOTH had three positive observed variables mother2, 5 and 10 whose loadings were 0.77, 0.62 and 0.72, respectively.

Table 4.5 λ_y Coefficients of Endogenous Latent Variables for the Main Study

Latent Variable	**Observed Variables**	**λ_y parameter**	**R^2**
	belief1	0.81	0.66
BELIEF	belief2	0.72	0.51
	belief12	0.64	0.40
	belt4	0.68	0.46
BEL_TEAC	belt6	0.69	0.47
	belt10	0.69	0.48
	eff_6	0.60	0.36
EFFICACY	eff_7	0.69	0.48
	eff_9	0.71	0.50
	mot2	0.49	0.24
MOT	mot8	0.69	0.48
	mot9	0.58	0.33
	anx_1	0.71	0.51
MAT_ANX	anx_2	0.72	0.51
	anx_3	0.65	0.42
	mat4	0.76	0.58
	mat5	0.78	0.60
MAT_ACH	mat10	0.80	0.64
	mat11	0.80	0.64
	mat18	0.76	0.58

In Table 4.5, the loadings of observed variables for endogenous latent variables were given. Observed variable belief1 had the highest loading with BELIEF (λ_y= 0.81). The others of BELIEF had 0.72 and 0.64 loadings. Other observed variables had significant loadings for the other latent variables.

The γ and β coefficients were given in Table 4.6 and Table 4.7, respectively. γ shows structural coefficient relating exogenous to endogenous latent variable and β shows structural coefficient relating endogenous to endogenous latent variable (Kelloway, 1998).

Table 4.6 γ Coefficients for the Main Study

Exogenous Latent Variable	**γ Parameter (t value)**	**Endogenous Latent Variable**
STUD_CEN	0.24 (8.56)	BELIEF
SP_TEAC	0.24 (8.23)	
SP_FATH	0.23 (21.54)	
STUD_CEN	0.16 (6.61)	BEL_TEAC
SP_MOTH	0.18 (15.97)	
SP_FATH	0.25 (5.95)	
TEAC_CEN	-0.16 (-7.64)	EFFICACY
CLIMATE	0.11 (5.54)	
SP_TEAC	0.37 (15.03)	
SP_FATH	0.25 (8.07)	
SP_MOTH	0.17 (5.41)	
STUD_CEN	0.054 (2.31)	MOT
CLIMATE	0.091 (4.52)	
SP_TEAC	-0.13 (-4.99)	MAT_ANX
SP_MOTH	0.18 (7.65)	
SES	0.49 (25.12)	**MAT_ACH**
TEAC_CEN	-0.13 (-7.26)	
CLIMATE	0.13 (6.86)	
SP_TEAC	-0.067 (-2.80)	

As seen in Table 4.6, exogenous latent variable STUD_CEN had positive direct effects for the latent variables BELIEF, BEL_TEAC and MOT (γ = 0.24, 0.16, and 0.054, resp.). These effects had significant t values (t = 8.56, 6.61 and 2.31). SP_TEAC had positive direct effects for BELIEF and EFFICACY (γ=0.24 and 0.37, t = 8.23 and 15.03, resp.), but it had negative direct effect on MAT_ANX (γ= -0.13, t = -4.99). CLIMATE had positive direct effect on MOT with small γ value 0.091. Both exogenous latent variables SP_FATH and SP_MOTH had positive direct effects on BEL_TEAC (γ = 0.25 and 0.18, resp.) and on EFFICACY (γ = 0.25 and 0.17, resp.). SP_MOTH had also positive direct effect on MAT_ANX (γ = 0. 18, t=7.65) and SP_FATH had positive direct effect on BELIEF (γ = 0.23, t= 21.54).

There were four exogenous latent variables for the latent variable MAT_ACH that they had direct effects on it. SES had the highest direct effect on MAT_ACH (γ= 0.49, t= 25.12). TEAC_CEN and SP_TEAC had negative direct effects on MAT_ACH (γ = -0.13, t = 7.26 and γ = -0.067, t = -2.80, resp.). In addition, CLIMATE had positive direct effect on MAT_ACH (γ = 0.13, t= 6.86).

Table 4.7 β Coefficients for the Main Study

Endogenous Latent Variable	**β Parameter (t value)**	**Endogenous Latent Variable**
BELIEF	0.32 (12.28)	BEL_TEAC
BELIEF	0.34 (12.90)	MOT
EFFICACY	0.71 (19.28)	
BELIEF	-0.23 (-10.08)	MAT_ANX
EFFICACY	-0.76 (-21.32)	
BEL_TEAC	0.23 (9.71)	
EFFICACY	0.12 (2.27)	**MAT_ACH**
MOT	0.13 (2.23)	
MAT_ANX	0.0043 (0.096)*	

* nonsignificant

Table 4.7 showed the effects of endogenous latent variables to endogenous latent variables with standardized coefficients and t values. BELIEF had positive direct effects on BEL_TEAC (β = 0.32, t= 12.28) and MOT (β =0.34, t=12.90); but it had negative direct effect on MAT_ANX (β = -0.23, t= -10.08). EFFICACY had high positive direct effect on MOT (β = 0.71, t=19.28) and negative direct effect on MAT_ANX (β = -0.76, t= -21.32).

Three endogenous latent variables BEL_TEAC (β=0.23, t=9.71), EFFICACY (β=0.12, t=2.27), and MOT (β=0.13, t=2.23) affected MAT_ACH directly. On the other hand, MAT_ANX didn't affect MAT_ACH significantly (β = 0.0043, t=0.096).

In the study, R^2 values were calculated to indicate the proportion of explained variance of the endogenous latent variables. In Table 4.8, R^2 values for endogenous latent variables were given.

Table 4.8 R^2 Values for Endogenous Latent Variables for the Main Study

Endogenous Latent Variable	$\mathbf{R^2}$
BELIEF	0.32
BEL_TEAC	0.48
EFFICACY	0.42
MOT	0.86
MAT_ANX	0.76
MAT_ACH	**0.53**

The latent variables STUD_CEN, SP_TEAC and SP_FATH explained 32% of the variance of BELIEF. The latent variables BELIEF, STUD_CEN, SP_FATH and SP_MOTH explained 48% of the variance of BEL_TEAC. The latent variables TEAC_CEN, CLIMATE, SP_TEAC, SP_FATH and SP_MOTH explained 42% of the variance of EFFICACY. The latent variables BELIEF, EFFICACY, STUD_CEN and CLIMATE explained 86% of the variance of MOT. BELIEF, EFFICACY, SP_TEAC and SP_MOTH explained 76% of the variance of

MAT_ANX. The latent variables BEL_TEAC, EFFICACY, MOT, SES, TEAC_CEN, CLIMATE and SP_TEAC explained 53% of the variance of MAT_ACH.

Table 4.9 and 4.10 showed indirect and total effects of exogenous latent variables on endogenous latent variables. STUD_CEN (γ =0.08), SP_TEAC (γ = 0.08) and SP_FATH (γ = 0.07) had indirect effects on BEL_TEAC. TEAC_CEN (γ = -0.11), STUD_CEN (γ = 0.08), CLIMATE (γ = 0.08), SP_TEAC (γ = 0.34), SP_FATH (γ = 0.26) and SP_MOTH (γ = 0.12) had indirect effects on MOT. STUD_CEN (γ = -0.06), CLIMATE (γ = -0.09), SP_TEAC (γ = -0.33), SP_FATH (γ =- 0.24) and SP_MOTH (γ = -0.13) had negative indirect effects on MAT_ANX. TEAC_CEN had a positive indirect effect on MAT_ANX (γ = 0.12).

STUD_CEN (γ = 0.07), CLIMATE (γ = 0.03), SP_TEAC (γ = 0.10), SP_FATH (γ =0.14) and SP_MOTH (γ = 0.08) had positive indirect effects on MAT_ACH. On the other hand, TEAC_CEN had a negative indirect effect on MAT_ACH (γ = -0.03).

Table 4.9 Indirect Effects of Exogenous Latent Variables on Endogenous Latent Variables for the Main Study

	SES	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	__	— —	— —	— —	— —	— —	— —
BEL_TEAC	__	— —	0.08 (7.16)	— —	0.08 (6.82)	0.07 (8.08)	— —
EFFICACY	__	— —	— —	— —	— —	— —	— —
MOT	__	-0.11 (-7.44)	0.08 (7.16)	0.08 (5.41)	0.34 (14.64)	0.26 (10.27)	0.12 (5.33)
MAT_ANX	__	0.12 (7.56)	-0.06 (-6.49)	-0.09 (-5.50)	-0.33 (-14.92)	-0.24 (-9.90)	-0.13 (-5.25)
MAT_ACH	__	-0.03 (-6.00)	0.07 (7.48)	0.03 (4.95)	0.10 (8.06)	0.14 (10.73)	0.08 (5.85)

Table 4.10 Total Effects of Exogenous Latent Variables on Endogenous Latent Variables for the Main Study

	SES	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	__	— —	0.24 (8.56)	— —	0.24 (8.23)	0.23 (10.14)	— —
BEL_TEAC	__	— —	0.24 (9.95)	— —	0.08 (6.82)	0.33 (10.20)	0.18 (5.95)
EFFICACY	__	-0.16 (-7.64)	— —	0.11 (5.54)	0.37 (15.03)	0.25 (8.07)	0.17 (5.41)
MOT	__	-0.11 (-7.44)	0.14 (5.87)	0.17 (7.66)	0.34 (14.64)	0.26 (10.27)	0.12 (5.33)
MAT_ANX	__	0.12 (7.56)	-0.06 (-6.49)	-0.09 (-5.50)	-0.46 (-17.87)	-0.24 (-9.90)	0.05 (1.80)*
MAT_ACH	0.49 (25.12)	-0.16 (-8.99)	0.07 (7.48)	0.16 (9.08)	0.04 (1.79)*	0.14 (10.73)	0.08 (5.85)

*nonsignificant

As seen in Table 4.10, STUD_CEN had 0.24 total effects on BEL_TEAC. SP_FATH had 0.33 positive total effects on BEL_TEAC. STUD_CEN had 0.14 positive total effects on MOT. CLIMATE had 0.17 positive total effect on MOT. SP_TEAC had high negative total effect on MAT_ANX ($\gamma = -0.46$). SP_FATH had a positive total effect on BEL_TEAC ($\gamma = 0.33$). SP_MOTH had nonsignificant total effect on MAT_ANX ($\gamma = 0.05$).

TEAC_CEN had negative total effect ($\gamma = -0.16$) and CLIMATE had positive total effect 0.16 on MAT_ACH. On the other hand, SP_TEAC had nonsignificant total effect on MAT_ACH ($\gamma = 0.04$, t=1.79).

Table 4.11 and 4.12 showed indirect and total effects of endogenous latent variables on endogenous latent variables.

Table 4.11 Indirect Effects of Endogenous Latent Variables on Endogenous Latent Variables for the Main Study

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
MAT_ACH	0.12 (6.48)	— —	0.09 (1.97)	— —	— —

Table 4.12 Total Effects of Endogenous Latent Variables on Endogenous Latent Variables for the Main Study

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
BELIEF	— —	— —	— —	— —	— —
BEL_TEAC	0.32 (12.28)	— —	— —	— —	— —
EFFICACY	— —	— —	— —	— —	— —
MOT	0.34 (12.90)	— —	0.71 (19.28)	— —	— —
MAT_ANX	-0.23 (-10.08)	— —	-0.76 (-21.32)	— —	— —
MAT_ACH	0.12 (6.48)	0.23 (9.71)	0.20 (8.68)	0.13 (2..23)	0.00 (0.10)*

*nonsignificant

As seen in Table 4.11 and 4.12, BELIEF had a positive indirect effect on MAT_ACH (β = 0.12). In addition, EFFICACY had positive indirect effect (β = 0.09) and total effect (β = 0.20) on MAT_ACH.

In summary, among the exogenous variables, STUD_CEN had positive total effects on BELIEF, BEL_TEAC, MOT, MAT_ACH and negative total effect on MAT_ANX; TEAC_CEN had negative total effects on EFFICACY, MOT, MAT_ACH and positive total effect on MAT_ANX. CLIMATE had positive total effects on EFFICACY, MOT, MAT_ACH and negative total effect on MAT_ANX.

SP_FATH had positive total effects on all endogenous variables except MAT_ANX. In addition, SP_MOTH had positive total effects on BEL_TEAC, EFFICACY, MOT and MAT_ACH. In addition, SP_TEAC had positive indirect effect on MAT_ACH.

Among the endogenous variables, BELIEF, BEL_TEAC, EFFICACY and MOT had positive total effects on MAT_ACH. In addition, EFFICACY had strong positive total effect on MOT and strong negative total effect on MAT_ANX. Moreover, BELIEF had positive total effects on BEL_TEAC and MOT and negative total effect on MAT_ANX.

Finally, for the main study with 3100 students, regression equations with standardized coefficients as direct effects were given below;

- BELIEF = 0.24*STUD_CEN + 0.24*SP_TEAC + 0.23*SP_FATH, Errorvar.= 0.68, R^2= 0.32

- BEL_TEAC = 0.32*BELIEF + 0.16*STUD_CEN + 0.25*SP_FATH + 0.18*SP_MOTH, Errorvar.= 0.52, R^2 = 0.48

- EFFICACY = -0.16*TEAC_CEN + 0.11*CLIMATE + 0.37*SP_TEAC + 0.25*SP_FATH + 0.17*SP_MOTH, Errorvar.= 0.58, R^2 = 0.42

- MOT = 0.34*BELIEF + 0.71*EFFICACY + 0.054*STUD_CEN + 0.091*CLIMATE, Errorvar.= 0.14, R^2 = 0.86

- MAT_ANX = - 0.23*BELIEF - 0.76*EFFICACY - 0.13*SP_TEAC + 0.18*SP_MOTH, Errorvar.= 0.24, R^2= 0.76

- MAT_ACH = 0.23*BEL_TEAC + 0.12*EFFICACY + 0.13*MOT + 0.0043*MAT_ANX + 0.49*SES - 0.13*TEAC_CEN + 0.13*CLIMATE - 0.067*SP_TEAC, Errorvar.= 0.47, R^2 = 0.53

4.3.2 Mathematics Achievement Model for Anatolian High School

Proposed model (see Figure 1.1) was tested with 960 Anatolian high school 9th grade students. PRELIS command language syntax was given in APPENDIX L. Path diagrams obtained in terms of standardized coefficients and t values were given with structural models in APPENDIX M.

The fit indices for the study were given in Table 4.13.

Table 4.13 Goodness of Fit Indices for Anatolian High School

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	2652.80 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.87
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.84
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.06
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.05

In the study, the value of RMSEA was 0.06 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). In addition, the values of GFI and AGFI were 0.87 and 0.84 which were very close to the value of 0.90. Because of small sample, these values could be affected by the sample size (Hu & Bentler, 1995). Overall, these fit indices were model fit.

Mathematics Achievement Model for Anatolian high school was given in Figure 4.2.

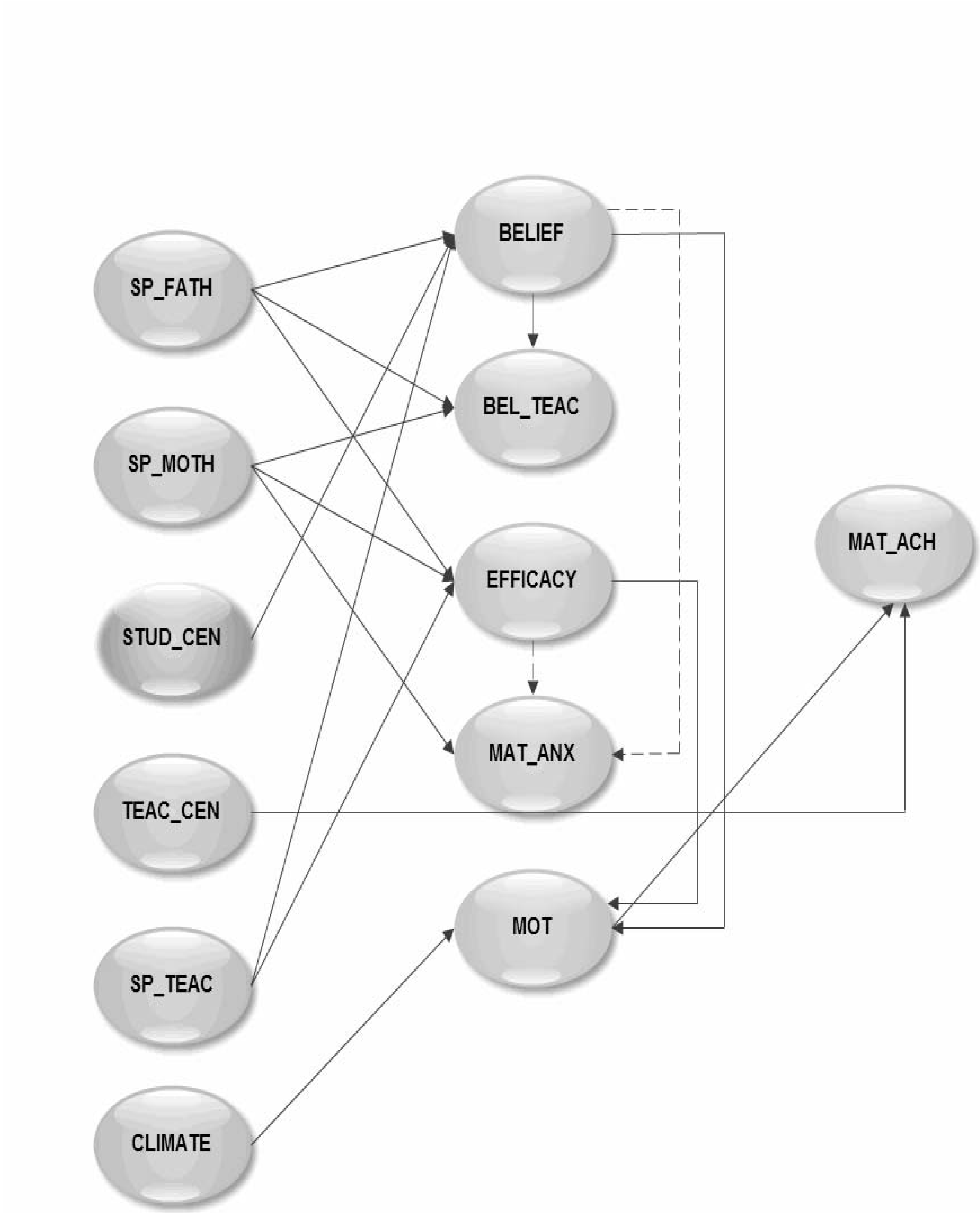

Figure 4.2 Mathematics Achievement Model for Anatolian High School
(Solid lines indicated positive direct effect, and dash line indicated negative direct effect)

In Table 4.14 and 4.15, λ_x coefficients of exogenous latent variables and λ_y coefficients of endogenous latent variables were given. In addition, R^2 values were given to indicate how well the observed variables were indicators of latent variables. As seen in Table 4.14, TEAC_CEN had three observed variables that one of them had highest loading (act_3, λ_x= 0.82). The latent variable STUD_CEN had three observed variables (act_5, 8 and 9) whose loadings were high (λ_x=0.73, 0.68 and 0.88, resp.). Cl_3 indicating the silence of the class had highest loading (λ_x=0.83). Teac_2, 7 and 10 of SP_TEAC had high loadings (λ_x=0.79, 0.53 and 0.87, resp.). The observed variables of SP_FATH and SP_MOTH had high loadings.

Table 4.14 λ_x Coefficients of Exogenous Latent Variables for Anatolian High School

Latent Variable	**Observed variables**	**λ_x parameter**	**R^2**
	act_1	0.53	0.28
TEAC_CEN	act_3	0.82	0.67
	act_4	0.49	0.24
	act_5	0.73	0.53
STUD_CEN	act_8	0.68	0.46
	act_9	0.88	0.78
	cl_3	0.83	0.68
CLIMATE	cl_4	0.65	0.43
	cl_6	0.49	0.41
	teac_2	0.79	0.62
SP_TEAC	teac_7	0.53	0.53
	teac_10	0.87	0.76
	father4	0.85	0.73
SP_FATH	father7	0.74	0.55
	father11	0.82	0.67
	mother2	0.80	0.64
SP_MOTH	mother5	0.73	0.53
	mother10	0.81	0.65

In Table 4.15, the loadings of observed variables for endogenous latent variables were given. Observed variables belief1, belief2 and belief12 had high loadings with BELIEF (λ_y= 0.72, 0.60 and 0.74, resp.). Observed variable anx_1 had the highest loading of MAT_ANX (λ_y= 0.88). It explained %78 of variance. Other observed variables had significant loadings for other latent variables.

Table 4.15 λ_y Coefficients of Endogenous Latent Variables for Anatolian High School

Latent Variable	**Observed variables**	**λ_y parameter**	**R^2**
	belief1	0.72	0.52
BELIEF	belief2	0.60	0.36
	belief12	0.74	0.54
	belt4	0.76	0.58
BEL_TEAC	belt6	0.69	0.48
	belt10	0.77	0.60
	eff_6	0.74	0.55
EFFICACY	eff_7	0.78	0.60
	eff_9	0.78	0.61
	mot2	0.58	0.34
MOT	mot8	0.66	0.43
	mot9	0.62	0.39
	anx_1	0.88	0.78
MAT_ANX	anx_2	0.79	0.62
	anx_3	0.79	0.62
	mat4	0.44	0.19
	mat5	0.70	0.49
MAT_ACH	mat10	0.67	0.45
	mat18	0.52	0.45

The γ and β coefficients were given in Table 4.16 and Table 4.17, respectively.

Table 4.16 γ Coefficients for Anatolian High School

Exogenous Latent Variable	γ Parameter (t value)	Endogenous Latent Variable
STUD_CEN	0.31 (7.46)	
SP_TEAC	0.23 (5.28)	BELIEF
SP_FATH	0.26 (6.92)	
STUD_CEN	— —	
SP_MOTH	0.089 (2.18)	BEL_TEAC
SP_FATH	0.25 (5.57)	
TEAC_CEN	— —	
CLIMATE	— —	
SP_TEAC	0.51 (13.57)	EFFICACY
SP_FATH	0.19 (4.75)	
SP_MOTH	0.14 (3.68)	
STUD_CEN	— —	MOT
CLIMATE	0.12 (3.64)	
SP_TEAC	— —	MAT_ANX
SP_MOTH	0.073 (2.63)	
SES	— —	
TEAC_CEN	0.13 (2.99)	**MAT_ACH**
CLIMATE	— —	
SP_TEAC	— —	

As seen in Table 4.16, exogenous latent variable STUD_CEN had positive direct effect for the latent variable BELIEF(γ = 0.31, t = 7.46). SP_TEAC had positive direct effects for BELIEF and EFFICACY (γ = 0.23 and 0.51, t = 5.28 and 13.57, resp.). CLIMATE had positive direct effect on MOT (γ = 0.12, t= 3.64). Both exogenous latent variables SP_FATH and SP_MOTH had positive direct effects on EFFICACY (γ = 0.19 and 0.14, resp.) and on BEL_TEAC (γ= 0.25 and 0.089, resp.). SP_MOTH had also low positive direct effect on MAT_ANX (γ = 0. 073, t= 2.63) and SP_FATH had positive direct effect on BELIEF (γ = 0.26, t= 6.92).

There was only one exogenous latent variable TEAC_CEN for the latent variable MAT_ACH that it had positive direct effect on it (γ= 0.13, t= 2.99).

Table 4.17 β Coefficients for Anatolian High School

Endogenous Latent Variable	**B Parameter (t value)**	**Endogenous Latent Variable**
BELIEF	0.48 (11.07)	BEL_TEAC
BELIEF	0.67 (10.55)	MOT
EFFICACY	0.34 (6.32)	
BELIEF	-0.29 (-6.60)	MAT_ANX
EFFICACY	-0.66 (-13.59)	
BEL_TEAC	— —	**MAT_ACH**
EFFICACY	— —	
MOT	0.39 (7.29)	
MAT_ANX	— —	

The endogenous latent variable BELIEF had positive direct effects on BEL_TEAC (β = 0.48, t= 11.07) and MOT (β = 0.67, t= 10.55), but it had negative direct effect on MAT_ANX (β = -0.29, t = -6.60). EFFICACY had positive direct effect on MOT (β = 0.34, t = 6.32) and negative direct effect on MAT_ANX (β = -0.66, t = -13.59).

The endogenous latent variable MOT had positive direct effect on MAT_ACH (β = 0.39, t = 7.29).

In the study, R^2 values were calculated to indicate the proportion of explained variance of the endogenous latent variables. In Table 4.18, R^2 values for endogenous latent variables were given.

Table 4.18 R^2 Values for Endogenous Latent Variables for Anatolian High School

Endogenous Latent Variable	R^2
BELIEF	0.38
BEL_TEAC	0.44
EFFICACY	0.43
MOT	0.93
MAT_ANX	0.74
MAT_ACH	**0.18**

The latent variables STUD_CEN, SP_TEAC and SP_FATH explained 38% of the variance of BELIEF. The latent variables BELIEF, SP_FATH and SP_MOTH explained 44% of the variance of BEL_TEAC. The latent variables SP_TEAC, SP_FATH and SP_MOTH explained 43% of the variance of EFFICACY. The latent variables BELIEF, EFFICACY and CLIMATE explained 93% of the variance of MOT. BELIEF, EFFICACY and SP_MOTH explained 74% of the variance of MAT_ANX. The latent variables MOT and TEAC_CEN explained 18% of the variance of MAT_ACH.

Table 4.19 and 4.20 showed indirect and total effects of exogenous latent variables on endogenous latent variables.

Table 4.19 Indirect Effects of Exogenous Latent Variables on Endogenous Latent Variables for Anatolian High School

	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	— —	— —	— —	— —	— —	— —
BEL_TEAC	— —	0.15 (6.54)	— —	0.11 (4.90)	0.13 (6.04)	— —
EFFICACY	— —	— —	— —	— —	— —	— —
MOT	— —	0.21 (6.60)	— —	0.33 (8.29)	0.24 (7.10)	0.05 (3.20)
MAT_ANX	— —	-0.09 (-5.17)	— —	-0.40 (-12.46)	-0.20 (-6.34)	-0.09 (-3.56)
MAT_ACH	— —	0.08 (5.20)	0.04 (3.34)	0.13 (5.92)	0.09 (5.44)	0.02 (2.99)

Table 4.20 Total Effects of Exogenous Latent Variables on Endogenous Latent Variables for Anatolian High School

	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	— —	0.31 (7.46)	— —	0.23 (5.28)	0.26 (6.92)	— —
BEL_TEAC	— —	0.15 (6.54)	— —	0.11 (4.90)	0.37 (8.48)	0.09 (2.18)
EFFICACY	— —	— —	— —	0.51 (13.57)	0.19 (4.75)	0.14 (3.68)
MOT	— —	0.21 (6.60)	0.12 (3.64)	0.33 (8.29)	0.24 (7.10)	0.05 (3.20)
MAT_ANX	— —	-0.09 (-5.17)	— —	-0.40 (-12.46)	-0.20 (-6.34)	-0.02 (-0.57)*
MAT_ACH	0.13 (2.99)	0.08 (5.20)	0.04 (3.34)	0.13 (5.92)	0.09 (5.44)	0.02 (2.99)

*nonsignificant

As seen in Table 4.19 and 4.20, STUD_CEN had positive indirect effects on BEL_TEAC (γ = 0.15) and MOT (γ = 0.21) and negative indirect effect on MAT_ANX (γ = -0.09). SP_TEAC had positive indirect effects on BEL_TEAC (γ = 0.11) and MOT (γ = 0.33) and negative indirect effect on MAT_ANX (γ = -0.40). SP_FATH had positive indirect effects on BEL_TEAC (γ = 0.13) and MOT (γ = 0.24) and negative indirect effect on MAT_ANX (γ = -0.20). In addition, the total effect of SP_FATH on BEL_TEAC was 0.37. SP_MOTH had a positive indirect effect on MOT (γ = 0.05) and negative indirect effect on MAT_ANX (γ = -0.09). Moreover, SP_MOTH had nonsignificant total effect on MAT_ANX (γ = -0.02).

The exogenous variables STUD_CEN, CLIMATE, SP_TEAC, SP_FATH and SP_MOTH had positive indirect effects on MAT_ACH. The strongest positive indirect effect on MAT_ACH was from SP_TEAC (γ = 0.13).

Table 4.21 and 4.22 showed indirect and total effects of endogenous latent variables on endogenous latent variables.

As seen in Table 4.21, BELIEF and EFFICAY had positive indirect effects on MAT_ACH (β = 0.26 and β =0.13, resp.). For other endogenous latent variables, the values of total effects were the same the values of direct effects.

Table 4.21 Indirect Effects of Endogenous Latent Variables on Endogenous Latent Variables for Anatolian High School

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
MAT_ACH	0.26 (6.60)	— —	0.13 (5.06)	— —	— —

Table 4.22 Total Effects of Endogenous Latent Variables on Endogenous Latent Variables for Anatolian High School

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
BELIEF	— —	— —	— —	— —	— —
BEL_TEAC	0.48 (11.07)	— —	— —	— —	— —
EFFICACY	— —	— —	— —	— —	— —
MOT	0.67 (10.55)	— —	0.34 (6.32)	— —	— —
MAT_ANX	-0.29 (-6.60)	— —	-0.66 (-13.59)	— —	— —
MAT_ACH	0.26 (6.60)	— —	0.13 (5.06)	0.39 (7.29)	— —

In summary, among the exogenous variables, STUD_CEN had positive effects on BELIEF, BEL_TEAC, MOT, MAT_ACH and negative effect on MAT_ANX; TEAC_CEN had positive effect on MAT_ACH. CLIMATE had positive effects on MOT and MAT_ACH. SP_TEAC and SP_FATH had positive effects on all endogenous variables except MAT_ANX. In addition, SP_MOTH had positive effects on BEL_TEAC, EFFICACY, MOT, MAT_ACH and negative effect on MAT_ANX. On the other hand, SES had no effect on any variables.

Among the endogenous variables, BELIEF, EFFICACY and MOT had positive effects on MAT_ACH. In addition, EFFICACY had positive effect on MOT and strong negative effect on MAT_ANX. Moreover, BELIEF had positive effects on BEL_TEAC, MOT and MAT_ACH and negative effect on MAT_ANX.

It was important to note that for Anatolian high school, SES had no effect on MAT_ACH but the variable MOT was seen more effective variable on it. In addition, exogenous variables CLIMATE, SP_TEAC and STUD_CEN had slight effect on MAT_ACH. Other differences from the main study were that TEAC_CEN had positive effect on MAT_ACH, as well as, BEL_TEAC had no effect on it.

Finally, regression equations with standardized coefficients as direct effects for 960 Anatolian high school students were given below;

- BELIEF = 0.31*STUD_CEN + 0.23*SP_TEAC + 0.26*SP_FATH,
  Errorvar.= 0.62, $R^2 = 0.38$

- BEL_TEAC = 0.48*BELIEF + 0.25*SP_FATH + 0.089*SP_MOTH,
  Errorvar.= 0.56, $R^2 = 0.44$

- EFFICACY = 0.51*SP_TEAC + 0.19*SP_FATH + 0.14*SP_MOTH,
  Errorvar.= 0.57, $R^2 = 0.43$

- MOT = 0.67*BELIEF + 0.34*EFFICACY + 0.12*CLIMATE,
  Errorvar.= 0.070, $R^2 = 0.93$

- MAT_ANX = - 0.29*BELIEF - 0.66*EFFICACY + 0.073*SP_MOTH,
  Errorvar.= 0.26, $R^2 = 0.74$

- MAT_ACH = 0.39*MOT + 0.13*TEAC_CEN,
  Errorvar.= 0.82, $R^2 = 0.18$

4.3.3 Mathematics Achievement Model for General High School

Proposed model (see Figure 1.1) was tested with 1230 9th grade general high school students. PRELIS command language syntax was given in APPENDIX L. Path diagrams obtained in terms of standardized coefficients and t values were given with structural models in APPENDIX M.

The fit indices for the model tested for general high school were given in Table 4.23.

Table 4.23 Goodness of Fit indices for General High School

Fit Index	**Criteria**	**Value**
Chi-square	Nonsignificant	2995.18 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.89
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.87
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.05
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.04

In the study, the value of RMSEA was 0.05 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). In addition, the values of GFI and AGFI were 0.89 and 0.87 which were very close to the value of 0.90. Because of small sample, these values could be affected by the sample size (Hu & Bentler, 1995). Overall, these fit indices were model fit.

Mathematics Achievement Model for general high school was given in Figure 4.3.

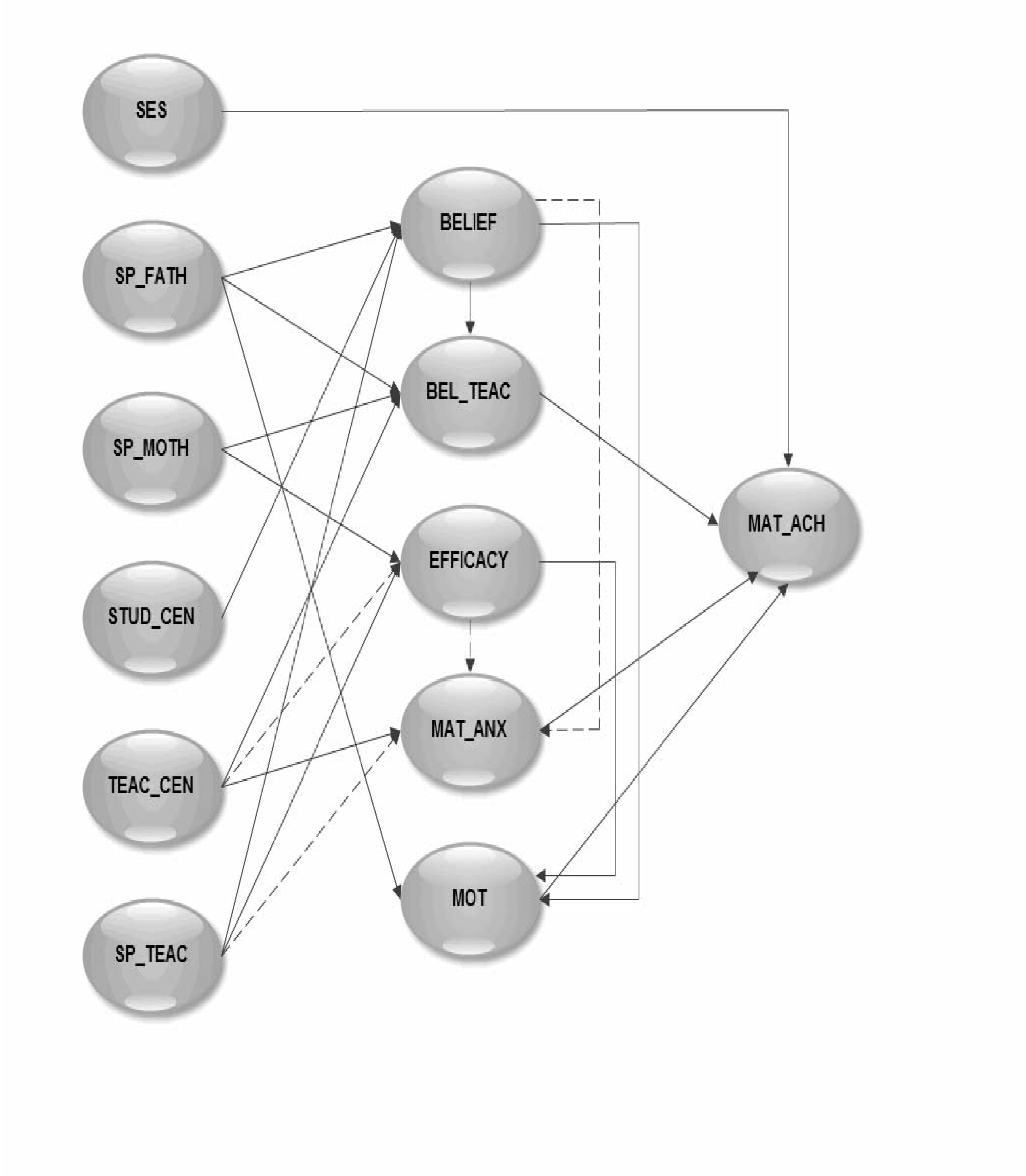

Figure 4.3 Mathematics Achievement Model for General High School
(Solid lines indicated positive direct effect, and dash line indicated negative direct effect)

In Table 4.24 and 4.25, λ_x coefficients of exogenous latent variables and λ_y coefficients of endogenous latent variables were given. In addition, R^2 values were given to indicate how well the observed variables were indicators of latent variables.

Table 4.24 λ_x Coefficients of Exogenous Latent Variables for General High School

Latent Variable	**Observed Variables**	**λ_x parameter**	**R^2**
	fat_educ	0.81	0.66
	mot_educ	0.83	0.68
SES	income	0.69	0.47
	sibling	-0.36	0.13
	act_1	0.61	0.31
TEAC_CEN	act_3	0.88	0.78
	act_4	0.55	0.30
	act_5	0.65	0.42
STUD_CEN	act_8	0.67	0.45
	act_9	0.78	0.61
	teac_2	0.80	0.65
SP_TEAC	teac_7	0.45	0.44
	teac_10	076	0.57
	father4	0.71	0.51
SP_FATH	father7	0.95	0.64
	father11	0.63	0.60
	mother2	0.59	0.55
SP_MOTH	mother5	0.80	0.54
	mother10	0.78	0.62

Observed variables fat_educ, mot_educ and income of SES had positive loadings ($\lambda_x =$ 0.81, 0.83 and 0.69, respectively), but sibling had a negative loading with SES (λ_x = -0.36). TEAC_CEN had three observed variables that one of them had highest loading (act_3, λ_x= 0.88). The latent variable STUD_CEN had three observed variables (act_5, 8 and 9) whose loadings were high (λ_x=0.65, 0.67 and 0.78, resp.). The observed variables teac_2 and teac_10 of SP_TEAC had high loadings (λ_x=0.80, and 0.76, resp.). The observed variable father7 had highest loading (λ_x= 0.95) which explained the latent variable SP_FATH with 0.64 of the variance. SP_MOTH had three positive observed variables mother2, 5 and 10 whose loadings were 0.59, 0.80 and 0.78, respectively.

In Table 4.25, the loadings of observed variables for endogenous latent variables were given.

Table 4.25 λ_y Coefficients of Endogenous Latent Variables for General High School

Latent Variable	**Observed variables**	**λ_y parameter**	**R^2**
	belief1	0.85	0.72
BELIEF	belief2	0.72	0.52
	belief12	0.67	0.45
	belt4	0.67	0.45
BEL_TEAC	belt6	0.68	0.47
	belt10	0.71	0.51
	eff_6	0.07	0.37
EFFICACY	eff_7	0.62	0.39
	eff_9	0.75	0.57
	mot2	1.86	0.53
MOT	mot8	0.74	0.55
	mot9	0.63	0.40
	anx_1	0.84	0.70
MAT_ANX	anx_2	0.25	0.35
	anx_3	0.75	0.56
	mat4	0.47	0.23
	mat5	0.41	0.16
MAT_ACH	mat10	0.28	0.07
	mat11	0.76	0.58
	mat18	0.62	0.38

Observed variable belief1 had the highest loading with BELIEF (λ_y= 0.85). The others of BELIEF had 0.72 and 0.67 loadings. The observed variable eff_6 of EFFICACY had very low loading (λ_y=0.07). But the other loadings of observed variables eff_7 and eff_9 were high (λ_y=0.62 and 0.75). The observed variable anx_1 had the highest loading for the latent variable MAT_ANX (λ_y= 0.84, R^2= 0.70). Other observed variables had significant loadings for the other latent variables.

The γ and β coefficients were given in Table 4.26 and Table 4.27.

Table 4.26 γ Coefficients for General High School

Exogenous Latent Variable	**γ Parameter (t value)**	**Endogenous Latent Variable**
STUD_CEN	0.26 (5.71)	BELIEF
SP_TEAC	0.30 (6.82)	
SP_FATH	0.15 (4.08)	
TEAC_CEN	0.20 (6.02)	BEL_TEAC
STUD_CEN	0.07 (1.55)*	
SP_MOTH	0.14 (3.29)	
SP_FATH	0.24 (5.23)	
TEAC_CEN	-0.26 (-7.55)	EFFICACY
SP_TEAC	0.46 (11.82)	
SP_MOTH	0.26 (7.20)	
SP_FATH	0.11 (5.53)	MOT
SP_TEAC	-0.50 (-11.13)	MAT_ANX
TEAC_CEN	0.11 (3.39)	
SES	0.32 (8.46)	**MAT_ACH**

*nonsignificant

As can be seen in Table 4.26, exogenous latent variable STUD_CEN had positive direct effects for the latent variables BELIEF (γ = 0.26, t=5.71), but the path from STUD_CEN to BEL_TEAC was not significant (γ = 0.07, t=1.55). TEAC_CEN had positive direct effect for the latent variable BEL_TEAC (γ = 0.20, t = 6.02) and negative direct effect for the latent variable EFFICACY (γ = -0.26, t = -7.55). SP_TEAC had positive direct effects on BELIEF and EFFICACY (γ=0.30 and 0.46, t = 6.82 and 11.82, resp.) but it had negative direct effect on MAT_ANX (γ = -0.50, t = -11.13). Both exogenous latent variables SP_FATH and SP_MOTH had positive direct effects on BEL_TEAC (γ = 0.24 and 0.14, t = 5.23 and 3.29, resp.). SP_MOTH had also positive direct effect on EFFICACY (γ = 0.26, t = 7.20) and SP_FATH had positive direct effect on BELIEF (γ = 0.15, t=4.08) and MOT (γ = 0.11, t = 5.53). There was only one exogenous latent variable SES that had positive direct effect on MAT_ACH (γ= 0.32, t= 8.46).

Table 4.27 β Coefficients for General High School

Endogenous Latent Variable	**β Parameter (t value)**	**Endogenous Latent Variable**
BELIEF	0.42 (10.27)	BEL_TEAC
BELIEF	0.18 (7.37)	MOT
EFFICACY	0.87 (17.60)	
BELIEF	-0.21 (-5.53)	MAT_ANX
EFFICACY	-0.14 (-3.59)	
BEL_TEAC	0.14 (3.04)	
EFFICACY	__ __	**MAT_ACH**
MOT	0.66 (7.19)	
MAT_ANX	0.13 (2.67)	

The endogenous latent variable BELIEF had positive direct effects on BEL_TEAC (β = 0.42, t= 10.27) and MOT (β = 0.18, t= 7.37), but it had negative direct effect on MAT_ANX (β = -0.21, t = -5.53). EFFICACY had strong positive direct effect on MOT (β = 0.87, t = 17.60) and negative direct effect on MAT_ANX (β = -0.14, t = -3.59). Moreover, the endogenous latent variables BEL_TEAC and MOT had positive direct effects on MAT_ACH (β = 0.14, t = 3.04; β = 0.66, t = 7.19, resp.). Surprisingly, MAT_ANX had also positive direct effect on MAT_ACH (β = 0.13, t = 2.67).

In the study, R^2 values were calculated to indicate the proportion of explained variance of the endogenous latent variables. In Table 4.28, R^2 values for endogenous latent variables were given.

Table 4.28 R^2 Values for Endogenous Latent Variables for General High School

Endogenous Latent Variable	$\mathbf{R^2}$
BELIEF	0.35
BEL_TEAC	0.60
EFFICACY	0.36
MOT	0.96
MAT_ANX	0.51
MAT_ACH	**0.30**

The latent variables STUD_CEN, SP_TEAC and SP_FATH explained 35% of the variance of BELIEF. The latent variables BELIEF, TEAC_CEN, SP_FATH and SP_MOTH explained 60% of the variance of BEL_TEAC. The latent variables SP_TEAC, TEAC_CEN and SP_MOTH explained 36% of the variance of EFFICACY. The latent variables BELIEF, EFFICACY and SP_FATH explained 96% of the variance of MOT. BELIEF, EFFICACY, TEAC_CEN and SP_TEAC explained 51% of the variance of MAT_ANX. The latent variables BEL_TEAC, MOT, MAT_ANX and SES explained 30% of the variance of MAT_ACH.

Table 4.29 and 4.30 showed the indirect and total effects of exogenous latent variable on endogenous latent variables.

Table 4.29 Indirect Effects of Exogenous Latent Variables on Endogenous Latent Variables for General High School

	SES	TEAC_CEN	STUD_CEN	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	__	— —	— —	— —	— —	— —
BEL_TEAC	__	— —	0.11 (5.03)	0.13 (5.68)	0.06 (3.88)	— —
EFFICACY	__	— —	— —	— —	— —	— —
MOT	__	-0.22 (-7.75)	0.05 (4.46)	0.46 (13.39)	0.03 (3.60)	0.23 (7.20)
MAT_ANX	__	0.04 (3.33)	-0.05 (-3.84)	-0.13 (-5.65)	-0.03 (-3.22)	-0.04 (-3.19)
MAT_ACH	__	-0.10 (-4.02)	0.05 (4.24)	0.24 (7.30)	0.13 (6.61)	0.17 (6.44)

As shown in Table 4.29, TEAC_CEN had negative indirect effect on MOT (γ=-0.22) and positive indirect effect on MAT_ANX (γ= 0.04). STUD_CEN had positive indirect effects on BEL_TEAC (γ = 0.11) and MOT (γ=0.05), but it had negative indirect effect on MAT_ANX (γ=-0.05). SP_TEAC had positive indirect effects on BEL_TEAC (γ = 0.13) and MOT (γ=0.46), but it had negative indirect effect on MAT_ANX (γ=-0.13). SP_FATH and SP_MOTH had positive indirect effects on MOT (γ = 0.03 and γ = 0.23, resp.) and negative indirect effects on MAT_ANX (γ= -0.03 and -0.04). In addition, SP_FATH had positive indirect effect on BEL_TEAC (γ=0.06).

The exogenous latent variable SP_TEAC had highest positive indirect effect on MAT_ACH (γ = 0.24). In additİon, SP_FATH and SP_MOTH had positive indirect effects on MAT_ACH (γ = 0.13 and 0.17). STUD_CEN had low positive indirect effect on MAT_ACH (γ = 0.05). On the other hand, TEAC_CEN had negative indirect effect on MAT_ACH (γ = -0.10)

As seen in Table 4.30, the total effect of TEAC_CEN was 0.14 on MAT_ANX. In addition, the total effect of STUD_CEN was 0.18 on BEL_TEAC.

Table 4.30 Total Effects of Exogenous Latent Variables on Endogenous Latent Variables for General High School

	SES	TEAC_CEN	STUD_CEN	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	__	__ __	0.26 (5.71)	0.30 (6.82)	0.15 (4.08)	__ __
BEL_TEAC	__	0.20 (6.02)	0.18 (4.11)	0.13 (5.68)	0.31 (6.39)	0.14 (3.29)
EFFICACY	__	-0.26 (-7.55)	__ __	0.46 (11.82)	__ __	0.26 (7.20)
MOT	__	-0.22 (-7.75)	0.05 (4.46)	0.46 (13.39)	0.13 (6.24)	0.23 (7.20)
MAT_ANX	__	0.14 (4.69)	-0.05 (-3.84)	-0.63 (-17.34)	-0.03 (-3.22)	-0.04 (-3.19)
MAT_ACH	0.32 (8.46)	-0.10 (-4.02)	0.05 (4.24)	0.24 (7.30)	0.13 (6.61)	0.17 (6.44)

Table 4.31 and 4.32 showed the indirect and total effects of endogenous latent variables on endogenous latent variables.

Table 4.31 Indirect Effects of Endogenous Latent Variables on Endogenous Latent Variables for General High School

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
MAT_ACH	0.15 (6.87)	__ __	0.56 (7.07)	__ __	__ __

As seen in Table 4.31, the indirect effects of endogenous latent variables BELIEF and EFFICACY were 0.15 and 0.56 on MAT_ACH, respectively.

Table 4.32 Total Effects of Endogenous Latent Variables on Endogenous Latent Variables for General High School

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
BELIEF	— —	— —	— —	— —	— —
BEL_TEAC	0.42 (10.27)	— —	— —	— —	— —
EFFICACY	— —	— —	— —	— —	— —
MOT	0.18 (7.37)	— —	0.87 (17.60)	— —	— —
MAT_ANX	-0.21 (-5.53)	— —	-0.14 (-3.59)	— —	— —
MAT_ACH	0.15 (6.87)	0.14 (3.04)	0.56 (7.07)	0.66 (7.19)	0.13 (2.67)

In summary, among the exogenous variables, STUD_CEN had positive total effects on BELIEF, BEL_TEAC, MOT, MAT_ACH and negative total effect on MAT_ANX; SP_TEAC, SP_FATH and SP_MOTH had positive total effects on BEL_TEAC, EFFICACY and MAT_ACH and negative total effects on MAT_ANX.

Among the endogenous variables, BELIEF, BEL_TEAC, EFFICACY and MOT had positive total effects on MAT_ACH. In addition, EFFICACY had strong positive total effect on MOT and negative total effect on MAT_ANX. Moreover, BELIEF had positive total effects on BEL_TEAC and MOT and negative total effect on MAT_ANX.

Surprisingly, for the general high school, the variable CLIMATE had no effect on any endogenous variables. In addition, MAT_ANX had positive total effect on MAT_ACH. On the other hand, like main study, SES had strong effect on MAT_ACH.

Finally, for the general high school study with 1230 students, regression equations with standardized coefficients as direct effects were given below;

- BELIEF = 0.26*STUD_CEN + 0.30*SP_TEAC + 0.15*SP_FATH, Errorvar.= 0.65, R^2 = 0.35

- BEL_TEAC = 0.42*BELIEF + 0.20*TEAC_CEN + 0.066*STUD_CEN + 0.24*SP_FATH + 0.14*SP_MOTH, Errorvar.= 0.40, R^2 = 0.60

- EFFICACY = - 0.26*TEAC_CEN + 0.46*SP_TEAC + 0.26*SP_MOTH, Errorvar.= 0.64, R^2 = 0.36

- MOT = 0.18*BELIEF + 0.87*EFFICACY + 0.11*SP_FATH, Errorvar.= 0.036, R^2 = 0.96

- MAT_ANX = - 0.21*BELIEF - 0.14*EFFICACY + 0.11*TEAC_CEN - 0.50*SP_TEAC, Errorvar.= 0.49, R^2 = 0.51

- MAT_ACH = 0.14*BEL_TEAC + 0.66*MOT + 0.13*MAT_ANX + 0.32*SES, Errorvar.= 0.70, R^2 = 0.30

4.3.4 Mathematics Achievement Model for Vocational High School

Proposed model (see Figure 1.1) was tested with 910 9^{th} grade vocational high school students. PRELIS command language syntax was given in APPENDIX L. Path diagrams obtained in terms of standardized coefficients and t values were given with structural models in APPENDIX M.

Table 4.33 Goodness of Fit Indices for Vocational High School

Fit Index	Criteria	Value
Chi-square	Nonsignificant	2663.93 (p=0.00)
Goodness of Fit Index (GFI)	> 0.90	0.86
Adjusted Goodness of Fit Index (AGFI)	> 0.90	0.84
Root Mean Square Error of Approximation (RMSEA)	< 0.05	0.06
Standardized Root Mean Square Residual (S-RMR)	< 0.05	0.05

In the study, the value of RMSEA was 0.06 which was reasonable because the value up to 0.08 represented reasonable errors of approximation (Browne & Cudeck, 1993). In addition, the values of GFI and AGFI were 0.86 and 0.84 which were very close to the value of 0.90. Because of small sample, these values could be affected by the sample size (Hu & Bentler, 1995). Overall, these indices indicated that the proposed model fit.

Mathematics Achievement Model for vocational high school was given in Figure 4.4.

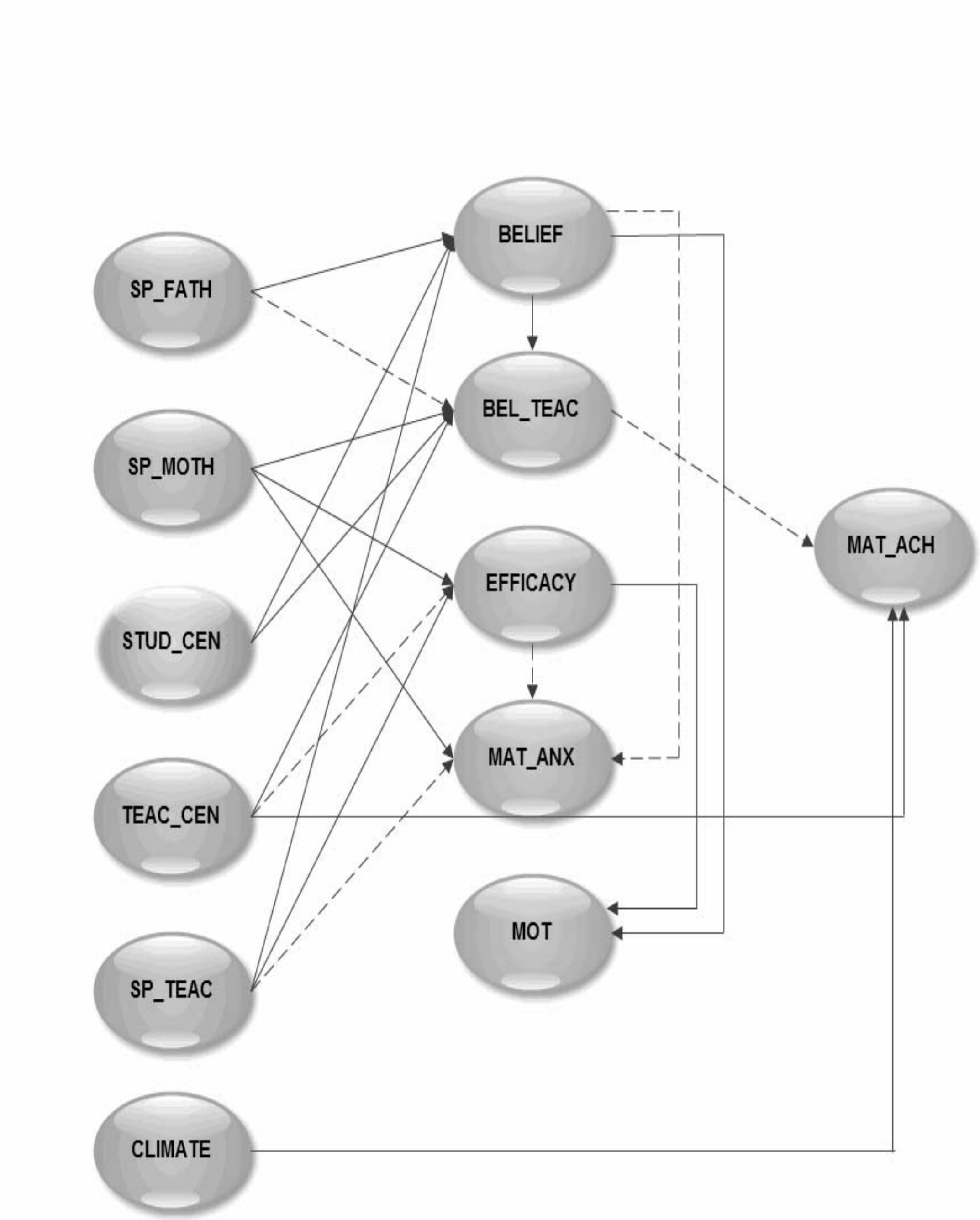

Figure 4.4 Mathematics Achievement Model for Vocational High School
(Solid lines indicated positive direct effect, and dash line indicated negative direct effect)

In Table 4.34 and 4.35, λ_x coefficients of exogenous latent variables and λ_y coefficients of endogenous latent variables were given. In addition, R^2 values were given to indicate how well the observed variables were indicators of latent variables.

Table 4.34 λ_x Coefficients of Exogenous Latent Variables for Vocational High School

Latent Variable	**Observed variables**	**λ_x parameter**	**R^2**
	act_1	0.40	0.16
TEAC_CEN	act_3	0.79	0.63
	act_4	0.51	0.26
	act_5	0.66	0.44
STUD_CEN	act_8	0.59	0.35
	act_9	0.76	0.58
	cl_3	0.86	0.73
CLIMATE	cl_4	0.06	0.003
	cl_6	0.48	0.23
	teac_2	0.70	0.49
SP_TEAC	teac_7	0.66	0.44
	teac_10	0.74	0.54
	father4	0.66	0.43
SP_FATH	father7	0.67	0.45
	father11	0.77	0.59
	mother2	0.53	0.44
SP_MOTH	mother5	0.60	0.36
	mother10	0.69	0.48

As seen in Table 4.34, TEAC_CEN had three observed variables that one of them had highest loading (act_3, λ_x= 0.79). The observed variables act_5, 8 and 9 of STUD_CEN had high loadings (λ_x=0.66, 0.59 and 0.76, resp.). On the other hand, the loading of observed variable cl_4 was not significant for the latent variable CLIMATE (λ_x= 0.06). But the other loadings of observed variables for CLIMATE were significant (λ_x= 0.86 and 0.48, R^2=0.73 and 0.23, resp.). The latent variable

SP_TEAC had three observed variables (teac_2, 7 and 10) whose loadings were high (λ_x=0.70, 0.66 and 0.74, resp.). The observed variables of SP_FATH and SP_MOTH had high loadings.

In Table 4.35, the loadings of observed variables for endogenous latent variables were given. Observed variable belief1 had the highest loading with BELIEF (λ_y= 0.75). The other items of BELIEF had 0.64 loadings. The observed variable eff_6 of EFFICACY had very low loading (λ_y=0.05) which was not significant. But the other loadings of observed variables eff_7 and eff_9 were high (λ_y=0.60 and 0.61). The observed variable mot9 had the highest loading for the latent variable MOT (λ_y= 0.88, R^2= 0.48). Other observed variables had significant loadings for the other latent variables.

Table 4.35 λ_y Coefficients of Endogenous Latent Variables for Vocational High School

Latent Variable	**Observed variables**	**λ_y parameter**	**R^2**
	belief1	0.75	0.56
BELIEF	belief2	0.64	0.41
	belief12	0.64	0.41
	belt4	0.66	0.43
BEL_TEAC	belt6	0.36	0.38
	belt10	0.61	0.37
	eff_6	0.05	0.35
EFFICACY	eff_7	0.60	0.37
	eff_9	0.61	0.37
	mot2	0.27	0.28
MOT	mot8	0.55	0.30
	mot9	0.88	0.48
	anx_1	0.75	0.56
MAT_ANX	anx_2	0.51	0.26
	anx_3	0.74	0.54
	mat4	0.37	0.14
	mat5	0.26	0.06
MAT_ACH	mat10	0.79	0.62
	mat18	-0.17	0.03

The γ and β coefficients were given in Table 4.36 and Table 4.37, respectively.

Table 4.36 γ Coefficients for Vocational High School

Exogenous Latent Variable	**γ Parameter (t value)**	**Endogenous Latent Variable**
STUD_CEN	0.27 (4.56)	
SP_TEAC	0.25 (3.95)	BELIEF
SP_FATH	0.17 (3.27)	
TEAC_CEN	0.33 (6.41)	
STUD_CEN	0.35 (6.12)	BEL_TEAC
SP_MOTH	0.35 (5.91)	
SP_FATH	-0.14 (-2.14)	
TEAC_CEN	-0.20 (-4.07)	
SP_TEAC	0.32 (6.48)	EFFICACY
SP_MOTH	0.26 (4.95)	
SP_TEAC	-0.36 (-7.36)	MAT_ANX
SP_MOTH	0.31 (7.58)	
TEAC_CEN	0.34 (4.00)	**MAT_ACH**
CLIMATE	0.25 (3.55)	

As seen in Table 4.36, exogenous latent variable STUD_CEN had positive direct effects for the latent variables BELIEF (γ = 0.27, t = 4.56), and BEL_TEAC (γ = 0.35, t=6.12). TEAC_CEN had positive direct effect for the latent variable BEL_TEAC (γ = 0.33, t = 6.41) and negative direct effect for the latent variable EFFICACY (γ = -0.20, t=-4.07). SP_TEAC had positive direct effects on BELIEF and EFFICACY (γ=0.25 and 0.32, t = 3.95 and 6.48, resp.) but it had negative direct effect on MAT_ANX (γ= -0.36, t = -7.36). The exogenous latent variable SP_FATH had positive direct effect on BELIEF (γ = 0.17 t= 3.27), but it had negative direct effect on BEL_TEAC (γ = -0.14, t= -2.14). On the other hand, SP_MOTH had positive direct effects on BEL_TEAC (γ = 0.35, t= 5.91), on EFFICACY (γ = 0. 26, t=4.95) and MAT_ANX (γ = 0.31, t=7.58).

There were two exogenous latent variables TEAC_CEN and CLIMATE that had direct effects on MAT_ACH (γ= 0.34, t= 4.00 and γ= 0.25, t= 3.55, resp.).

Table 4.37 β Coefficients for Vocational High School

Endogenous Latent Variable	**β Parameter (t value)**	**Endogenous Latent Variable**
BELIEF	0.21 (3.85)	BEL_TEAC
BELIEF	0.36 (7.66)	MOT
EFFICACY	0.85 (10.67)	
BELIEF	-0.22 (-4.70)	MAT_ANX
EFFICACY	-0.48 (-8.84)	
BEL_TEAC	-0.47 (-4.36)	**MAT_ACH**

As seen in Table 4.37, the endogenous latent variable BELIEF had positive direct effects on BEL_TEAC (β = 0.21, t= 3.85) and MOT (β = 0.36, t= 7.66), but it had negative direct effect on MAT_ANX (β = -0.22, t = -4.70). EFFICACY had strong positive direct effect on MOT (β = 0.85, t = 10.67) and negative direct effect on MAT_ANX (β = -0.48, t = -8.84).

Moreover, the endogenous latent variable BEL_TEAC had negative direct effect on MAT_ACH (β = -0.47, t = -4.36).

In the study, R^2 values were calculated to indicate the proportion of explained variance of the endogenous latent variables. In Table 4.38, R^2 values for endogenous latent variables were given. The latent variables STUD_CEN, SP_TEAC and SP_FATH explained 34% of the variance of BELIEF. The latent variables BELIEF, TEAC_CEN, STUD_CEN, SP_FATH and SP_MOTH explained 56% of the variance of BEL_TEAC. The latent variables SP_TEAC, TEAC_CEN and SP_MOTH explained 19% of the variance of EFFICACY. The latent variables BELIEF and EFFICACY explained 95% of the variance of MOT. BELIEF, EFFICACY, SP_TEAC and SP_MOTH explained 59% of the variance of MAT_ANX. The latent variables BEL_TEAC, TEAC_CEN and CLIMATE explained 19% of the variance of MAT_ACH.

Table 4.38 R^2 Values for Endogenous Latent Variables for Vocational High School

Endogenous Latent Variable	$\mathbf{R^2}$
BELIEF	0.34
BEL_TEAC	0.56
EFFICACY	0.19
MOT	0.95
MAT_ANX	0.59
MAT_ACH	**0.19**

Table 4.39 and 4.40 showed the indirect and total effects of exogenous latent variable on endogenous latent variables.

As shown in Table 4.39, TEAC_CEN had negative indirect effect on MOT (γ=-0.17) and positive indirect effect on MAT_ANX (γ= 0.10). STUD_CEN had positive indirect effects on BEL_TEAC (γ = 0.06) and MOT (γ=0.09), but it had negative indirect effect on MAT_ANX (γ=-0.06). SP_TEAC had positive indirect effects on BEL_TEAC (γ = 0.05) and MOT (γ=0.36), but it had negative indirect effect on MAT_ANX (γ=-0.21). SP_FATH and SP_MOTH had positive indirect effects on MOT (γ = 0.06 and γ = 0.22, resp.) and negative indirect effects on

MAT_ANX (γ= -0.04 and -0.13). In addition, SP_FATH had positive indirect effect on BEL_TEAC (γ=0.04).

Table 4.39 Indirect Effects of Exogenous Latent Variables on Endogenous Latent Variables for Vocational High School

	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	— —	— —	— —	— —	— —	— —
BEL_TEAC	— —	0.06 (3.13)	— —	0.05 (2.69)	0.04 (2.48)	— —
EFFICACY	— —	— —	— —	— —	— —	— —
MOT	-0.17 (-4.04)	0.09 (3.97)	— —	0.36 (7.33)	0.06 (3.04)	0.22 (4.88)
MAT_ANX	0.10 (3.87)	-0.06 (-3.18)	— —	-0.21 (-6.71)	-0.04 (-2.61)	-0.13 (-4.45)
MAT_ACH	-0.15 (-3.52)	-0.19 (-3.89)	— —	-0.03 (-2.34)	0.05 (1.54)*	-0.16 (-3.68)

*nonsignificant

Table 4.40 Total Effects of Exogenous Latent Variables on Endogenous Latent Variables for Vocational High School

	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH	SP_MOTH
BELIEF	— —	0.27 (4.56)	— —	0.25 (3.95)	0.17 (3.27)	— —
BEL_TEAC	0.33 (6.41)	0.41 (7.44)	— —	0.05 (2.69)	-0.11 (-1.64)*	0.35 (5.91)
EFFICACY	-0.20 (-4.07)	— —	— —	0.32 (6.48)	— —	0.26 (4.95)
MOT	-0.17 (-4.04)	0.09 (3.97)	— —	0.36 (7.33)	0.06 (3.04)	0.22 (4.88)
MAT_ANX	0.10 (3.87)	-0.06 (-3.18)	— —	-0.57 (-11.91)	-0.04 (-2.61)	0.18 (4.20)
MAT_ACH	0.19 (3.06)	-0.19 (-3.89)	0.25 (3.55)	-0.03 (-2.34)	0.05 (1.54)*	-0.16 (-3.68)

*nonsignificant

The exogenous latent variables TEAC_CEN and STUD_CEN had negative indirect effects on MAT_ACH (γ = -0.15 and -0.19). In addition, SP_TEAC had negative indirect effect on MAT_ACH (γ = -0.03). SP_FATH had nonsignificant indirect effect on MAT_ACH (γ = 0.05). On the other hand, SP_MOTH had negative indirect effect on MAT_ACH (γ = -0.16). As seen in Table 4.40, the total effect of STUD_CEN was 0.41 for BEL_TEAC. The total effect of SP_TEAC was -0.57 for MAT_ANX. The total effect of SP_FATH was -0.11 for the latent variable BEL_TEAC which was not significant. In addition, the total effect of SP_MOTH was 0.18 for MAT_ANX. Moreover, TEAC_CEN had 0.19 total effects for the latent variable MAT_ACH.

Table 4.41 and 4.42 showed the indirect and total effects of endogenous latent variables on endogenous latent variables.

Table 4.41 Indirect Effects of Endogenous Latent Variables on Endogenous Latent Variables for Vocational High School

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
MAT_ACH	-0.10 (-2.98)	— —	— —	— —	— —

Table 4.42 Total Effects of Endogenous Latent Variables on Endogenous Latent Variables for Vocational High School

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX
BELIEF	— —	— —	— —	— —	— —
BEL_TEAC	0.21 (3.85)	— —	— —	— —	— —
EFFICACY	— —	— —	— —	— —	— —
MOT	0.36 (7.66)	— —	0.85 (10.67)	— —	— —
MAT_ANX	-0.22 (4.70)	— —	-0.48 (-8.84)	— —	— —
MAT_ACH	-0.10 (-2.98)	-0.47 (-4.36)	— —	— —	— —

As seen in Table 4.41, the endogenous latent variable BELIEF had negative indirect effect on MAT_ACH (β = -0.10)

In summary, among the exogenous variables, STUD_CEN had positive effects on BELIEF, BEL_TEAC, MOT, and negative effect on MAT_ANX; TEAC_CEN had positive total effects on BEL_TEAC, and MAT_ANX; and negative total effects on EFFICAY and MOT; CLIMATE had positive effects on MAT_ACH. SP_TEAC had positive effects on all endogenous variables except MAT_ANX and MAT_ACH. In addition, SP_MOTH had positive effects on BEL_TEAC, EFFICACY, MOT, MAT_ACH and MAT_ANX.

Among the endogenous variables, EFFICACY had strong positive total effect on MOT and strong negative total effect on MAT_ANX. Moreover, BELIEF had positive total effects on BEL_TEAC and MOT; and negative effect on MAT_ANX.

It was important to note that for vocational high school, like Anatolian high school, SES had no effect on MAT_ACH but the variable CLIMATE was seen more effective variable on it. In addition, the variables SP_TEAC and SP_FATH had slight effects on MAT_ACH.

Surprisingly, although TEAC_CEN had negative indirect effect on MAT_ACH, totally, it had positive effect on MAT_ACH, whereas, STUD_CEN had negative total effect on MAT_ACH. Unlike the main study, EFFICACY and MOT had no effects on MAT_ACH. In addition, BEL_TEAC and BELIEF had negative total effects on MAT_ACH.

Finally, for 910 vocational high school students, regression equations with standardized coefficients as direct effects were given below;

- BELIEF = 0.27*STUD_CEN + 0.25*SP_TEAC + 0.17*SP_FATH, Errorvar.= 0.66, R^2 = 0.34

- BEL_TEAC = 0.21*BELIEF + 0.33*TEAC_CEN + 0.35*STUD_CEN - 0.14*SP_FATH + 0.35*SP_MOTH, Errorvar.= 0.44, R^2 = 0.56

- EFFICACY = - 0.20*TEAC_CEN + 0.32*SP_TEAC + 0.26*SP_MOTH, Errorvar.= 0.81, R^2 = 0.19

- MOT = 0.36*BELIEF + 0.85*EFFICACY, Errorvar.= 0.047, R^2 = 0.95

- MAT_ANX = - 0.22*BELIEF - 0.48*EFFICACY - 0.36*SP_TEAC + 0.31*SP_MOTH, Errorvar.= 0.41, R^2 = 0.59

- MAT_ACH = - 0.47*BEL_TEAC + 0.34*TEAC_CEN + 0.25*CLIMATE, Errorvar.= 0.81, R^2 = 0.19

4. 4 Summary of the Results of SEM

This section presented a summary of the results for the main study and with respect to three different high schools.

4.4.1 Summary of the Results for MAT_ACH

This section presented a summary of the results for MAT_ACH with respect to three different high schools given in Table 4.43. In this table, direct, indirect and total effects of the variables were given (coefficients were given in standardized value).

Table 4.43 Summary of the Results of SEM for MAT_ACH

HIGH SCHOOL / VARIABLE	TO ENDOGENOUS VARIABLE		ANATOLIAN	GENERAL	VOCATIONAL	MAIN
SES	**MAT_ACH**	**Direct**	-	0.32	-	0.49
		Indirect	-	-	-	-
		Total	-	0.32	-	0.49
TEAC_CEN		**Direct**	0.13	-	0.34	-0.13
		Indirect	-	-0.10	-0.15	-0.03
		Total	0.13	-0.10	0.19	-0.16
STUD_CEN		**Direct**	-	-	-	-
		Indirect	0.08	0.05	-0.19	0.07
		Total	0.08	0.05	-0.19	0.07
CLIMATE		**Direct**	-	-	0.25	0.13
		Indirect	0.04	-	-	0.03
		Total	0.04	-	0.25	0.16
SP_TEAC		**Direct**	-	-	-	-0.067
		Indirect	0.13	0.24	-0.03	0.10
		Total	0.13	0.24	-0.03	0.04*
SP_FATH		**Direct**	-	-	-	-
		Indirect	0.09	0.13	0.05*	0.14
		Total	0.09	0.13	0.05*	0.14
SP_MOTH		**Direct**	-	-	-	-
		Indirect	0.02	0.17	-0.16	0.08
		Total	0.02	0.17	-0.16	0.08
BELIEF		**Direct**	-	-	-	-
		Indirect	0.26	0.15	-0.10	0.12
		Total	0.26	0.15	-0.10	0.12
BEL_TEAC		**Direct**	-	0.14	-0.47	0.23
		Indirect	-	-	-	-
		Total	-	0.14	-0.47	0.23
EFFICACY		**Direct**	-	-	-	0.12
		Indirect	0.13	0.56	-	0.09
		Total	0.13	0.56	-	0.21
MOT		**Direct**	0.39	0.66	-	0.13
		Indirect	-	-	-	-
		Total	0.39	0.66	-	0.13
MAT_ANX		**Direct**	-	0.13	-	0.043*
		Indirect	-	-	-	-
		Total	-	0.13	-	-

*nonsignificant

4.4.2 Summary of the Findings

This section presented the conclusions of the findings of the present study.

SES

1. In the main study, and for general high schools, SES had positive strong direct effect on mathematics achievement.

TEAC_CEN

2. In the main study, teacher-centered activities had negative direct effects on self efficacy and mathematics achievement.
3. In Anatolian and vocational high schools, teacher-centered activities had positive direct effect on mathematics achievement.
4. In general and vocational high schools, teacher-centered activities had positive direct effect on beliefs about teaching of mathematics and negative direct effects on self-efficacy.
5. For general high schools, teacher-centered activities had positive direct effect on mathematics anxiety.
6. In the main study and for general and vocational high schools, teacher-centered activities had negative indirect effects on motivation and positive indirect effects on mathematics anxiety.

STUD_CEN

7. In the present study, student-centered activities had positive direct effect on beliefs about mathematics.
8. In the main study, student-centered activities had positive direct effects on motivation (but very slight) and beliefs about teaching of mathematics.

9. In vocational high schools, student-centered activities had positive direct effect on beliefs about teaching of mathematics.
10. In Anatolian high schools, student-centered activities had positive indirect effects on beliefs about teaching of mathematics and motivation.
11. In the main study and for Anatolian and general high schools, student-centered activities had positive indirect effect (but very slight) on mathematics achievement.
12. In vocational high schools, student-centered activities had negative indirect effect on mathematics achievement

SP_TEAC

13. In the present study, the result indicated that SP_TEAC had positive direct effects on beliefs about mathematics and self-efficacy toward mathematics.
14. In the main study and for general and vocational high schools, SP_TEAC had negative direct effects on mathematics anxiety.
15. In the present study, the result indicated that SP_TEAC had no direct effect on mathematics achievement in any schools. However, it had positive indirect effect on mathematics achievement in Anatolian and general high schools.
16. In the present study, the result indicated that SP_TEAC had strong positive indirect effect on motivation and negative indirect effect on mathematics anxiety. In addition, it had slight positive indirect effect on beliefs about teaching of mathematics.

CLIMATE

17. In the main study, classroom climate had positive direct effect on mathematics self-efficacy and motivation toward mathematics.
18. In the main study, the results indicated that classroom climate affected mathematics achievement directly.

19. For Anatolian high schools, classroom climate had positive direct effect on motivation toward mathematics.
20. For general high schools, classroom climate had no effect on any variables.
21. For vocational high schools, classroom climate had positive direct effect on mathematics achievement.
22. For Anatolian high schools, classroom climate had slight positive indirect effect on mathematics achievement.

SP_FATH and SP_MOTH

23. The results of the present study indicated that SP_FATH had positive direct effect on beliefs about mathematics.
24. The results of the present study indicated that SP_MOTH had positive direct effects on beliefs about teaching of mathematics and self-efficacy.
25. In the main study and for Anatolian high schools, SP_FATH had positive direct effect on self-efficacy.
26. SP_FATH had negative direct effect on beliefs about teaching of mathematics for vocational high school students.
27. In the main study and for Anatolian and vocational high schools, SP_MOTH had positive direct effect on mathematics anxiety.
28. For general high school students, SP_FATH had positive direct effect on their motivation toward mathematics.
29. The results of the present study indicated that SP_FATH and SP_MOTH had positive indirect effects on motivation and negative indirect effects on mathematics anxiety.
30. The results of the present study indicated that SP_FATH had positive indirect effect on mathematics achievement. SP_MOTH had also positive indirect effect on mathematics achievement except vocational high schools. This effect was negative for this type of school.

BELIEF

31. In the present study, beliefs about the nature of mathematics had positive direct effect on beliefs about teaching of mathematics and motivation. It had negative direct effect on mathematics anxiety.
32. In the main study and for Anatolian and vocational high schools, beliefs about the nature of mathematics had positive indirect effect on mathematics achievement. On the other hand, in vocational high schools, this effect was negative.

BEL_TEAC

33. In the main study and for general high schools, beliefs about teaching of mathematics had positive direct effect on mathematics achievement. On the other hand, for vocational high schools, this effect was negative.

EFFICACY

34. In the present study, self-efficacy toward mathematics had strong positive direct effect on motivation and negative direct effect on mathematics anxiety.
35. In the main study, self-efficacy toward mathematics had positive direct effect on mathematics. For Anatolian and general high schools, this effect was indirect.

MOT

36. In the main study and for Anatolian and vocational high schools, motivation toward mathematics had high positive direct effect on mathematics achievement.

MAT_ANX

37. In the main study, and for Anatolian and vocational high schools, there was no significant path from mathematics anxiety to mathematics achievement. But for general high school, mathematics anxiety had positive direct effect on mathematics achievement.

CHAPTER 5

DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

This chapter includes discussions, conclusions and recommendations of the study.

5.1 Discussions

In the present study, the effects of socioeconomic status, school factors (classroom climate, classroom activities) and affective variables (motivation, self-efficacy, mathematics anxiety, beliefs about the nature of the mathematics and teaching of mathematics, students' perceptions of their teachers and their parents' attitudes toward them as learners of mathematics) were investigated on mathematics achievement with respect to different kinds of high schools by using structural equation modeling techniques.

Anderman and Maehr (1994) noted that the special attention must be given to students at middle grades. According to them, during the middle grades, motivational problems and negative attitudes toward school might rise because of the classroom and school environments. They emphasized a decrease of students' motivational behaviors after the transition from elementary to secondary schools. According to them, this was due to changing environmental situations. In the present study, the results were analyzed and discussed with respect to three school types (Anatolian, general and vocational high schools) and without any school type discrimination to explain the situations both as a whole and as a private.

Socioeconomic status had the strongest effect on mathematics achievement in the main study. On the other hand, for Anatolian and vocational high schools, this variable didn't make a sense for the achievement. However, for the general high school, again, SES had the highest effect.

For Anatolian high school, the socioeconomic status of the students was high. That is, generally, parents whose child was in Anatolian high school had high educational degrees and income. Inverse, parents whose child was in vocational high school had low educational degrees and income. Namely, although it was seen that the variable SES had no effect on mathematics achievement for both Anatolian and vocational high schools, at the beginning, students with high socioeconomic status were tended to take high scores from the mathematics achievement tests due to a desire to enter to any Anatolian high schools. That is, at the beginning or at the end SES had effect on mathematics achievement. But why was this variable so important? In the main study, the factors of SES were the number of siblings, family income, father education and mother education. The factor loading of the number of sibling was negative. That is, it could be said that parents with high socioeconomic status could have one or two children, whereas, parents with low socioeconomic status could have more than two children. Thus, parents who had less children tended to be more interested in their children's interests, necessities and their schools' needs (getting text books, private lesson, etc.). On the other hand, according to Alwin and Thornton (1984) parental socioeconomic status tended to be positively related to achievement except family size which was contradictory to the present result.

Father and mother education were another factors of SES. These factors were positively related to the variable SES. This could mean that students with more educated parents tended to get higher scores on mathematics achievement tests (Khmelkov & Wang, 2002). In addition, parents with high educational degree might be more willing to interest in their child's achievement and his or her school performance. This result was seemed to be the same with the result of Entwisle and Alexander (1996). Another reason for the effects of parent's education might be that more educated parents could be aware of the importance of the achievement in mathematics courses for their child's future performance and so they could encourage and motivate his or her to take more advanced courses (Ozturk & Sighn, 2006).

Family income with positive factor loading was another factor of SES. Students with high income had more opportunities to respond expenditures related to the school needs.

Many researchers investigated how classroom activities affected student mathematics achievement. In several studies, some of the activities were implemented to investigate their effects on learning and on some affective variables. In the present study, the effects of student-centered and teacher-centered activities on affective variables and mathematics achievement were investigated.

The results of the main study indicated that teacher-centered activities had negative direct effects on self efficacy. In addition, in general and vocational high schools, teacher-centered activities had positive direct effects on beliefs about teaching of mathematics and negative direct effects on self-efficacy. For general high school, teacher-centered activities had positive direct effect on mathematics anxiety as well as for vocational high school, this effect was indirect. In teacher-centered activities, teachers control and manage the class, set objectives expected achieving by the students and teach the rules and let students implement learning activities step by step. Thus, students are not involved in teaching and learning process which may lead to increase mathematics anxiety and decrease self-efficacy toward mathematics.

The results of the present study also indicated that student-centered activities had positive direct effect on beliefs about mathematics. In addition, in the main study, student-centered activities had positive direct effects on motivation (but very slight) and beliefs about teaching of mathematics. In vocational high schools, student-centered activities had positive direct effect on beliefs about teaching of mathematics. Moreover, in Anatolian high schools, student-centered activities had positive indirect effects on beliefs about teaching of mathematics and motivation. According to the results, it could be said that students might feel that mathematics could be learned if it was taught by using some activities which included discovering, integrating other topics, expressing their own ideas, and organizing information. So, this might increase their beliefs and motivation toward mathematics. In addition, the results might indicate that if students had actually constructed their own framework or knowledge by implementing learner based activities, they were more likely to have high motivation and positive beliefs toward mathematics.

The results of the study indicated that in the main study and for Anatolian and general high schools, student-centered activities had positive indirect effect (but very slight) on mathematics achievement. In addition, in the main study, teacher-centered activities had negative direct effects on mathematics achievement. Generally, student-centered activities might provide students to discover and use their creativity, express their own ideas independently, positive interactions with the teacher and their friends that led to increase their beliefs and motivation toward subject, which in turn, increase mathematics achievement. In vocational high school, on the other hand, student-centered activities had negative indirect effect on mathematics achievement. In addition, in Anatolian and vocational high schools, the direct effects of teacher-centered activities on mathematics achievement were positive. According to Berberoglu et al (2003), this result occurred because of the difficulty of the application of the student-centered activities in classrooms and unfamiliar with some student-centered activities such as project works, classroom discussions or group work for the students.

In the present study, *classroom climate* was defined as students' perceptions related to classroom environment during teaching-learning process. It included teacher-student, student-student interactions, classroom management and control of silence in class. In the main study, classroom climate had positive direct effect on mathematics self efficacy and motivation toward mathematics. This effect was seen for Anatolian high school students, too. This result might occur because of students' feelings about their safety and their perceptions toward teacher's control and empowerment in class. When students thought that teacher could manage classroom problems effectively and prevent undesired sounds in math class, they could show respect to their teacher and develop positive motivational beliefs. According to

Haladyna et al (1983), classroom environment affected students' motivation that might increase selection of mathematics courses.

Moreover, in the main study, the results indicated that classroom climate affected mathematics achievement directly. This effect was also seen in vocational high schools. This result was seemed to be the same with the results of Bos and Kuiper (1999), Papanastasiou (2002) who focused on positive relationship between climate and student achievement in mathematics. Surprisingly, for general high school, classroom climate had no effect on any variables.

Teacher was an important part of learning to mathematics. In the present study, the result indicated that students' perceptions of their teachers' attitudes toward them as learners of mathematics had positive direct effects on beliefs about mathematics and self efficacy toward mathematics. This could mean that teachers' encouragements, expectations and confidence in students' ability might affect student behavior. Students who were encouraged, took feedback, and communicated with their teacher independently and friendly might be more confident about their ability and had more positive beliefs about mathematics. Moreover, in the main study and for general and vocational high schools, students' perceptions of their teachers' attitudes toward them as learners of mathematics had negative direct effects on mathematics anxiety.

In the present study, the result indicated that students' perceptions toward their teachers had strong positive indirect effect on motivation. In addition, in the present study, the result indicated that students' perceptions about their teachers' expectations toward them had no direct effects on mathematics achievement in any schools. However, it had positive indirect effect on mathematics achievement in Anatolian and general high schools. According to Pintrich and Schunk (2002), teacher expectations and different types of feedback affected students' beliefs about their performance capabilities, this in turn, affected student motivation and achievement. But how did teachers' expectations differ? There were many reasons that could affect teacher behaviors toward students. Some possible reasons might be students' intelligence, gender, age, information from previous teachers, social and ethnic background of the students (Braun, 1976).

Parents could be also important persons for children’s social and cognitive development. The results of the present study indicated that students’ perceptions of their parents’ attittudes toward them as learners of mathematics had positive indirect effects on motivation and negative indirect effects on mathematics anxiety. In addition, for general high school students, that students’ perceptions of their fathers’ attittudes toward them as learners of mathematics had positive direct effect on their motivation toward mathematics. According to Pintrich and Schunk (2002), families were critical for children’s motivation. The results of the present study indicated that that students’ perceptions of their fathers’ attittudes toward them as learners of mathematics had positive direct effects on beliefs about teaching of mathematics and self-efficacy and that students’ perceptions of their fathers’ attittudes toward them as learners of mathematics had positive direct effect on beliefs about mathematics. Moreover, in the main study and for Anatolian high school, that students’ perceptions of their fathers’ attittudes toward them as learners of mathematics had positive direct effect on self efficacy. With the light on the results, it could be said that if the students’ perceptions of their parents’ attitudes toward them as learners of mathematics were positive, then they might be more likely to have more positive beliefs toward mathematics and high self-efficacy, which in turn directly increased academic motivation. According to Eccles et all (1998), parents attributions for the child’s academic performance as well as expectations and confidence in child’s learning abilities might affect motivation.

On the other hand, students’ perceptions toward their fathers’ attitudes about their mathematics achievement had negative direct effect on beliefs about teaching of mathematics for vocational high school students. In addition, in the main study and for Anatolian and vocational high schools, students’ perceptions toward their mothers’ attitudes about their mathematics achievement had positive direct effect on mathematics anxiety. If mother and father expectations and values for their child’s school performance were very high, child might be under stress to get high notes in order to respond his or her parents’ expectations which could lead to increase negative beliefs and anxiety.

Parental involvement in school might predict children's achievement. The results of the present study indicated that students' perceptions toward their fathers' attitudes about their mathematics achievement had positive indirect effect on mathematics achievement. Students' perceptions toward their mothers' attitudes about their mathematics achievement had also positive indirect effect on mathematics achievement except vocational high schools. This effect was negative for this type of school.

In the main study, and for the studies of Anatolian and general high schools, the results showed that motivation affected mathematics achievement directly. This could mean that students might success in mathematics because of motivation that forced them to make an effort through the implemented goals. This result was seemed to be the same with the results of Singh, Granville and Dika (2002) and Bergin (1992) who focused on the importance of motivation to predict achievement. If that is so, then how did this variable affect achievement? Pintrich and Schunk (2002) noted that people might not show their performances until they were motivated to display them. According to them, motivation was important to set *goals*, make impetus and decide the direction of an action. In addition, learning process required continuing attention. If a teacher provided motivation to students to learn the subject, he or she could lead to *permanent* learning for them. In addition, motivation could acquire greater attention to displays for meaningful learning by interesting the subject, desiring to show their performances and striving to achieve intended goals (Pintrich & Schunk, 2002).

So, which variables could affect motivation? There might be many reasons to affect students' motivation (prior knowledge, beliefs, interests, competence, etc.). As the goal theory emphasized, goals are important determinants of expectations, motivational orientations and achievement behaviors (Anderman & Maehr, 1994). In the present study, the results indicated that students' beliefs about the nature of mathematics and self-efficacy toward mathematics affected students' motivation directly. These results might indicate the importance of affective variables for motivation. Students who believed the importance and usefulness of mathematics and had positive beliefs toward it might be more willing to learn the subject, and this might motivate them to gain more attention to it.

The results of the study also showed that self-efficacy was the most effective variable for motivation. According to Pintrich and Schunk (2002), self-efficacy affected choice of activities, making effort and persistence of learning. They noted that students who had high positive self-efficacy work harder when they faced with difficulties. Whereas, students who had low self-efficacy might avoid form making decisions and achieving a task. Moreover, in the main study, the results indicated that student-centered activities and climate affected motivation directly. These effects were positive but slight. Classroom climate indicated how the atmosphere of class was while teaching and learning process. Students might have high motivation toward the subject if the climate of the class was friendly, democratic and silence. In addition, student-centered activities provided group working, giving opportunities to students discovering and applying rules and letting them show their ideas independently. Thus, this might lead the students to believe that they were capable of learning and so this might motivate them to work on the subject.

In the main study, teacher-centered activities had negative indirect effect on motivation. This could happen because of the fact that effective teaching practices could lead students to integrate and demonstrate their knowledge during teaching and learning process which were important influences on motivation.

Moreover, in the main study, father, mother and teacher had indirect positive effects on motivation. Parents were affective persons for their child during developing cognitive and psychological constructs. Students who believed that their parents were interested in their success in mathematics might have high motivation because of willing to work on mathematics to get high notes. In addition, teachers' expectations about achievement might be affective for students' motivation because of raising self-efficacy toward the subject.

Pajares (1996) noted that self-efficacy could influence individuals' emotional reactions when confronting obstacles and their feelings. He concluded that self-efficacy could be seen as strong predictors and determinants of the level of achievement. In the main study, the results indicated that self-efficacy affected mathematics achievement directly. In addition, for the studies of Anatolian and general high schools, the results showed that this affect was available but indirect. That is, students who had high self-efficacy toward the subject might be more tended to show high performance on mathematics. This result was seemed to be the same with the results of Hackett and Betz (1989) and Pajares and Graham (1999) who found strong positive relationship between self-efficacy and performance.

Hackett and Betz (1989) reported that "mathematics self-efficacy can be distinguished from other measures of attitudes toward mathematics in that mathematics self-efficacy is a situational or problem specific assessment of an individual's confidence in her or his ability to successfully perform or accomplish a particular task or problem" (p. 262). In addition, they related mathematics anxiety with mathematics self-efficacy except that self-efficacy was more important predictor variable for the future mathematics performance. In the present study, the results indicated that beliefs and self-efficacy had negative direct effects on mathematics anxiety. This could happen because of the fact that students who had more positive beliefs about mathematics and had high self-efficacy toward it might have less negative feelings and more willing to show their performances.

Based on the research studies, Adeyemo (2005) stated that self-efficacy had an important role in the process of cognitive development and it influenced school activities and academic performance. In the present study, teacher-centered activities had negative direct effects on self-efficacy.

There has been wide research about the relation between mathematics anxiety and achievement in math (Ashcraft & Kirk, 2001; Hembree, 1990; Nasser & Birenbaum, 2005; Sherman & Wither, 2003). In these studies, the researchers tried to identify the effects of math anxiety on performance on solving math problems, valuing for choosing math courses, perceptions of their abilities toward the subject. Many researchers concluded the negative existence between these variables (Ashcraft & Kirk, 2001; Hembree, 1990; Nasser & Birenbaum, 2005). But in the main study, this relationship didn't exist. In addition, when looking at the models of the school types, for Anatolian and vocational high schools, this relationship didn't exist, either. This result was seemed to be the same with the result of Sherman and Wither (2003) in which they reported in their study that anxiety caused a lack of mathematics achievement was too unlikely to be accepted. On the other hand, in the present study, for general high school, it was concluded that mathematics anxiety affected mathematics achievement positively. This was not surprise for some researchers (Wigfield & Meese, 1988). According to them, a degree of concern or worry might be required to motivate students to try harder. That is, anxiety might cause the attention and so motivate them on mathematical performance. But it was important to note that if the degree of negative feelings was too strong; this might cause poor performance (Wigfield & Meese, 1988).

The results of the main, Anatolian and general high schools studies indicated that beliefs about the nature of mathematics had positive indirect effects on mathematics achievement through the affective variables motivation and beliefs about teaching of mathematics. It could be said that students who believed that mathematics was an important subject might have high motivation resulting in achievement. This result was seemed to be related to the results of Kloosterman and Stage (1992) who stated that beliefs were important with respect to student motivation to learn mathematics and increasing students' beliefs about usefulness of mathematics, which in turn, increase achievement. But, for vocational high school, this indirect effect was negative. It could be stated that students at different high schools had different beliefs about mathematics. This result might occur due to external factors. These external factors could be the structure of the classrooms and mathematics instruction. These results seemed to be related to the results of Mert and Bulut (2006); Aksu, Demir and Sümer (2002) who focused on the influences of classroom environment and experiences on students' beliefs, motivation and achievement. In addition, Anatolian and general high school students took more mathematics courses than the students who were in vocational high schools. Students who had taken a variety of mathematics courses might be expected to have differing beliefs about mathematics and the teaching of mathematics. According to Kloosterman and Stage (1992), this wouldn't be surprising. Moreover, this difference might occur because of willingness to enroll in mathematics courses.

Kloosterman and Stage (1992) also stated that while intent to enroll in mathematics courses might be related to increasing beliefs about learning mathematics.

5.2 Conclusions

This section presented the conclusions of the findings of the present study. In the study, the influences of factors considered to affect mathematics achievement were investigated based on 3100 9^{th} grade students' data. The structural equation modeling techniques were used for determining the effects of these factors simultaneously. In addition, it was also investigated three school types (Anatolian, general and vocational high schools) to understand the differences among different types of schools.

According to the results of the main study, students with high socioeconomic status tended to be more successful in mathematics. This could be because of getting students' needs by parents easily. In addition, parents with high education could be more interested in their students' performances in mathematics this might cause achievement in mathematics.

Another important conclusion for the study could be that, students who participated classroom activities effectively, they were more motivated and more confident about their ability for doing math, this in turn, they were more likely to achieve in mathematics.

On the other hand, for vocational high school students, student-centered activities had negative indirect effect on mathematics achievement. In addition, in Anatolian and vocational high schools, the direct effects of teacher-centered activities on mathematics achievement were positive. In Anatolian and vocational high schools, students who were taught mathematics by teachers step by step might be tended to get high notes in mathematics. But generally, students could be more willing to learn mathematics as a part of teaching and learning process to show their abilities and to share their feelings and ideas independently. Because this might be motivate them and increase their self-efficacy.

Classrooms are important places that teaching and learning process occur. In the main study, the results indicated that classroom climate affected mathematics self-efficacy and motivation toward mathematics as well as mathematics achievement positively. This effect was also seen in vocational high schools. It could be arrived to the conclusion that students who were in more friendly and silence class, were more likely to be motivated to the subject being taught, this in turn, they were more likely to success in it.

Another conclusion form the study could be that teachers' attitudes and expectations toward their students were important determinants of students' perceptions about their capabilities, and their judgments toward whether achieving in mathematics. Teachers who were more interested in their student's abilities and personal inequalities, they could be more aware of what happened in class and know how to behave toward students and what the weakness or incapability that some students had. According to the study, if students thought that their mathematics teacher had positive expectations toward them and he or she was more willing to know their interests and difficultness in learning to mathematics, they might be more confident about their success in mathematics and they might be more willing to learn mathematics.

In the study, the important conclusion could be that parents' expectations toward their child's success and their attitudes toward importance of mathematics were important role to affect one's affective variables, this in turn, could affect mathematics achievement. But sometimes, if these expectations were high, child could be under pressure and stress and he or she might have feelings of tension and fear toward the subject.

Affective variables were another important influences on mathematics achievement. Thus, it could be concluded form the study that if students had high motivation and self-efficacy as well as positive beliefs about mathematics and teaching of mathematics, they could be more interested in the subject and thus more willing to get high notes in it.

According to the present study, the differences between school types were remarkable. There could be various reasons but it was important to note that these differences should be minimized in order to provide equality in education.

5.3 Recommendations

The findings of the present study indicated that further research should be conducted to examine the influence of socioeconomic status, affective and school factors on mathematics achievement. The models presented for mathematics achievement in this study had implications for further research studies. In addition, the implications for mathematics achievement suggested by the result were various with respect to three school types: Anatolian, general and vocational high schools.

The differences between school types are remarkable. There can be various reasons such as school size, culture, place of the school, administration, school services and facilities, as well as the way of entrance of the schools and different curriculum applied. It is important to note that these differences should be minimized in order to provide equality in education.

Although, teacher has no direct effect on mathematics achievement in any schools, it has positive indirect effect on mathematics achievement in Anatolian and general high schools. Moreover, in the present study, the results indicate that teachers are important roles for students' self-efficacy and beliefs about mathematics, which in turn, affect their motivation and mathematics achievement. That is, teachers are critical roles for students' emotional and cognitive development. According to Pintrich and Schunk (2002), teacher- student interaction and teacher' expectancies affect student's self-efficacy and motivation. Thus, mathematics teacher is a critical component of achievement.

Classroom climate is another important influence on both affective variables and students' learning. According to Yayan and Berberoglu (2004), one of the greatest effects on mathematics achievement is classroom climate. The results of the present study pointed out that important role of the teacher in the classroom. Teacher plays a critical role that he or she should build and sustain warmth, positive and secure atmosphere. In teacher education programs, classroom management skills should be considered as one of the factors which are influential on student mathematics achievement.

Socioeconomic status is an effective positive influence on mathematics achievement. It can be said that if school environment and expenditures spent for each student are equal school by school, the effect of SES can be minimized.

Student perceptions about their parents for their competencies and academic achievement generally affect affective constructs and so achievement. In discussion part, it gives some ideas about the reasons of their influences. But now, it should be considered how we turn these effects positive. In schools, school administrators and counselors can play important roles. Counselors can advise and inform parents how to enact their child and guide how to show their feelings and expectations about their child effectively and without any discomfort. In addition, school administrators can give knowledge to parents about their child's behavior in schools, grades and attendance in class. According to Bandura (1997), it is disadvantaged for students whose parents have low involvement with schools. Thus, school administrators should more interact with parents and let teachers communicate with parents more often.

Effects of student-centered and teacher-centered activities are valuable for both affective variables and achievement. It is important to note that generally, student-centered activities affect students' beliefs, self-efficacy and motivation positively, whereas, the influence of teacher-centered activities on these affective variables are negative. Generally, student-centered activities provide to students to set end give their ideas independently, encourage students for creativity thinking and so icrease their self-efficacy and motivation to the subject. Thus, teachers should be more willing to implement learning activities which are based on student-centered. On the other hand, in Anatolian and vocational high schools, teacher-centered activities had positive direct effect on mathematics achievement. Thus, for these types of schools which favor teacher-centered activities, an active teacher model should be adopted in the classrooms since students can learn this way better.

According to the results of the present study, affective variables are important parts of mathematics achievement. Thus, it should be taken into account students' interests and emotions, climate in math class, teacher and parents' behaviors, learning activities to be able to increase their affective constructs positively. Results also indicated the importance of teacher not only learning but also students' beliefs about mathematics. For this reason, students' affective developments should also be a part of the curriculum of teacher education programs as well as cognitive developments.

Finally, on the light of the results of the present study the followings can be taken into consideration:

Mathematics teachers should

- foster students' self efficacy toward mathematics by using different teaching approaches such as small group discussion, and give feedback to motivate them for further learning,
- obtain information about students' prior knowledge to ensure their competencies about the subject being taught,
- encourage students for creativity thinking,
- make sure that students have opportunities to set end give their ideas independently,
- provide opportunities to set intended goals,
- show interest about their problems,
- make sure that classroom is free from negative feelings such as fear, anxiety, worry,
- maintain classroom climate friendly and respectfully.

Secondary mathematics education programs can be improved where preservice teachers can have competency on

- how to teach mathematics in a way that children can understand and apply it to other subject areas and real life, and realize the relationship among mathematics concepts,
- how to develop students' affective constructs in a positive direction,
- how to control and manage classroom,
- how to communicate and behave to students,
- how to apply teaching methods that include discovering, integrating, analyzing and sharing the ideas in classes effectively.

Mathematics curriculum should include

- reflection so that students can analyze their performances in learning,
- opportunities for communication so that students can clarify their ideas independently,
- different types of activites to increase studentrs' motivation.

Recommendations for further research studies on the light of the present study might be given as the followings:

- Sample size can be increased for further research studies. To be able to talk about Turkey overall, subjects from different schools of different geographical regions should be selected.
- The reasons of the differences among school types can be investigated in order to minimize inequality.
- For a deep investigation about the effects of classroom climate, learning activities, teachers and parents' expectations and affective variables on students' mathematics achievement, qualitative research methods can be utilized.
- Different grade levels can be searched for.
- The effects of these factors can be investigated at different subject areas such as biology, physics or chemistry.
- To be able to get more reliable results, the different measurements can be used with mathematics achievement test such as grades, verbal notes.

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APPENDIX A

SCALES

Beliefs About the Nature of Mathematics Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katıl**mı**yorum	Kesinlikle Katıl**mı**yorum
1. Matematik hayatı kolaylaştırır.					
2. Matematik, insanların hayatta karşılaştıkları problemleri çözerken geliştirdikleri bir düşünme biçimidir.					
3. Matematik mantıksal düşünmenin kazandırılmasında yardımcı olur.					
4. Matematik, uygarlığın gelişimi için kullanılan bir araç değildir.					
5. Matematik, toplum için bir ihtiyaç değildir.					
6. Matematik bir dildir.					
7. Matematik, problem çözme becerisini geliştirir.					
8. Matematik diğer bilim dallarının gelişmesine katkıda bulunan bir araçtır.					
9. Matematik, resim, şiir ve müzik gibi bir sanattır					
10.Matematik bir oyundur.					
11.Matematikte yaratıcılığın yeri yoktur					
12.Matematik her insan için ilgilenmeye değer bir konudur.					

Beliefs About the Teaching of Mathematics Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katıl**mı**yorum	Kesinlikle Katıl**mı**yorum
1. Matematik öğretilirken, farklı öğretim yöntemleri kullanılmalıdır.					
2. Matematik öğretimi, matematik konusunda kendimize olan güveni arttırıcı nitelikte olmalıdır.					
3. Konuların yanı sıra sorular çözülürken kullanabilecek kısa ve pratik yollar öğretilmelidir.					
4. Matematik öğretimi sırasında, farklı stratejiler kullanılarak problem çözme becerilerimizin geliştirilmesine çalışılmalıdır.					
5. Matematik öğretimi, matematik korkusu oluşturucu nitelikte olmamalıdır.					
6. Matematiksel düşünce şeklinin öğretilmesine önem verilmelidir.					
7. Matematiğin toplumdaki ve diğer alanlardaki değeri, uygulama alanları gösterilerek öğretilmelidir.					
8. Matematik öğretmeninin, konuyla ilgili fikirlerimize değer verip, bunları dinlemesi gerekir.					
9. Matematikteki kurallar öğretilirken, bunların nasıl elde edildiği bizlere keşfettirilmelidir.					
10.Matematik öğretimi, matematiğe karşı bakış açılarımızı olumlu yönde değiştirici nitelikte olmalıdır.					
11.Matematikte ezber yönteminden kaçınılmalıdır.					
12.Problemi anlama, plan kurma, planı uygulama ve kontrol etme aşamalarını içeren “problem çözme” yöntemine önem verilmelidir.					
13.Matematik, gerçek yaşantıdan benzetme yapılarak öğretilmelidir.					

Mathematics Self-efficacy Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematik dersinde öğretilen konulardan başarılı olacağıma inanıyorum.					
2.Yeterince çaba gösterirsem, matematik dersinin konularını anlayacağıma inanıyorum.					
3. Bu derste öğretilen temel kavramları bile öğrenebileceğim konusunda kendime <u>güvenmiyorum</u>.					
4.Matematik dersinde verilen ödevleri en iyi şekilde hazırlayıp teslim edeceğimden eminim.					
5. Bu derste öğretilen becerilerde uzmanlaşabileceğimden emin değilim.					
6. Matematik dersinde sunulan çok karmaşık konuları bile anlayabileceğimi düşünüyorum.					
7. Matematik dersinden mükemmel bir not alacağıma <u>inanmıyorum.</u>					
8. Zor bir problem ile karşı karşıya kaldığımda, çeşitli çözümler bulabilirim.					
9. Dersteki zorlukları, öğretmenimi ve yeteneğimi göz önüne aldığımda bu derste başarılı olacağımı <u>düşünmemekteyim.</u>					
10.Çok çalışsam bile en kolay problemleri bile çözebileceğimi sanmıyorum.					

Classroom Activities Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematik dersini her zaman öğretmen anlatır.					
2. Matematik dersinde, soruları hep öğretmen çözer.					
3. Matematik öğretmeni, problemlerin nasıl çözüleceğini kendisi gösterir.					
4. Ders notlarını tahtadan geçiririm.					
5. Matematik öğretmeni bizlerle, konularla ilgili soruları tartışır.					
6. Derste grup çalışması yapılır.					
7. Derste, ezber yönteminden faydalanılmaz.					
8. Derste, farklı stratejiler kullanılarak problem çözülür.					
9. Matematik öğretmeni, konuyla ilgili fikirlerimize değer verip, bunları dinler.					
10. Matematik öğretiminde bilgisayar, tepegöz gibi araç ve gereçlerden faydalanılır.					

Motivation Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematik dersine çalışırken kendime sürekli yeni hedefler koyarım.					
2. Matematik dersinde beni en mutlu eden şey, konuları elimden geldiğince iyi anlamaya çaba göstermemdir.					
3. Matematik dersinin konularını öğrenmek benim için çok önemli değildir.					
4. Matematik dersinden iyi bir not almak beni en mutlu edecek şeydir.					
5. Matematik dersinde, öğrenilmesi zor da olsa, merakımı uyandıran konuları tercih ederim.					
6. Matematik dersinde çok başarılı olmak istiyorum, çünkü çevremdekilere başarabileceğimi göstermem önemlidir.					
7. Matematik dersinde, sınıftaki öğrencilerin çoğundan daha iyi bir not alacağımı düşünmüyorum.					
8. Matematik çalışırken içim sıkılır ve planladıklarımı bitirmeden çalışmayı bırakırım.					
9. Matematik dersinde öğrendiklerimi diğer derslerde kullanabileceğimi sanmıyorum.					
10. Matematik dersinin kaynakları sıkıcı olduklarında bile, bitirinceye kadar çalışmayı beceririm.					
11. Not ortalamamı yükseltmek için, matematik dersinden iyi bir not almak benim için önemli değildir.					
12. Matematik dersine çalışırken zorlandığımda, ya çalışmayı bırakırım ya da sadece kolay kısımları çalışırım.					

Classroom Climate Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Dersin başında, beş dakikadan fazla hiçbirşey yapmadan zaman geçer.					
2. Sınıfta öğretmenin koyduğu kurallara uyulur.					
3. Sınıf ortamı genelde gürültülüdür.					
4. Matematik öğretmeni, derse başlamadan önce öğrencilerin susmaları için uzun süre bekler.					
5. Matematik öğretmeni, sınıfta ayrım yapmadan hepimize eşit davranır.					
6. Ders başladıktan sonra, öğrenciler dikkatle öğretmeni dinlerler.					

Mathematics Anxiety Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katıl**mı**yorum	Kesinlikle Katıl**mı**yorum
1. Matematik beni hiç korkutmaz.					
2. Matematik beni gerginleştirir.					
3. Matematik problemlerini çözebilmek konusunda genelde hiç endişelenmem.					
4. Bir matematik sınavında hemen hemen hiç elim ayağım titremedi.					
5. Matematik çalışırken aklıma hiçbirşey gelmez ve net düşünemem.					
6. Matematik derslerinde genellikle rahatımdır.					
7. Matematik genellikle beni sinirlendirir.					
8. Daha fazla matematik dersi almak beni hiç rahatsız etmez.					
9. Zor matematik problemleri ile uğraştığımı düşündüğüm zaman, kendimi çaresiz hissederim.					
10. Matematik sınavları süresince genellikle rahatımdır.					
11. Matematik sınavı beni korkutur.					
12. Matematik beni huzursuz eder ve kafamı karıştırır.					

Mother Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Annem, matematiği başarabilecek nitelikte biri olduğumu düşünüyor.					
2. Annem, matematikte başarılı olabileceğimi düşünüyor.					
3. Annem ileri matematiğin benim için zaman kaybı olduğunu düşünüyor.					
4. Annem, her zaman matematikte başarılı olmam yönünde beni teşvik etmiştir.					
5. Annem, daha çok matematik dersi alıp almamam konusuyla hiç ilgilenmemiştir.					
6. Annem, liseden mezun olduktan sonra yapmak istediğim her işte matematiğe ihtiyaç duyacağımı düşünmektedir.					
7. Annem, her zaman matematikteki başarı durumumla ilgilenmiştir.					
8. Annem genellikle matematikte nasıl olduğumla ilgilenmemiştir.					
9. Annem, matematik gerektiren bir alanda kariyer yapmam (meslek sahibi olmam) yönünde beni desteklememiştir.					
10. Annem aldığım dersler içinde matematiğin en önemlilerinden biri olduğunu düşünüyor.					
11. Annem, çok az matematik bilgisinin benim için yeterli olduğunu düşünüyor.					

Father Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Babam, matematiği başarabilecek nitelikte biri olduğumu düşünüyor.					
2. Babam, çok az matematik bilgisinin benim için yeterli olduğunu düşünüyor.					
3. Babam ileri matematiğin benim için zaman kaybı olduğunu düşünüyor.					
4. Babam, her zaman matematikte başarılı olmam yönünde beni teşvik etmiştir.					
5. Babam aldığım dersler içinde matematiğin en önemlilerinden biri olduğunu düşünüyor.					
6. Babam, matematik gerektiren bir alanda kariyer yapmam (meslek sahibi olmam) yönünde beni desteklememiştir.					
7. Babam, her zaman matematikteki başarı durumumla ilgilenmiştir.					
8. Babam genellikle matematikte nasıl olduğumla ilgilenmemiştir.					
9. Babam, liseden mezun olduktan sonra yapmak istediğim her işte matematiğe ihtiyaç duyacağımı düşünmektedir.					
10. Babam, daha çok matematik dersi alıp almamam konusuyla hiç ilgilenmemiştir.					
11. Babam, matematikte başarılı olabileceğimi düşünüyor.					

Teacher Scale

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katıl**mı**yorum	Kesinlikle Katıl**mı**yorum
1. Matematik öğretmenim daha çok matematik çalışmam için teşvik eder.					
2. Matematik öğretmenim matematikte başarılı olabilecek nitelikte bir kişi olduğumu düşünüyor.					
3. Matematik öğretmenimin benimle matematik hakkında ciddi olarak konuşmalarını sağlarken zorlanırım.					
4. Matematik öğretmenim alabileceğim bütün matematik derslerini almam için teşvik eder.					
5. Matematik öğretmenlerinin saygısını kazanmanın zor olduğunu düşünüyorum.					
6. Matematik öğretmenimle, matematik gerektiren bir meslek (kariyer) hakkında konuşurum.					
7. Matematik öğretmenim benim matematikteki gelişmemle ilgilenir.					
8. Matematik öğretmenlerim, ileri matematiğin benim için zaman kaybı olduğunu düşünüyorlar.					
9. Matematik öğretmenimle konuşurken konuşma ciddi konulara geldiğinde dikkate alınmamış hissederim.					
10. Matematik öğretmenim, matematik alanında ilerlemem için gerekli yeteneğe sahip olduğumu hissettirir.					
11. Bir matematik öğretmeninin beni ciddiye almasını sağlamak genellikle sorun olmuştur.					
12. Eğer matematik öğretmenime fen ve matematik alanlarında bir meslek ile ilgilendiğimi söylemiş olsam ciddi olmadığımı düşünür.					

APPENDIX B

MATEMATİK BAŞARI TESTİ

1. $3-\cfrac{4}{3-\cfrac{4}{3+\cfrac{1}{2}}}$ işleminin sonucu nedir?

a) $\frac{11}{13}$ b) $\frac{9}{7}$ c) $\frac{13}{11}$ d) $\frac{4}{3}$ e) $\frac{9}{11}$

2. $\frac{3}{4}-\frac{1}{4}:\frac{1}{3}+\frac{1}{2}+\frac{1}{6}\cdot\frac{1}{2}$ işleminin sonucu nedir?

a) $\frac{1}{12}$ b) $\frac{1}{4}$ c) $\frac{5}{12}$ d) $\frac{7}{12}$ e) $\frac{1}{2}$

3. Bir yolcu gideceğin yolun önce $\frac{1}{5}$ ini, sonra kalanın yarısını yürüyor. Yolcu toplam 15 km yürüdüğüne göre, geriye kaç km yolu kalmıştır?

a) 3 b) 5 c) 6 d) 10 e) 15

4. A ve B iki küme olmak üzere s(A)=2s(B) dir. $A\cap B$' nin alt kümelerinin sayısı 32 ve $A\cup B$ nin sayısı 13 ise s(B\A) kaçtır?

a) 1 b) 2 c) 5 d) 6 e) 7

5. $\frac{\sqrt{1,69}+\sqrt{1,21}}{\sqrt{0,0001}+\sqrt[3]{0,008}}$ işleminin sonucu nedir?

a) 1 b) $\frac{13}{67}$ c) $\frac{21}{100}$ d) $\frac{72}{5}$ e) $\frac{80}{7}$

6. s(A)=2 ve s(B)=3 ise A’ dan B’ ye tanımlanan kaç tane bağıntı vardır?

a) 128 b) 64 c) 48 d) 32 e) 28

7. 4 basamaklı a45b sayısı 15 ile kalansız bölünebilmektedir. a’ nın alabileceği en küçük değer ile en büyük değerin toplamı kaçtır?

a) 8 b) 9 c) 10 d) 11 e)12

8. Bir sınıftaki öğrenciler 8’erli gruplara ayrıldığında 4 öğrenci, 9’lu gruplara ayrıldığında 5 öğrenci, 12’li gruplara ayrıldığında ise 8 öğrenci artıyor. Buna göre bu sınıftaki öğrenci sayısı en az kaçtır?

a) 68 b) 60 c) 54 d) 50 e) 45

9. g(x)=2x+5, f(x)=x+3 ve $(g^{-1}of)(a)=4$ ise a kaçtır?

a) 10 b) 7 c) $\frac{7}{2}$ d) $\frac{3}{2}$ e) 0

10. f: R→R olmak üzere, f(x)= x + f(x-1) ve f(1)=2 ise f(4) kaçtır?

a) 6 b)7 c) 8 d) 10 e)11

11. Tam sayılar kümesinde
$a\Delta b = a^b - 2$ ve $a\square b = b^2 - a^2$ işlemleri tanımlanıyor. Buna göre (2□1) Δ (1□2) işleminin sonucu kaçtır?

a) -29 b) -22 c) -14 d) -8 e) -6

12. Bugün Pazartesi ise 1000 gün sonra hangi gün olur?

a) Cuma

b) Cumartesi

c) Pazar

d)Pazartesi

e) Salı

13. $(13)^{25}$ sayısının 5 ile bölümünden kalan kaçtır?

a) 4 b) 3 c) 2 d) 1 e)0

14. f: R →R için

$f^{-1}(9x-1)=3x-1$ ise **f(x) nedir?**

a) 3x-2

b) 3x-1

c) 3x+2

d) 6x-1

e) 9x-1

15. İki basamaklı dört doğal sayının aritmetik ortalaması 18'dir.

Bu sayıların en büyüğü en fazla kaç olabilir?

a) 42 b) 40 c) 39 d) 37 e) 21

16. Bir sınıfta 64 öğrenci bulunmaktadır. Bunlardan bazıları İngilizce, bazıları Fransızca konuşabilmekte, bir kısmı da hiçbirini konuşamamaktadır. Sadece İngilizce ve sadece Fransızca bilen öğrencilerin sayıları birbirlerine eşittir. İngilizce ve Fransızca bilenlerin sayısı bu iki dili de bilmeyenlerin sayısının 2 katına, bütün sınıfın ise yarısına eşittir. Buna göre, **Fransızca bilenlerin sayısı kaçtır?**

a) 4 b) 8 c) 16 d) 32 e) 40

17. R'de Δ işlemi
aΔb =a+b+2 ile tanımlanıyor. Buna göre, 3'ün Δ işlemine göre tersi nedir?

a) $\frac{1}{3}$ b)-3 c)3 d)-7 e)7

18. $\frac{x}{4} = \frac{x+y}{16}$ ise $\frac{y-x}{y+x}$ oranı nedir?

a) 1 b) $\frac{1}{2}$ c) $-\frac{1}{2}$ d) $-\frac{3}{2}$ e) -2

19. $x < y < 0$ ise $|x| + |y| + |x - y| + |y - x|$ ifadesi aşağıdakilerden hangisine eşittir?

a) 0 b) x-3y c) x+y d) 3x-y e) y-3x

20. $3^{2x-4} = m$ ve $3^{x+4} = m^2$ ise **m kaçtır?**

a) -2 b) 2 c) 4 d) 5 e) -10

APPENDIX C

ITEM TOTAL STATISTICS FOR THE SCALES

Item-Total Statistics for BELIEF

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
belief6	38.8424	54.897	.484	.251	.781
belief12	38.5906	56.115	.419	.217	.788
belief7	37.6871	56.866	.474	.256	.784
belief9	39.1435	56.048	.348	.149	.796
belief2	38.5694	54.571	.498	.274	.780
belief5	38.2612	54.373	.510	.300	.779
belief1	38.4353	52.888	.571	.369	.772
belief4	38.5318	56.547	.405	.203	.789
belief11	38.4776	57.599	.312	.121	.798
belief3	37.9953	57.731	.411	.201	.789
belief10	38.6494	55.181	.419	.190	.788
belief8	38.2212	54.819	.503	.272	.780

Item-Total Statistics for BEL_TEAC

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
belt1	48.9012	46.547	.515	.318	.809
belt2	48.8753	45.944	.537	.349	.807
belt3	48.6494	45.016	.591	.384	.802
belt4	48.7341	46.389	.561	.353	.806
belt5	48.7224	46.206	.474	.295	.811
belt6	49.0706	46.500	.466	.242	.812
belt7	49.2894	46.848	.462	.235	.812
belt8	48.7953	47.130	.436	.225	.814
belt9	49.0824	46.283	.415	.212	.817
belt10	48.9365	46.442	.495	.343	.810
belt11	48.7882	47.691	.331	.129	.823
belt12	48.8824	47.222	.453	.259	.813
belt13	49.5553	46.738	.367	.163	.821

Item-Total Statistics for EFFICACY

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
eff_1	36.76	25.206	.609	.523	.762
eff_2	36.27	28.141	.517	.397	.779
eff_3	36.37	28.353	.300	.119	.796
eff_4	36.87	28.315	.261	.107	.802
eff_5	37.37	25.442	.450	.236	.782
eff_6	37.03	24.672	.649	.494	.756
eff_7	37.18	23.708	.544	.354	.770
eff_8	37.09	26.614	.494	.339	.776
eff_9	36.70	24.857	.588	.356	.763
eff_10	36.17	28.888	.349	.144	.791

Item-Total Statistics for ACTIVITY

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
act_1	29.20	31.165	.323	.257	.688
act_2	30.82	33.835	.219	.152	.701
act_3	29.02	30.626	.466	.267	.664
act_4	29.27	33.111	.187	.158	.711
act_5	29.15	28.525	.601	.554	.637
act_6	30.60	33.593	.157	.206	.716
act_7	29.46	30.507	.322	.184	.690
act_8	29.20	28.936	.551	.393	.646
act_9	29.00	29.427	.547	.519	.649
act_10	31.29	32.732	.318	.156	.687

Item-Total Statistics for TEAC_CEN

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
act_1	9.91	5.329	.437	.195	.462
act_2	11.54	6.686	.351	.136	.535
act_3	9.76	6.340	.366	.135	.522
act_4	9.99	5.917	.338	.118	.547

Item-Total Statistics for STUD_CEN

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
act_5	15.47	14.082	.620	.543	.624
act_6	16.91	16.426	.289	.132	.726
act_7	15.78	15.042	.363	.181	.710
act_8	15.52	14.295	.576	.355	.637
act_9	15.32	14.598	.582	.505	.638
act_10	17.61	17.274	.311	.125	.714

Item-Total Statistics for CLIMATE

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
cl_1	17.68	18.633	.433	.277	.760
cl_2	16.80	19.430	.524	.366	.736
cl_3	17.52	16.497	.668	.463	.692
cl_4	17.09	17.737	.580	.393	.719
cl_5	16.57	20.115	.347	.209	.778
cl_6	17.00	18.956	.571	.339	.725

Item-Total Statistics for MOT

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
mot1	43.44	29.988	.344	.195	.639
mot2	43.01	29.754	.363	.224	.636
mot3	42.69	30.367	.314	.169	.644
mot4	42.81	33.173	.074	.156	.677
mot5	42.92	31.865	.181	.100	.664
mot6	43.19	31.831	.109	.158	.682
mot7	43.12	30.252	.297	.210	.646
mot8	43.26	26.674	.576	.490	.594
mot9	43.16	28.870	.366	.219	.634
mot10	43.77	28.125	.464	.280	.617
mot11	42.69	33.135	.081	.061	.676
mot12	43.43	27.567	.455	.350	.616

Item-Total Statistics for ANXIETY

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
anx_1	37.82	97.848	.651	.552	.902
anx_2	37.40	96.524	.694	.615	.900
anx_3	37.96	96.729	.743	.671	.898
anx_4	38.44	95.300	.629	.750	.903
anx_5	37.52	100.259	.601	.423	.904
anx_6	37.51	97.251	.651	.465	.902
anx_7	37.44	98.319	.641	.601	.902
anx_8	37.67	103.178	.423	.340	.912
anx_9	37.90	98.569	.603	.441	.904
anx_10	38.24	95.335	.685	.779	.900
anx_11	38.01	95.717	.683	.573	.900
anx_12	37.56	96.318	.717	.598	.899

Item-Total Statistics for SP_TEAC

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
teac_1	38.90	61.551	.230	.185	.827
teac_2	38.45	57.495	.538	.482	.802
teac_3	38.45	54.509	.593	.501	.796
teac_4	39.25	56.104	.558	.472	.799
teac_5	38.49	59.956	.339	.253	.818
teac_6	39.51	55.682	.501	.333	.804
teac_7	38.15	60.450	.353	.173	.816
teac_8	38.94	55.962	.550	.434	.800
teac_9	38.76	58.328	.382	.305	.815
teac_10	38.13	57.515	.486	.391	.806
teac_11	38.37	57.698	.508	.363	.804
teac_12	38.61	54.664	.648	.616	.791

Item-Total Statistics for SP_FATH

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
father 1	41.35	51.778	.597	.858
father 2	41.24	51.081	.674	.853
father 3	41.37	50.662	.638	.855
father 4	41.41	48.631	.754	.846
father 5	41.30	50.886	.624	.856
father6	42.24	56.938	.074	.903
father 7	41.59	48.467	.671	.851
father 8	41.48	47.761	.722	.847
father 9	41.49	50.904	.607	.857
father10	41.73	47.698	.645	.853
father11	41.35	52.646	.552	.861

Item-Total Statistics for SP_MOTH

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
mother 1	41.67	35.333	.355	.785
mother2	41.69	34.929	.387	.782
mother 3	41.87	33.692	.406	.781
mother4	41.87	32.508	.568	.764
mother5	41.93	32.383	.478	.773
mother6	42.32	31.181	.521	.768
mother7	42.09	31.124	.580	.760
mother8	41.68	31.990	.592	.761
mother9	42.36	34.107	.241	.807
mother10	41.77	33.842	.467	.775
mother11	41.50	34.938	.428	.779

APPENDIX D

MODEL FIT CRITERIA AND ACCEPTABLE FIT INTERPRETATION

(Jöreskog & Sörbom, 1993; Schumacker & Lomax, 1996; Kelloway,1998)

Model fit criterion	*Acceptable level*	*Interpretation*
Chi-square	Tabled x^2 value	Compares obtained x^2 value with tabled value for given df
Goodness-of-fit (GFI)	0 (no fit) to 1 (perfect fit)	The values exceeding 0.9 indicates a good fit to the data.
Adjusted GFI	0 (no fit) to 1 (perfect fit)	The values exceeding 0.9 indicates a good fit to the data
Root-mean-suare residual (RMR)	Researcher defines level.	Value less than 0.05 indicates a good model fit
Standardized RMR (S-RMR)	<0.05	Value less than 0.05 indicates a good model fit.
Root-mean-suare error of approximation (RMSEA)	<0.05	Value less than 0.05 indicates a good model fit. Value up to 0.08 represent reasonable errors of approximation (Browne & Cudeck, 1993)
Normed fit index (NFI)	0 (no fit) to 1 (perfect fit)	Value close to 0.90 reflects a good model fit
Non-Normed Fit Index (NNFI)	>0.90	Value exceeding 0.90 indicates a good fit to the data.
Normed Chi-Square (NC)	1.0-5.0 χ^2 / df ratio	Less than 1.0 is a poor model fit; more than 5.0 reflects a need for improvement
Comparative Fit Index (CFI)	>0.90	Value exceeding 0.90 indicates a good fit to the data.
Incremental Fit Index (IFI)	0 (no fit) to 1 (perfect fit)	Value close to 1 indicates a better fit to the data
Relative Fit Index (RFI)	0 (no fit) to 1 (perfect fit)	Value close to 1 indicates a better fit to the data
Parsimonious Fit Index (PFI)	0 (no fit) to 1 (perfect fit)	Compares values in alternative values
Parsimonious Normed Fit Index (PNFI)	0 (no fit) to 1 (perfect fit)	Value close to 1 indicates a better fit to the data
Parsimonious Goodness-of-Fit Index (PGFI)	0 (no fit) to 1 (perfect fit)	Value close to 1 indicates a better fit to the data

APPENDIX E

SIMPLIS SYNTAXES FOR THE SCALES

BELIEF

BELIEF CFA

Observed variables
belief1 belief2 belief3 belief4 belief5 belief6 belief7 belief8 belief9 belief10
belief11 belief12
covariance matrix from file: belief.cov
sample size: 231

Latent variables
BELIEF

Relationships
belief1 belief2 belief3 belief4 belief5 belief6 belief7 belief8 belief9 belief10
belief11 belief12 = BELIEF
Set Error Covariance of belief5 and belief4 Free
Set Error Covariance of belief11 and belief1 Free
Path diagram
End of problem

BEL_TEAC

BELIEF TEACHING CFA
Observed variables
belT1 belT2 belT3 belT4 belT5 belT6 belT7 belT8 belT9 belT10 belT11 belT12
belT13
covariance matrix from file: belt.cov
sample size: 231
Latent variables
BEL_TEAC

Relationships
belT1 belT2 belT3 belT4 belT5 belT6 belT7 belT8 belT9 belT10 belT11 belT12
belT13= BEL_TEAC
Set Error Covariance of belT10 and belT4 Free
Set Error Covariance of belT12 and belT9 Free
Set Error Covariance of belT2 and belT1 Free
Set Error Covariance of belT10 and belT2 Free
Set Error Covariance of belT13 and belT2 Free
Set Error Covariance of belT13 and belT12 Free
Set Error Covariance of belT9 and belT3 Free
Path diagram
End of problem

EFFICACY

EFFICACY CFA

Observed Variables
eff_1 eff_2 eff_3 eff_4 eff_5 eff_6 eff_7 eff_8 eff_9 eff_10

Covariance Matrix From File: efficacy.cov
Sample Size: 231

Latent Variables
EFFICACY

Relationships
eff_1 eff_2 eff_3 eff_4 eff_5 eff_6 eff_7 eff_8 eff_9 eff_10 = EFFICACY

Set Error Covariance of eff_1 and eff_2 Free
Set Error Covariance of eff_1 and eff_7 Free
Set Error Covariance of eff_6 and eff_8 Free

Path Diagram
End of Problem

ACTIVITY

ACTIVITY CFA
Observed variables
act_1 act_2 act_3 act_4 act_5 act_6 act_7 act_8 act_9 act_10

covariance matrix from file: activity_2.cov
sample size: 231

Latent variables
TEAC_CEN STUD_CEN

Relationships
act_1 act_2 act_3 act_4 = TEAC_CEN
act_5 act_6 act_7 act_8 act_9 act_10= STUD_CEN

Set Error Covariance of act_1 and act_3 Free
Set Error Covariance of act_1 and act_6 Free
Set Error Covariance of act_4 and act_6 Free
Set Error Covariance of act_5 and act_9 Free
Set Error Covariance of act_6 and act_10 Free
Set Error Covariance of act_1 and act_3 Free
Set Error Covariance of act_4 and act_8 Free

Path diagram
End of problem

MOT

MOTIVATION CFA
Observed variables
mot1 mot2 mot3 mot4 mot5 mot6 mot7 mot8 mot9 mot10 mot11 mot12

covariance matrix from file: motivation.cov
sample size: 231

Latent variables
MOT

Relationships
mot1 mot2 mot3 mot4 mot5 mot6 mot7 mot8 mot9 mot10 mot11 mot12 = MOT

Set Error Covariance of mot1 and mot2 Free
Set Error Covariance of mot6 and mot4 Free
Set Error Covariance of mot8 and mot6 Free
Set Error Covariance of mot8 and mot7 Free
Set Error Covariance of mot5 and mot9 Free
Set Error Covariance of mot11 and mot3 Free
Set Error Covariance of mot11 and mot6 Free

Path diagram
End of problem

CLIMATE

CLIMATE CFA

Observed variables
cl_1 cl_2 cl_3 cl_4 cl_5 cl_6

covariance matrix from file: climate.cov
sample size: 231

Latent variables
CLIMATE

Relationships
cl_1 cl_2 cl_3 cl_4 cl_5 cl_6 = CLIMATE

Set Error Covariance of cl_1 and cl_2 Free
Set Error Covariance of cl_1 and cl_4 Free
Set Error Covariance of cl_2 and cl_5 Free

Path diagram
End of problem

ANXIETY

ANXIETY CFA
Observed variables
anx_1 anx_2 anx_3 anx_4 anx_5 anx_6 anx_7 anx_8 anx_9 anx_10 anx_11 anx_12
covariance matrix from file: anxiety.cov
sample size: 231

Latent variables
MAT_ANX TEST_ANX

Relationships
anx_1 anx_2 anx_3 anx_5 anx_6 anx_7 anx_8 anx_9 anx_12 = MAT_ANX
anx_4 anx_10 anx_11 = TEST_ANX

Set Error Covariance of anx_1 and anx_3 Free
Set Error Covariance of anx_2 and anx_7 Free
Set Error Covariance of anx_3 and anx_7 Free
Set Error Covariance of anx_3 and anx_8 Free
Set Error Covariance of anx_4 and anx_10 Free
Set Error Covariance of anx_5 and anx_10 Free
Set Error Covariance of anx_6 and anx_10 Free
Set Error Covariance of anx_9 and anx_11 Free
Set Error Covariance of anx_11 and anx_12 Free

Path diagram
End of problem

SP_MOTH

SP_MOTH CFA
Observed variables
mother1 mother2 mother3 mother4 mother5 mother6 mother7 mother8 mother9
mother10 mother11

covariance matrix from file: mother.cov
sample size: 200

Latent variables
SP_MOTH

Relationships
mother1 mother2 mother3 mother4 mother5 mother6 mother7 mother8 mother9
mother10 mother11 = SP_MOTH

Set Error Covariance of mother1 and mother2 Free
Set Error Covariance of mother1 and mother5 Free
Set Error Covariance of mother2 and mother5 Free

Set Error Covariance of mother11 and mother3 Free
Set Error Covariance of mother4 and mother7 Free
Set Error Covariance of mother4 and mother10 Free
Set Error Covariance of mother6 and mother8 Free
Set Error Covariance of mother6 and mother10 Free

Path diagram
End of problem

SP_FATH

SP_FATH CFA
Observed variables
father1 father2 father3 father4 father5 father6 father7 father8 father9 father10 father11
covariance matrix from file: father.cov
sample size: 200

Latent variables
SP_FATH

Relationships
father1 father2 father3 father4 father5 father6 father6 father7 father9 father10 father11= SP_FATH

Set Error Covariance of father1 and father3 Free
Set Error Covariance of father1 and father11 Free
Set Error Covariance of father2 and father3 Free
Set Error Covariance of father2 and father8 Free
Set Error Covariance of father2 and father11 Free
Set Error Covariance of father2 and father1 Free
Set Error Covariance of father3 and father7 Free
Set Error Covariance of father4 and father5 Free
Set Error Covariance of father4 and father7 Free
Set Error Covariance of father5 and father8 Free
Set Error Covariance of father9 and father8 Free

Path diagram
End of problem

SP_TEAC

SP_TEAC CFA
Observed variables
teac_1 teac_2 teac_3 teac_4 teac_5 teac_6 teac_7 teac_8 teac_9 teac_10 teac_11 teac_12

covariance matrix from file: teacher.cov
sample size: 200

Latent variables
SP_TEAC

Relationships
teac_1 teac_2 teac_3 teac_4 teac_5 teac_6 teac_7 teac_8 teac_9 teac_10 teac_11 teac_12 = SP_TEAC

Set Error Covariance of teac_1 and teac_4 Free
Set Error Covariance of teac_1 and teac_11 Free
Set Error Covariance of teac_2 and teac_12 Free
Set Error Covariance of teac_3 and teac_5 Free
Set Error Covariance of teac_3 and teac_7 Free
Set Error Covariance of teac_3 and teac_11 Free
Set Error Covariance of teac_4 and teac_10 Free
Set Error Covariance of teac_4 and teac_12 Free
Set Error Covariance of teac_4 and teac_11 Free
Set Error Covariance of teac_5 and teac_9 Free
Set Error Covariance of teac_5 and teac_10 Free
Set Error Covariance of teac_9 and teac_11 Free
Set Error Covariance of teac_10 and teac_11 Free

Path diagram
End of problem

APPENDIX F
TABLE OF SPECIFICATION FOR MATHEMATICS ACHIEVEMENT TEST

Level Contents	Comprehension	Application
Sets	4, 6	16
Functions	10,14	9
Operation	11	17
Rational numbers	2, 1	3
Divisibility		8, 7
Modular arithmetic		12, 13
Absolute value		19
Exponential numbers		20
Root numbers	5	
Ratio-proportion		15
Equations	18	

APPENDIX G

ITEM ANALYSIS FOR MATHEMATICS ACHIEVEMENT TEST

Seq. No.	Item Statistics: Prop. Correct	Biser.	Point Biser.	Alternative Statistics: Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
1	0.920	1.000	0.561	1	0.920	1.000	0.561	*
				2	0.025	-0.976	-0.365	
				3	0.020	-0.617	-0.213	
				4	0.015	-0.904	-0.281	
				5	0.010	-0.434	-0.116	
				Other	0.010	-0.729	-0.195	
2	0.910	1.000	0.580	1	0.030	-0.857	-0.342	
				2	0.015	-0.577	-0.180	
				3	0.040	-0.850	-0.374	
				4	0.910	1.000	0.580	*
				5	0.005	-0.867	-0.178	
				Other	0.000	-9.000	-9.000	
3	0.780	0.540	0.386	1	0.015	-0.577	-0.180	
				2	0.015	-0.755	-0.235	
				3	0.075	-0.231	-0.124	
				4	0.780	0.540	0.386	*
				5	0.085	-0.342	-0.191	
				Other	0.030	-0.345	-0.137	
4	0.555	0.719	0.571	1	0.555	0.719	0.571	*
				2	0.050	-0.342	-0.162	
				3	0.055	-0.390	-0.190	
				4	0.095	-0.337	-0.194	
				5	0.150	-0.257	-0.168	
				Other	0.095	-0.523	-0.302	
5	0.750	0.775	0.569	1	0.035	-0.276	-0.116	
				2	0.025	-0.956	-0.358	
				3	0.045	-0.169	-0.077	
				4	0.030	-0.460	-0.184	
				5	0.750	0.775	0.569	*
				Other	0.115	-0.627	-0.382	
6	0.585	0.625	0.495	1	0.045	-0.122	-0.056	
				2	0.585	0.625	0.495	*
				3	0.055	-0.299	-0.146	
				4	0.205	-0.343	-0.242	
				5	0.005	-0.633	-0.130	
				Other	0.105	-0.507	-0.301	
7	0.645	0.471	0.367	1	0.095	-0.657	-0.378	
				2	0.155	0.008	0.005	
				3	0.645	0.471	0.367	*
				4	0.020	-0.408	-0.141	
				5	0.060	0.003	0.002	
				Other	0.025	-0.803	-0.300	

Seq. No.	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
	Item Statistics			Alternative Statistics				
8	0.735	0.719	0.534	1	0.735	0.719	0.534	*
				2	0.060	-0.252	-0.126	
				3	0.030	-0.526	-0.210	
				4	0.060	-0.441	-0.221	
				5	0.020	-0.478	-0.165	
				Other	0.095	-0.557	-0.321	
9	0.605	0.672	0.529	1	0.605	0.672	0.529	*
				2	0.105	-0.055	-0.033	
				3	0.065	-0.451	-0.232	
				4	0.050	-0.190	-0.090	
				5	0.060	-0.648	-0.325	
				Other	0.115	-0.488	-0.297	
10	0.575	0.801	0.635	1	0.045	-0.205	-0.094	
				2	0.080	-0.539	-0.295	
				3	0.060	-0.582	-0.292	
				4	0.075	-0.255	-0.137	
				5	0.575	0.801	0.635	*
				Other	0.165	-0.438	-0.293	
11	0.825	0.955	0.648	1	0.825	0.955	0.648	*
				2	0.005	-0.789	-0.162	
				3	0.030	-0.890	-0.355	
				4	0.030	-0.477	-0.190	
				5	0.020	-0.617	-0.213	
				Other	0.090	-0.689	-0.391	
12	0.730	0.482	0.359	1	0.055	-0.309	-0.151	
				2	0.120	-0.165	-0.102	
				3	0.730	0.482	0.359	*
				4	0.050	-0.430	-0.203	
				5	0.025	-0.437	-0.164	
				Other	0.020	-0.454	-0.157	
13	0.690	0.452	0.345	1	0.050	-0.179	-0.085	
				2	0.690	0.452	0.345	*
				3	0.030	-0.708	-0.282	
				4	0.070	-0.125	-0.066	
				5	0.080	-0.259	-0.142	
				Other	0.080	-0.251	-0.138	
14	0.465	0.583	0.465	1	0.060	-0.101	-0.051	
				2	0.145	-0.178	-0.115	
				3	0.465	0.583	0.465	*
				4	0.080	-0.199	-0.109	
				5	0.105	-0.031	-0.018	
				Other	0.145	-0.632	-0.409	

	Item Statistics			Alternative Statistics				
Seq. No.	Prop. Correct	Biser.	Point Biser.	Alt.	Prop. Endorsing	Biser.	Point Biser.	Key
15	0.570	0.564	0.448	1	0.570	0.564	0.448	*
				2	0.025	-0.572	-0.214	
				3	0.220	-0.054	-0.038	
				4	0.035	-0.786	-0.330	
				5	0.075	-0.358	-0.193	
				Other	0.075	-0.430	-0.231	
16	0.295	0.566	0.429	1	0.030	0.036	0.014	
				2	0.250	-0.053	-0.039	
				3	0.185	-0.334	-0.229	
				4	0.135	-0.211	-0.134	
				5	0.295	0.566	0.429	*
				Other	0.105	-0.253	-0.150	
17	0.555	0.628	0.499	1	0.060	-0.667	-0.335	
				2	0.100	-0.396	-0.232	
				3	0.120	-0.002	-0.001	
				4	0.555	0.628	0.499	*
				5	0.025	-0.321	-0.120	
				Other	0.140	-0.358	-0.230	
18	0.835	0.909	0.608	1	0.045	-0.596	-0.273	
				2	0.835	0.909	0.608	*
				3	0.035	-0.669	-0.281	
				4	0.020	-0.733	-0.254	
				5	0.005	-0.711	-0.146	
				Other	0.060	-0.601	-0.302	
19	0.545	0.643	0.512	1	0.025	-0.302	-0.113	
				2	0.045	-0.110	-0.050	
				3	0.220	-0.206	-0.147	
				4	0.070	-0.435	-0.229	
				5	0.545	0.643	0.512	*
				Other	0.095	-0.637	-0.367	
20	0.570	0.682	0.541	1	0.075	-0.541	-0.291	
				2	0.080	-0.236	-0.130	
				3	0.570	0.682	0.541	*
				4	0.030	-0.345	-0.137	
				5	0.060	-0.120	-0.060	
				Other	0.185	-0.443	-0.305	

N of Items	20
N of Examinees	200
Mean	13.140
Variance	19.760
Std. Dev.	4.445
Skew	-0.780
Kurtosis	-0.152
Minimum	0.000
Maximum	20.000
Median	14.000
Alpha	0.837

APPENDIX H

MATH SCORES OF ANATOLIAN, GENERAL AND VOCATIONAL HIGH SCHOOL STUDENTS

High schools (number of students)	**Anatolian** (960)		**General** (1230)		**Vocational** (910)	
Score / **Math items**	**1 (%)**	**0 (%)**	**1(%)**	**0 (%)**	**1(%)**	**0 (%)**
Mat1	945 (98.2)	9 (0.9)	969 (78.8)	223 (18.1)	564 (62.0)	322 (35.4)
Mat2	933 (97.2)	27 (2.8)	928 (75.4)	270 (22.0)	528 (58.0)	363 (39.9)
Mat3	876 (91.3)	72 (7.5)	513 (41.7)	641 (52.1)	285 (31.3)	584 (64.2)
Mat4	724 (75.4)	190 (19.8)	274 (22.3)	760 (61.8)	104 (11.4)	685 (75.3)
Mat5	808 (84.2)	103 (10.7)	339 (27.6)	671 (54.6)	164 (18.0)	602 (66.2)
Mat6	731 (76.1)	187 (19.5)	560 (45.5)	521 (42.4)	288 (31.6)	524 (57.6)
Mat7	686 (71.5)	257 (26.8)	402 (32.7)	731 (59.7)	228 (25.1)	598 (65.7)
Mat8	831 (86.6)	95 (9.9)	550 (44.7)	551 (44.8)	286 (31.4)	545 (59.9)
Mat9	746 (77.7)	160 (16.7)	387 (31.5)	642 (52.2)	155 (17.0)	608 (66.8)
Mat10	737 (76.8)	172 (17.9)	248 (20.2)	760 (61.8)	98 (10.8)	660 (72.5)
Mat11	892 (92.9)	49 (5.1)	641 (52.1)	440 (35.8)	236 (25.9)	538 (59.1)
Mat12	808 (84.2)	140 (14.6)	758 (61.6)	435 (35.4)	400 (44.0)	486 (53.4)
Mat13	734 (76.5)	184 (19.2)	639 (52.0)	486 (39.5)	273 (30.0)	561 (61.6)
Mat14	651 (67.8)	249 (25.9)	274 (22.3)	768 (62.4)	198 (21.8)	594 (61.3)
Mat15	656 (68.3)	261 (27.2)	351 (28.5)	684 (55.6)	167 (18.4)	619 (68.0)
Mat16	498 (51.9)	415 (43.2)	151 (12.3)	898 (73.0)	53 (5.8)	791 (86.9)
Mat17	690 (71.9)	211 (22.0)	329 (26.7)	722 (58.7)	141 (15.5)	627 (68.9)
Mat18	861 (89.7)	76 (7.9)	555 (45.1)	541 (44.0)	191 (21.0)	586 (64.4)
Mat19	628 (68.4)	287 (29.9)	210 (17.1)	826 (67.2)	91 (10.0)	698 (76.7)
Mat20	770 (80.2)	121 (12.6)	288 (23.4)	676 (55.0)	210 (23.1)	550 (60.4)

APPENDIX I

TOTAL VARIANCES AND FACTOR LOADINGS OF EACH SCALES IN THE PRESENT STUDY

Total Variance Explained for BELIEF

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.782	31.518	31.518	3.782	31.518	31.518
2	1.323	11.021	42.539			
3	1.179	9.825	52.364			
4	.801	6.672	59.036			
5	.790	6.581	65.617			
6	.710	5.914	71.531			
7	.663	5.523	77.054			
8	.607	5.056	82.110			
9	.588	4.898	87.008			
10	.579	4.824	91.832			
11	.551	4.592	96.424			
12	.429	3.576	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of BELIEF

	Component
	1
belief1	0.731
belief2	0.672
belief12	0.652
belief3	0.642
belief8	0.611
belief7	0.593
belief5	0.520
belief6	0.505
belief10	0.499
belief9	0.476
belief4	0.367
belief11	0.316

Extraction Method: Principal Component Analysis.
1 components extracted.

Total Variance Explained for BEL_TEAC

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.756	36.586	36.586	4.756	36.586	36.586
2	.966	7.434	44.021			
3	.840	6.462	50.483			
4	.809	6.221	56.703			
5	.766	5.896	62.599			
6	.727	5.592	68.191			
7	.673	5.177	73.368			
8	.669	5.144	78.512			
9	.616	4.740	83.252			
10	.595	4.573	87.825			
11	.544	4.187	92.012			
12	.539	4.148	96.160			
13	.499	3.840	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of BEL_TEAC

	Component
	1
belT10	0.675
belT4	0.672
belT6	0.652
belT7	0.638
belT2	0.636
belT3	0.632
belT12	0.618
belT8	0.606
belT5	0.587
belT9	0.580
belT1	0.550
belT13	0.496
belT11	0.484

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for EFFICACY

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.818	38.184	38.184	3.818	38.184	38.184
2	1.322	13.220	51.404			
3	.848	8.478	59.881			
4	.749	7.485	67.366			
5	.651	6.508	73.875			
6	.605	6.052	79.927			
7	.566	5.662	85.588			
8	.492	4.925	90.513			
9	.483	4.829	95.342			
10	.466	4.658	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of EFFICACY

	Component
	1
eff_9	0.686
eff_7	0.668
eff_6	0.667
eff_1	0.661
eff_2	0.639
eff_3	0.622
eff_10	0.592
eff_8	0.580
eff_5	0.561
eff_4	0.470

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for MOT

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.398	28.320	28.320	3.398	28.320	28.320
2	1.656	13.798	42.118			
3	1.352	11.264	53.382			
4	.821	6.842	60.225			
5	.708	5.898	66.123			
6	.689	5.745	71.868			
7	.636	5.301	77.168			
8	.615	5.122	82.290			
9	.595	4.962	87.252			
10	.574	4.780	92.032			
11	.507	4.224	96.256			
12	.449	3.744	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the MOT Items

	Component
	1
mot8	0.695
mot2	0.610
mot9	0.604
mot3	0.598
mot7	0.571
mot12	0.561
mot10	0.545
mot1	0.522
mot11	0.434
mot5	0.400
mot4	0.368
mot6	0.357

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for CLIMATE

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.188	36.459	36.459	2.188	36.459	36.459
2	1.228	20.460	56.919			
3	.844	14.058	70.977			
4	.706	11.763	82.740			
5	.562	9.366	92.106			
6	.474	7.894	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of CLIMATE

	Component
	1
cl_3	0.706
cl_6	0.701
cl_4	0.634
cl_2	0.567
cl_1	0.516
cl_5	0.457

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for SP_MOTH

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.018	36.524	36.524	4.018	36.524	36.524
2	1.387	12.611	49.135			
3	1.059	9.624	58.759			
4	.834	7.577	66.337			
5	.749	6.809	73.145			
6	.599	5.446	78.591			
7	.562	5.113	83.704			
8	.525	4.770	88.474			
9	.483	4.387	92.861			
10	.418	3.804	96.665			
11	.367	3.335	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of SP_MOTH

	Component
	1
mother10	0.693
mother2	0.687
mother5	0.666
mother4	0.631
mother11	0.626
mother6	0.598
mother7	0.597
mother1	0.589
mother3	0.558
mother8	0.514
mother9	0.443

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for SP_FATH

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.186	38.052	38.052	4.186	38.052	38.052
2	1.424	12.943	50.995			
3	.827	7.516	58.511			
4	.797	7.245	65.756			
5	.685	6.226	71.982			
6	.638	5.799	77.782			
7	.572	5.197	82.979			
8	.516	4.689	87.668			
9	.499	4.540	92.208			
10	.467	4.245	96.452			
11	.390	3.548	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of SP_FATH

	Component
	1
father11	0.701
father4	0.699
father7	0.677
father10	0.655
father5	0.638
father1	0.592
father3	0.588
father9	0.571
father6	0.563
father8	0.543
father2	0.525

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for SP_TEAC

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.351	27.924	27.924	3.351	27.924	27.924
2	2.446	20.379	48.304			
3	.884	7.369	55.672			
4	.780	6.503	62.175			
5	.719	5.993	68.168			
6	.663	5.524	73.692			
7	.645	5.377	79.068			
8	.566	4.713	83.781			
9	.534	4.446	88.227			
10	.513	4.275	92.502			
11	.491	4.088	96.590			
12	.409	3.410	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of SP_TEAC

	Component
	1
teac_10	0.695
teac_7	0.689
teac_2	0.661
teac_11	0.581
teac_4	0.549
teac_12	0.538
teac_9	0.498
teac_6	0.427
teac_5	0.420
teac_8	0.400
teac_1	0.380
teac_3	0.342

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for MAT_ANX

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.996	44.400	44.400	3.996	44.400	44.400
2	1.130	12.559	56.959			
3	.765	8.504	65.463			
4	.652	7.249	72.712			
5	.600	6.664	79.377			
6	.567	6.294	85.671			
7	.464	5.154	90.825			
8	.451	5.009	95.835			
9	.375	4.165	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of MAT_ANX

	Component
	1
anx_2	0.747
anx_12	0.745
anx_7	0.707
anx_1	0.707
anx_3	0.678
anx_6	0.670
anx_9	0.594
anx_5	0.562
anx_8	0.552

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for TEAC_CEN

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.724	43.102	43.102	1.724	43.102	43.102
2	.973	24.321	67.423			
3	.736	18.391	85.815			
4	.567	14.185	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of TEAC_CEN

	Component
	1
act_1	0.740
act_3	0.716
act_4	0.586
act_2	0.566

Extraction Method: Principal Component Analysis.
a 1 components extracted.

Total Variance Explained for STUD_CEN

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.313	38.549	38.549	2.313	38.549	38.549
2	1.137	18.947	57.496			
3	.842	14.026	71.522			
4	.656	10.941	82.463			
5	.598	9.964	92.427			
6	.454	7.573	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of STUD_CEN

	Component
	1
act_9	0.767
act_5	0.701
act_8	0.699
act_6	0.568
act_7	0.489
act_10	0.428

Extraction Method: Principal Component Analysis.

Total Variance Explained for SES

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.408	60.201	60.201	2.408	60.201	60.201
2	.795	19.880	80.081			
3	.485	12.129	92.210			
4	.312	7.790	100.000			

Extraction Method: Principal Component Analysis.

Factor Loadings of the Items of SES

	Component
	1
Mather Education	0.865
Father Education	0.854
Family Income	0.785
Number of Sibling	-0.561

Extraction Method: Principal Component Analysis.
a 1 components extracted.

APPENDIX J
THE NAME OF THE SCHOOLS PARTICIPATED IN THE PRESENT STUDY

SCHOOL TYPE	SCHOOL NAME
Anatolian	• Mehmet Emin Resulzade Anatolian High School • Çankaya Anatolian High School • Bahçelievler Anatolian High School • Yavuz Sultan Selim Anatolian High School • Cumhuriyet Anatolian High School • Atatürk Anatolian High School • Yıldırım Beyazıt Anatolian High School • Hacı Ömer Tarman Anatolian High School • Hasan Ali Yücel Anatolian High School
General	• Çankaya High School • Ayrancı High School • 50. Yıl High School • Necla Kızılbağ High School • Abidinpaşa High School • Dikmen High School • Mimar Kemal High School
Vocational	• Abidinpaşa Vocational High School • Cebeci Vocational High School • 100. Yıl Vocational High School • Aliye Yahşi Vocational High School • Güzel Sanatlar Vocational High School • Balgat Vocational High School

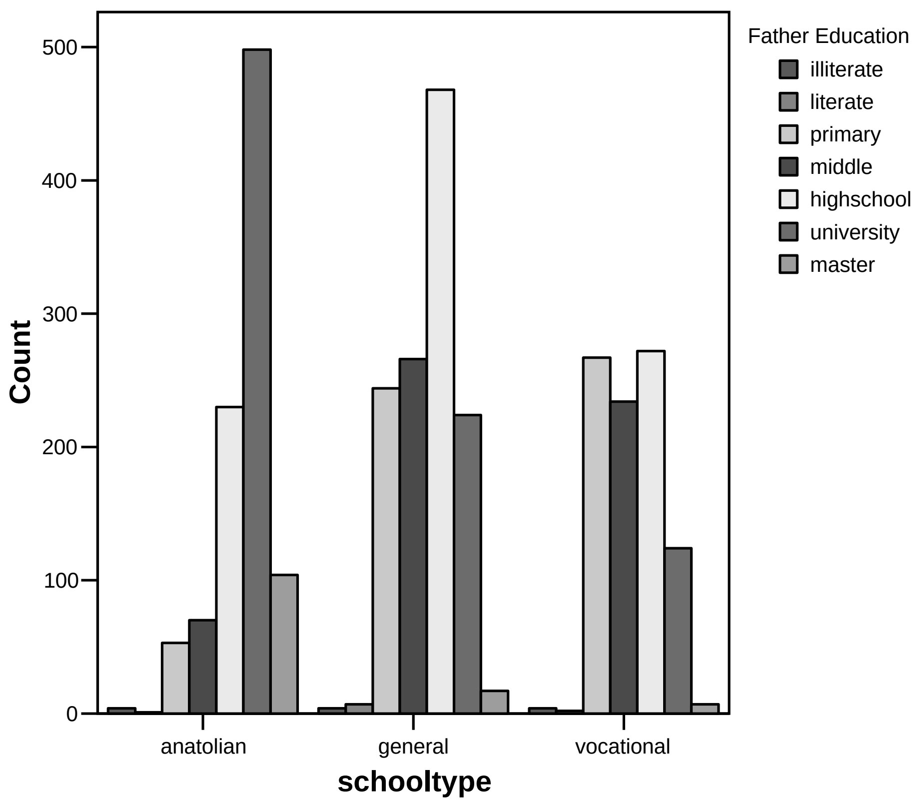
APPENDIX K

CROSSTABULATION BETWEEN SCHOOL TYPE AND SES VARIABLES

Father Education * schooltype Crosstabulation

		schooltype			Total
		anatolian	general	vocational	
Father Education	illiterate	4	4	4	12
	literate	1	7	2	10
	primary	53	244	267	564
	middle	70	266	234	570
	highschool	230	468	272	970
	university	498	224	124	846
	master	104	17	7	128
Total		960	1230	910	3100

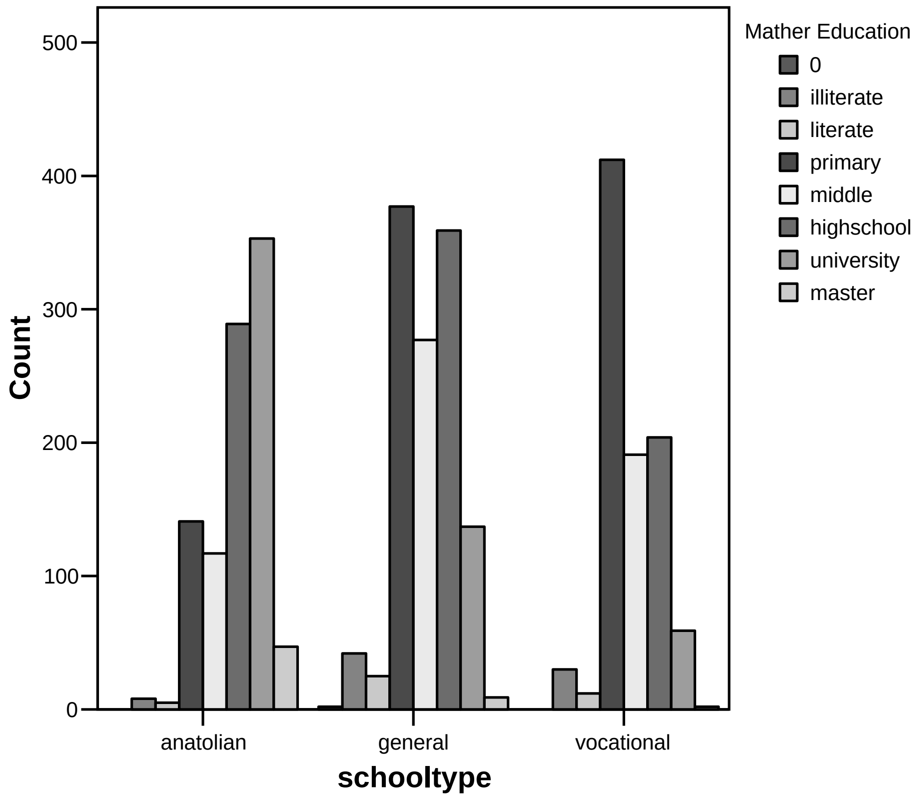
Bar Chart



Mather Education * schooltype Crosstabulation

		schooltype			Total
		anatolian	general	vocational	
Mather Education	illiterate	8	42	30	80
	literate	5	25	12	42
	primary	141	377	412	930
	middle	117	277	191	585
	highschool	289	359	204	852
	university	353	137	59	549
	master	47	9	2	58
Total		960	1228	910	3098

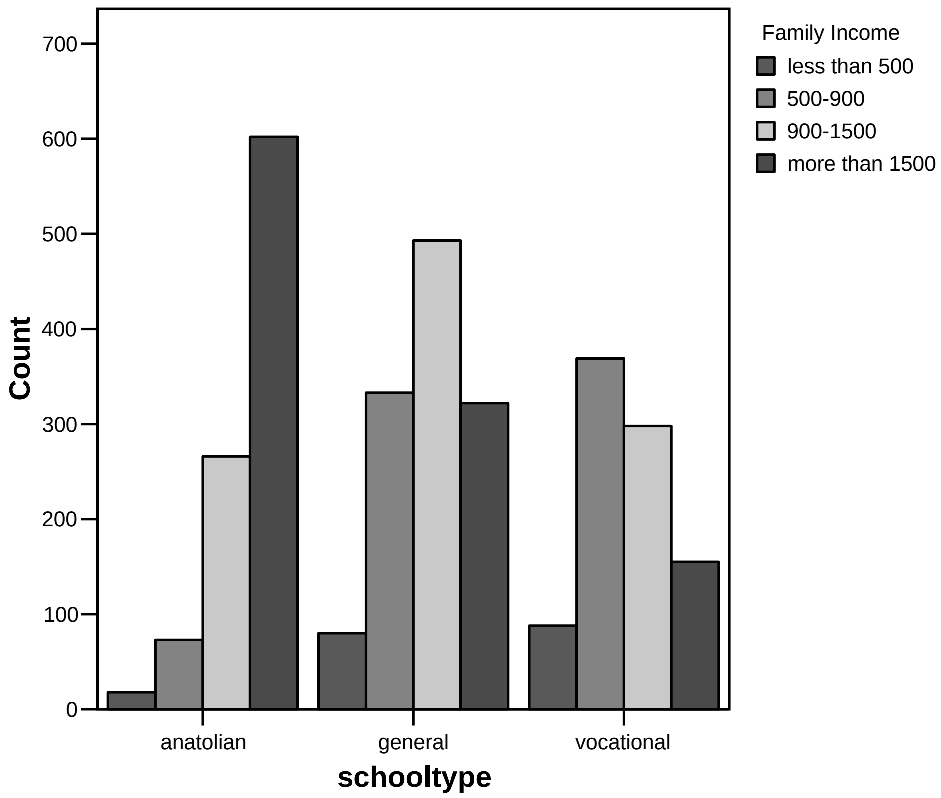
Bar Chart



schooltype * Family Income Crosstabulation

		Family Income				Total
		less than 500	500-900	900-1500	more than 1500	
schooltype	anatolian	18	73	266	602	959
	general	80	333	493	322	1228
	vocational	88	369	298	155	910
Total		186	775	1057	1079	3097

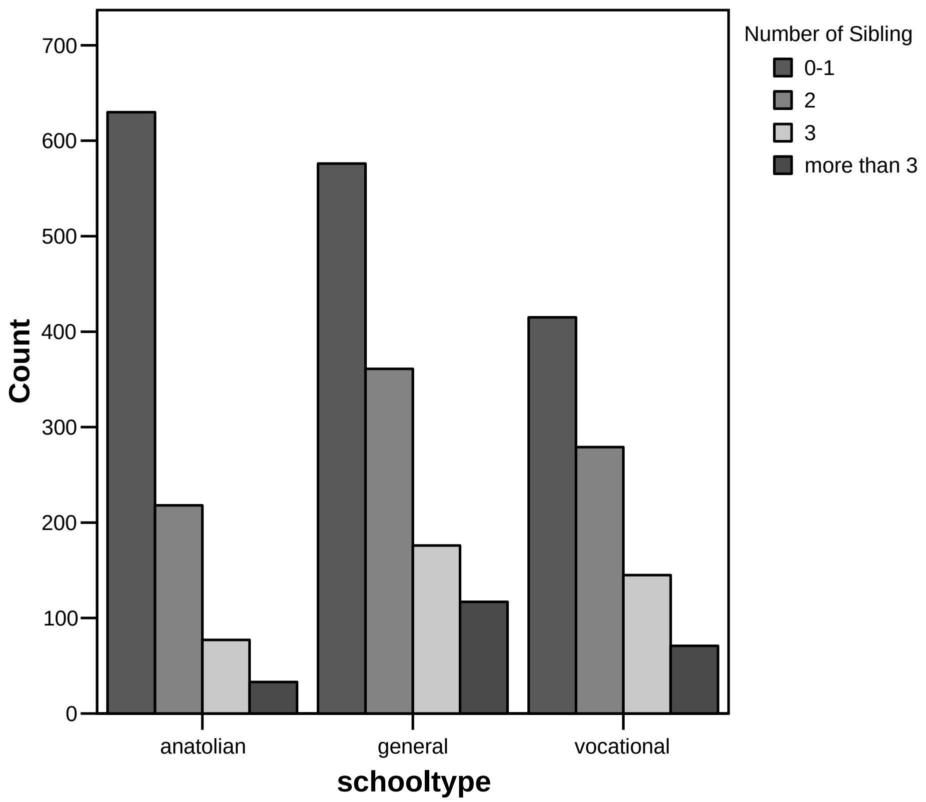
Bar Chart



schooltype * Number of Sibling Crosstabulation

		Number of Sibling				Total
		0-1	2	3	more than 3	
schooltype	anatolian	630	218	77	33	958
	general	576	361	176	117	1230
	vocational	415	279	145	71	910
Total		1621	858	398	221	3098

Bar Chart



APPENDIX L
SIMPLIS SYNTAXES FOR THE FACTORS AFFECTING MATHEMATICS ACHIEVEMENT

THE MAIN STUDY

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FACTORS AFFECTING MATHEMATICS ACHIEVEMENT
Observed variables
ID GENDER SCHOOLTY GPA FAT_EDUC MOT_EDUC FOC MOC INCOME
SIBLING BELIEF1 BELIEF2 BELIEF3 BELIEF4 BELIEF5 BELIEF6
BELIEF7 BELIEF8 BELIEF9 BELIEF10 BELIEF11 BELIEF12 BELT1 BELT2
BELT3 BELT4 BELT5 BELT6 BELT7 BELT8 BELT9 BELT10
BELT11 BELT12 BELT13 EFF_1 EFF_2 EFF_3 EFF_4 EFF_5
EFF_6 EFF_7 EFF_8 EFF_9 EFF_10 MOT1 MOT2 MOT3 MOT4 MOT5 MOT6
MOT7 MOT8 MOT9 MOT10 MOT11
MOT12 ACT_1 ACT_2 ACT_3 ACT_4 ACT_5 ACT_6 ACT_7
ACT_8 ACT_9 ACT_10 CL_1 CL_2 CL_3 CL_4 CL_5
CL_6 ANX_1 ANX_2 ANX_3 ANX_4 ANX_5 ANX_6 ANX_7 ANX_8 ANX_9
ANX_10 ANX_11 ANX_12 TEAC_1 TEAC_2 TEAC_3
TEAC_4 TEAC_5 TEAC_6 TEAC_7 TEAC_8 TEAC_9 TEAC_10 TEAC_11
TEAC_12 FATHER1 FATHER2 FATHER3 FATHER4 FATHER5 FATHER6
FATHER7
FATHER8 FATHER9 FATHER10 FATHER11 MOTHER1 MOTHER2
MOTHER3 MOTHER4
MOTHER5 MOTHER6 MOTHER7 MOTHER8 MOTHER9 MOTHER10
MOTHER11 MAT1 MAT2
MAT3 MAT4 MAT5 MAT6 MAT7 MAT8 MAT9
MAT10 MAT11 MAT12 MAT13 MAT14 MAT15 MAT16 MAT17 MAT18
MAT19 MAT20 TOTALMAT

covariance matrix from file: sem.cov
sample size: 3100

Latent variables
SES BELIEF BEL_TEAC EFFICACY MOT TEAC_CEN STUD_CEN CLIMATE
MAT_ANX SP_TEAC  SP_FATH SP_MOTH  MAT_ACH

Relationships
FAT_EDUC MOT_EDUC INCOME SIBLING = SES
CL_3 CL_6 CL_4 = CLIMATE
TEAC_10 TEAC_7 TEAC_2 = SP_TEAC
ACT_1 ACT_3 ACT_4 = TEAC_CEN
ACT_9 ACT_5 ACT_8 = STUD_CEN
```

FATHER11 FATHER4 FATHER7= SP_FATH
MOTHER10 MOTHER2 MOTHER5 = SP_MOTH
BELIEF1 BELIEF2 BELIEF12 = BELIEF
BELT10 BELT4 BELT6 = BEL_TEAC
EFF_9 EFF_7 EFF_6 = EFFICACY
MOT8 MOT2 MOT9 = MOT
ANX_1 ANX_2 ANX_3 = MAT_ANX

MAT11 MAT18 MAT5 MAT4 MAT10 = MAT_ACH

BELIEF = SP_TEAC STUD_CEN SP_FATH
BEL_TEAC= SP_FATH SP_MOTH BELIEF STUD_CEN
EFFICACY= CLIMATE SP_TEAC TEAC_CEN SP_MOTH SP_FATH
MOT = CLIMATE BELIEF STUD_CEN EFFICACY
MAT_ANX = BELIEF SP_TEAC SP_MOTH EFFICACY
MAT_ACH = SES MOT BEL_TEAC TEAC_CEN CLIMATE MAT_ANX
EFFICACY SP_TEAC

Set Error Covariance of CL_6 and STUD_CEN Free
Set Error Covariance of ANX_1 and ANX_3 Free

LISREL output: EF SC
Path diagram
End of problem

ANATOLIAN HIGH SCHOOL

FACTORS AFFECTING MATHEMATICS ACHIEVEMENT
Observed variables
ID GENDER SCHOOLTY GPA FAT_EDUC MOT_EDUC FOC MOC INCOME
SIBLING BELIEF1 BELIEF2 BELIEF3 BELIEF4 BELIEF5 BELIEF6 BELIEF7
BELIEF8 BELIEF9 BELIEF10 BELIEF11 BELIEF12 BELT1 BELT2 BELT3
BELT4 BELT5 BELT6 BELT7 BELT8 BELT9 BELT10
BELT11 BELT12 BELT13 EFF_1 EFF_2 EFF_3 EFF_4 EFF_5
EFF_6 EFF_7 EFF_8 EFF_9 EFF_10 MOT1 MOT2 MOT3 MOT4 MOT5
MOT6 MOT7 MOT8 MOT9 MOT10 MOT11
MOT12 ACT_1 ACT_2 ACT_3 ACT_4 ACT_5 ACT_6 ACT_7
ACT_8 ACT_9 ACT_10 CL_1 CL_2 CL_3 CL_4 CL_5
CL_6 ANX_1 ANX_2 ANX_3 ANX_4 ANX_5 ANX_6 ANX_7 ANX_8 ANX_9
ANX_10 ANX_11
ANX_12 TEAC_1 TEAC_2 TEAC_3 TEAC_4 TEAC_5 TEAC_6 TEAC_7
TEAC_8 TEAC_9 TEAC_10 TEAC_11
TEAC_12 FATHER1 FATHER2 FATHER3 FATHER4 FATHER5 FATHER6
FATHER7
FATHER8 FATHER9 FATHER10 FATHER11 MOTHER1 MOTHER2
MOTHER3 MOTHER4
MOTHER5 MOTHER6 MOTHER7 MOTHER8 MOTHER9 MOTHER10
MOTHER11 MAT1 MAT2
MAT3 MAT4 MAT5 MAT6 MAT7 MAT8 MAT9
MAT10 MAT11 MAT12 MAT13 MAT14 MAT15 MAT16 MAT17 MAT18
MAT19 MAT20

covariance matrix from file: anatolian.cov
sample size: 960

Latent variables
BELIEF BEL_TEAC EFFICACY MOT TEAC_CEN STUD_CEN CLIMATE
MAT_ANX SP_TEAC SP_FATH SP_MOTH MAT_ACH

Relationships
CL_3 CL_6 CL_4 = CLIMATE
TEAC_10 TEAC_7 TEAC_2 = SP_TEAC
ACT_1 ACT_3 ACT_4 = TEAC_CEN
ACT_9 ACT_5 ACT_8 = STUD_CEN
FATHER11 FATHER4 FATHER7 = SP_FATH
MOTHER10 MOTHER2 MOTHER5 = SP_MOTH
BELIEF1 BELIEF2 BELIEF12 = BELIEF
BELT10 BELT4 BELT6 = BEL_TEAC
EFF_9 EFF_7 EFF_6 = EFFICACY
MOT8 MOT2 MOT9 = MOT
ANX_1 ANX_2 ANX_3 = MAT_ANX

MAT18 MAT5 MAT4 MAT10 = MAT_ACH

BELIEF = SP_TEAC STUD_CEN SP_FATH
BEL_TEAC= SP_FATH SP_MOTH BELIEF
EFFICACY= SP_TEAC SP_MOTH SP_FATH
MOT = CLIMATE BELIEF EFFICACY
MAT_ANX = BELIEF SP_MOTH EFFICACY
MAT_ACH = MOT TEAC_CEN

Set Error Covariance of BELIEF and EFFICACY Free
Set Error Covariance of BELIEF2 and BELIEF1 Free
Set Error Covariance of CL_6 and STUD_CEN Free
Set Error Covariance of MAT18 and BELIEF Free
Set Error Covariance of MOTHER2 and TEAC_10 Free
Set Error Covariance of TEAC_7 and STUD_CEN Free
Set Error Covariance of BEL_TEAC and MAT_ANX Free
Set Error Covariance of MAT10 and BELT6 Free

LISREL output: EF SC
Path diagram
End of problem

GENERAL HIGH SCHOOL

FACTORS AFFECTING MATHEMATICS ACHIEVEMENT
Observed variables
ID GENDER GPA FAT_EDUC MOT_EDUC FOC MOC INCOME SIBLING BELIEF1
BELIEF2 BELIEF3 BELIEF4 BELIEF5 BELIEF6
BELIEF7 BELIEF8 BELIEF9 BELIEF10 BELIEF11 BELIEF12 BELT1 BELT2 BELT3 BELT4 BELT5
BELT6 BELT7 BELT8 BELT9 BELT10 BELT11 BELT12 BELT13 EFF_1 EFF_2 EFF_3 EFF_4 EFF_5
EFF_6 EFF_7 EFF_8 EFF_9 EFF_10 MOT1 MOT2 MOT3 MOT4 MOT5 MOT6 MOT7 MOT8 MOT9
MOT10 MOT11 MOT12 ACT_1 ACT_2 ACT_3 ACT_4 ACT_5 ACT_6 ACT_7 ACT_8 ACT_9 ACT_10 CL_1 CL_2 CL_3 CL_4 CL_5
CL_6 ANX_1 ANX_2 ANX_3 ANX_4 ANX_5 ANX_6 ANX_7 ANX_8 ANX_9 ANX_10 ANX_11
ANX_12 TEAC_1 TEAC_2 TEAC_3 TEAC_4 TEAC_5 TEAC_6 TEAC_7 TEAC_8 TEAC_9 TEAC_10 TEAC_11 TEAC_12 FATHER1 FATHER2 FATHER3 FATHER4 FATHER5 FATHER6 FATHER7
FATHER8 FATHER9 FATHER10 FATHER11 MOTHER1 MOTHER2 MOTHER3 MOTHER4
MOTHER5 MOTHER6 MOTHER7 MOTHER8 MOTHER9 MOTHER10 MOTHER11 MAT1 MAT2
MAT3 MAT4 MAT5 MAT6 MAT7 MAT8 MAT9
MAT10 MAT11 MAT12 MAT13 MAT14 MAT15 MAT16 MAT17 MAT18 MAT19 MAT20

covariance matrix from file: general.cov
sample size: 1230

Latent variables
SES BELIEF BEL_TEAC EFFICACY MOT TEAC_CEN STUD_CEN MAT_ANX SP_TEAC SP_FATH SP_MOTH MAT_ACH

Relationships
FAT_EDUC MOT_EDUC INCOME SIBLING = SES
TEAC_10 TEAC_7 TEAC_2 = SP_TEAC
ACT_1 ACT_3 ACT_4 = TEAC_CEN
ACT_9 ACT_5 ACT_8 = STUD_CEN
FATHER11 FATHER4 FATHER7 = SP_FATH
MOTHER10 MOTHER2 MOTHER5 = SP_MOTH
BELIEF1 BELIEF2 BELIEF12 = BELIEF
BELT10 BELT4 BELT6 = BEL_TEAC
EFF_9 EFF_7 EFF_6 = EFFICACY
MOT8 MOT2 MOT9 = MOT

ANX_1 ANX_2 ANX_3 = MAT_ANX

MAT11 MAT18 MAT5 MAT4 MAT10 = MAT_ACH

BELIEF = SP_TEAC STUD_CEN SP_FATH
BEL_TEAC= SP_FATH SP_MOTH BELIEF STUD_CEN
EFFICACY= SP_TEAC TEAC_CEN SP_MOTH
MOT = BELIEF EFFICACY
MAT_ANX = BELIEF SP_TEAC EFFICACY TEAC_CEN
MAT_ACH = SES MOT MAT_ANX BEL_TEAC

Set Error Covariance of EFF_6 and MAT_ANX Free
Set Error Covariance of MOT2 and BEL_TEAC Free
Set Error Covariance of MOTHER2 and SP_TEAC Free
Set Error Covariance of MOT2 and EFFICACY Free
Set Error Covariance of ANX_2 and MOT Free
Set Error Covariance of MOTHER2 and FATHER11 Free
Set Error Covariance of FATHER11 and SP_TEAC Free
Set Error Covariance of MOTHER5 and STUD_CEN Free
Set Error Covariance of EFF_6 and BEL_TEAC Free
Set Error Covariance of ACT_1 and STUD_CEN Free
Set Error Covariance of BEL_TEAC and TEAC_CEN Free
Set Error Covariance of TEAC_7 and STUD_CEN Free
Set Error Covariance of MAT11 and MOT8 Free
Set Error Covariance of FATHER7 and SP_MOTH Free
Set Error Covariance of MOT and SP_FATH Free
Set Error Covariance of MAT_ACH and EFFICACY Free
Set Error Covariance of MOT_EDUC and MAT4 Free
Set Error Covariance of MAT10 and MAT4 Free
Set Error Covariance of ACT_9 and MAT11 Free
Set Error Covariance of TEAC_10 and TEAC_7 Free

LISREL output: EF SC

Path diagram
End of problem

VOCATIONAL HIGH SCHOOL

FACTORS AFFECTING MATHEMATICS ACHIEVEMENT
Observed variables
ID GENDER GPA FAT_EDUC MOT_EDUC FOC MOC INCOME SIBLING
BELIEF1
BELIEF2 BELIEF3 BELIEF4 BELIEF5 BELIEF6
BELIEF7 BELIEF8 BELIEF9 BELIEF10 BELIEF11 BELIEF12 BELT1 BELT2
BELT3 BELT4 BELT5
BELT6 BELT7 BELT8 BELT9 BELT10 BELT11 BELT12 BELT13 EFF_1 EFF_2
EFF_3 EFF_4 EFF_5
EFF_6 EFF_7 EFF_8 EFF_9 EFF_10 MOT1 MOT2 MOT3 MOT4 MOT5 MOT6
MOT7 MOT8 MOT9
MOT10 MOT11 MOT12 ACT_1 ACT_2 ACT_3 ACT_4 ACT_5 ACT_6 ACT_7
ACT_8 ACT_9 ACT_10 CL_1 CL_2 CL_3 CL_4 CL_5
CL_6 ANX_1 ANX_2 ANX_3 ANX_4 ANX_5 ANX_6 ANX_7 ANX_8 ANX_9
ANX_10 ANX_11
ANX_12 TEAC_1 TEAC_2 TEAC_3 TEAC_4 TEAC_5 TEAC_6 TEAC_7
TEAC_8 TEAC_9 TEAC_10 TEAC_11 TEAC_12 FATHER1 FATHER2
FATHER3 FATHER4 FATHER5 FATHER6 FATHER7
FATHER8 FATHER9 FATHER10 FATHER11 MOTHER1 MOTHER2
MOTHER3 MOTHER4
MOTHER5 MOTHER6 MOTHER7 MOTHER8 MOTHER9 MOTHER10
MOTHER11 MAT1 MAT2
MAT3 MAT4 MAT5 MAT6 MAT7 MAT8 MAT9
MAT10 MAT11 MAT12 MAT13 MAT14 MAT15 MAT16 MAT17 MAT18
MAT19 MAT20

covariance matrix from file: vocational.cov
sample size: 910

Latent variables
BELIEF BEL_TEAC EFFICACY MOT TEAC_CEN STUD_CEN CLIMATE
MAT_ANX SP_TEAC SP_FATH SP_MOTH MAT_ACH

Relationships
CL_2 CL_6 CL_4 = CLIMATE
TEAC_10 TEAC_7 TEAC_2 = SP_TEAC
ACT_1 ACT_3 ACT_4 = TEAC_CEN
ACT_9 ACT_5 ACT_8 = STUD_CEN
FATHER11 FATHER4 FATHER7 = SP_FATH
MOTHER10 MOTHER2 MOTHER5 = SP_MOTH
BELIEF1 BELIEF2 BELIEF12 = BELIEF
BELT10 BELT4 BELT6 = BEL_TEAC
EFF_9 EFF_7 EFF_6 = EFFICACY
MOT8 MOT2 MOT9 = MOT

ANX_1 ANX_2 ANX_3 = MAT_ANX

MAT18 MAT5 MAT4 MAT10 = MAT_ACH

BELIEF = SP_TEAC STUD_CEN SP_FATH
BEL_TEAC= SP_FATH SP_MOTH BELIEF STUD_CEN SP_FATH
EFFICACY= SP_TEAC TEAC_CEN SP_MOTH
MOT = BELIEF EFFICACY
MAT_ANX = BELIEF SP_TEAC SP_MOTH EFFICACY
MAT_ACH = BEL_TEAC TEAC_CEN CLIMATE

Set Error Covariance of BELT6 and BELIEF Free
Set Error Covariance of MOTHER2 and SP_TEAC Free
Set Error Covariance of EFF_6 and MAT_ANX Free
Set Error Covariance of ACT_5 and ACT_3 Free
Set Error Covariance of MOT2 and BEL_TEAC Free
Set Error Covariance of MOT9 and MAT_ANX Free
Set Error Covariance of BEL_TEAC and TEAC_CEN Free

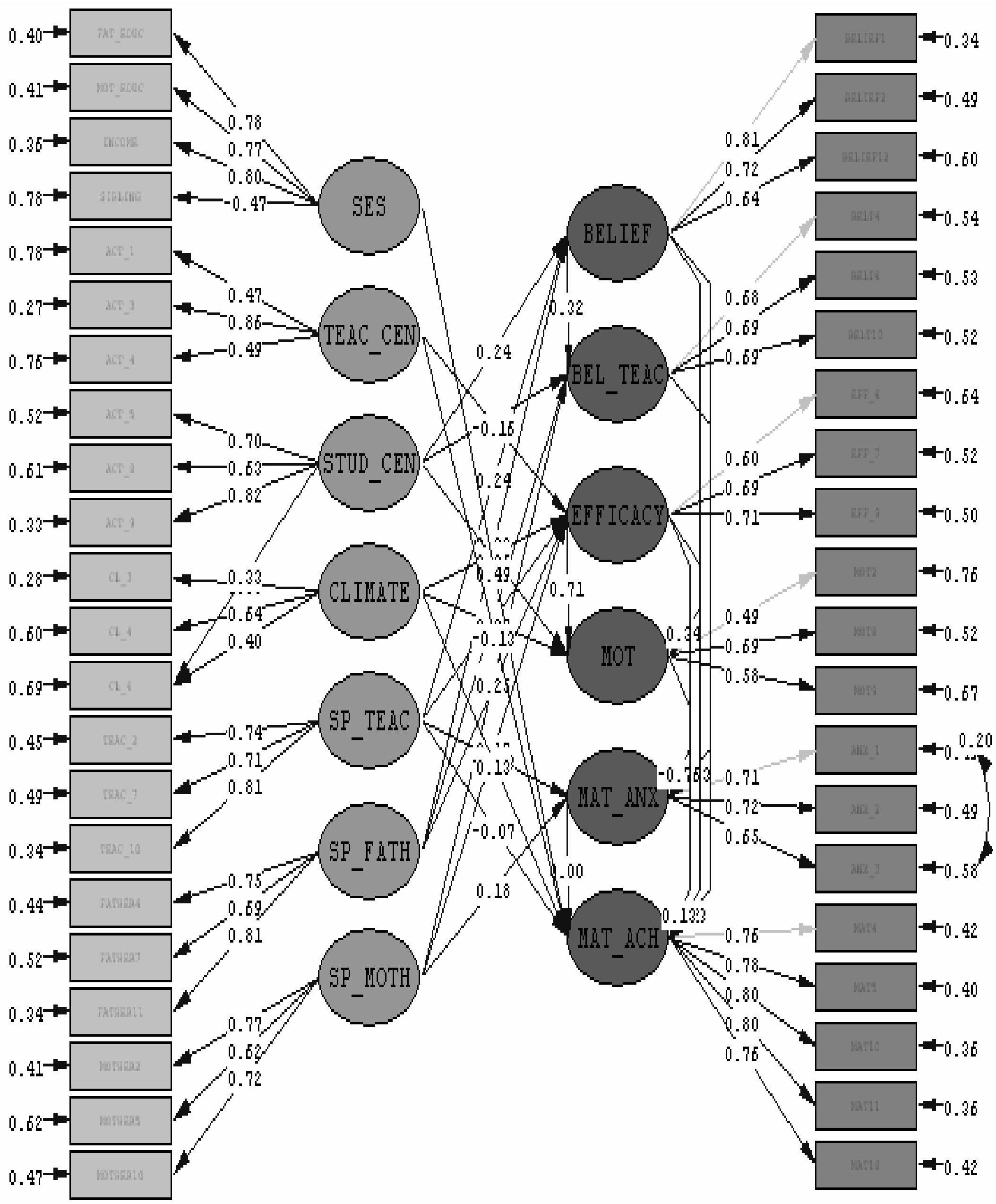
LISREL output: EF SC

Path diagram
End of problem

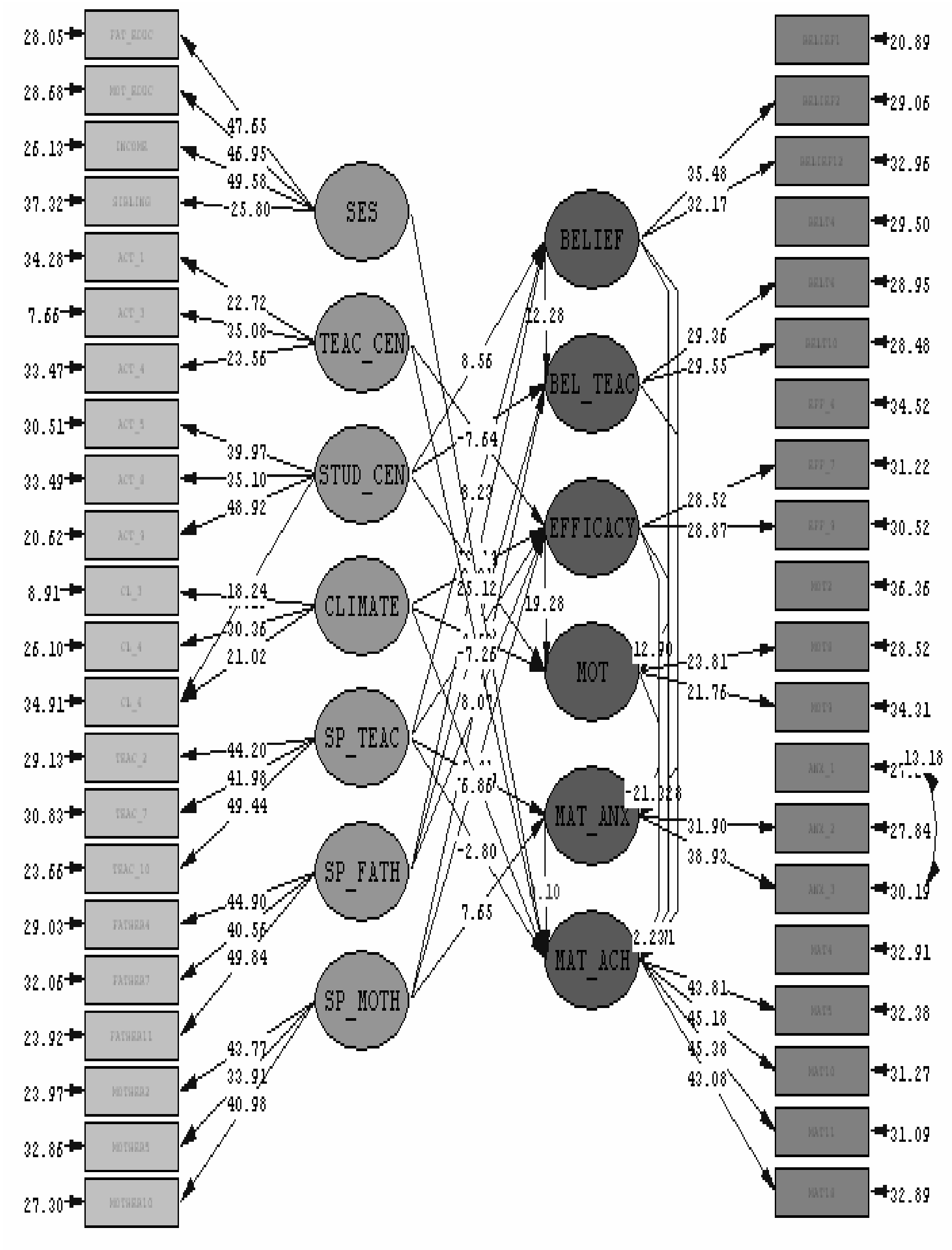
APPENDIX M

STRUCTURAL MODELS WITH STANDARDIZED COEFFICIENTS AND T VALUES

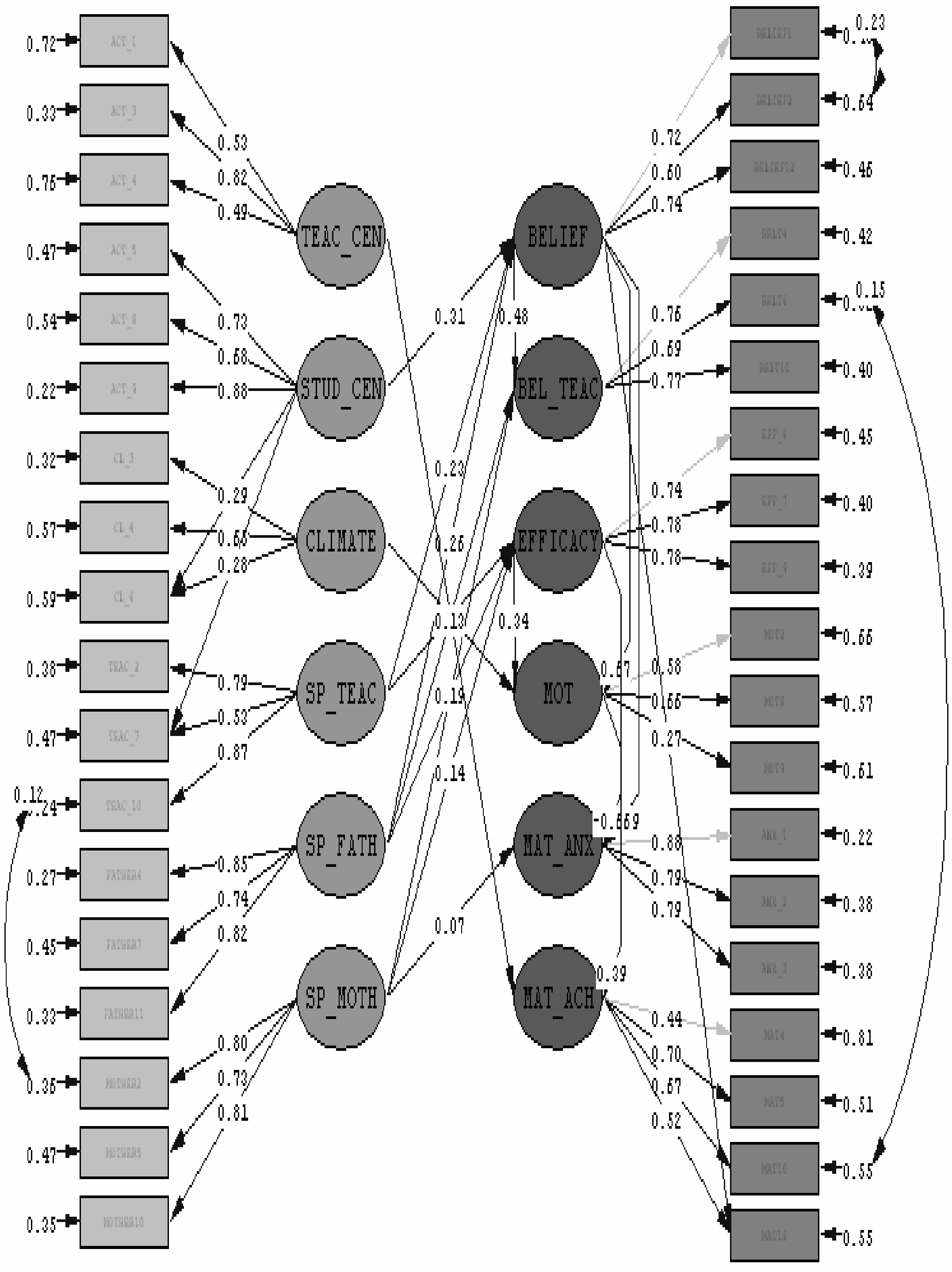
THE MAIN STUDY WITH STANDARDIZED COEFFICIENTS



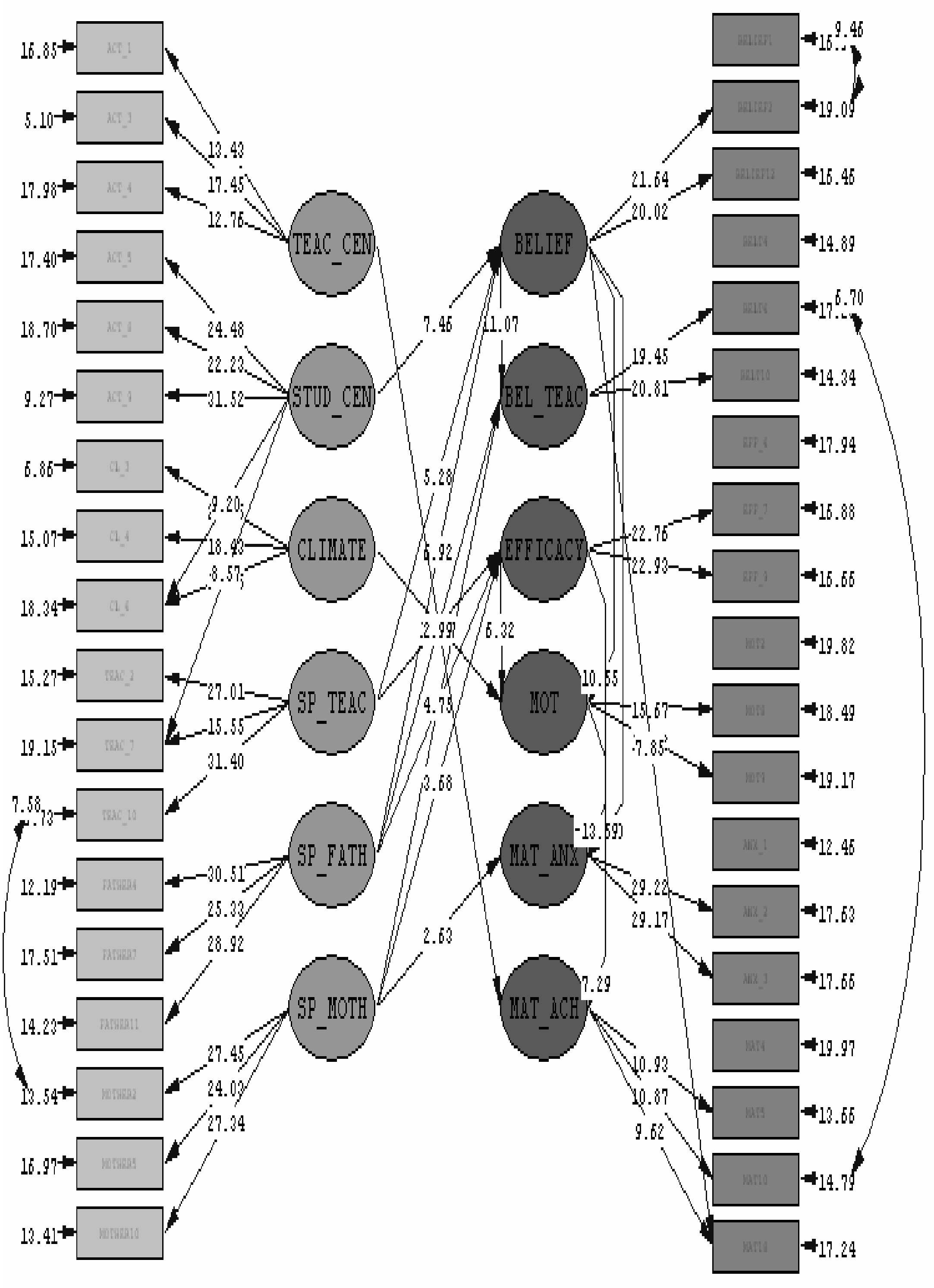
THE MAIN STUDY WITH t VALUES



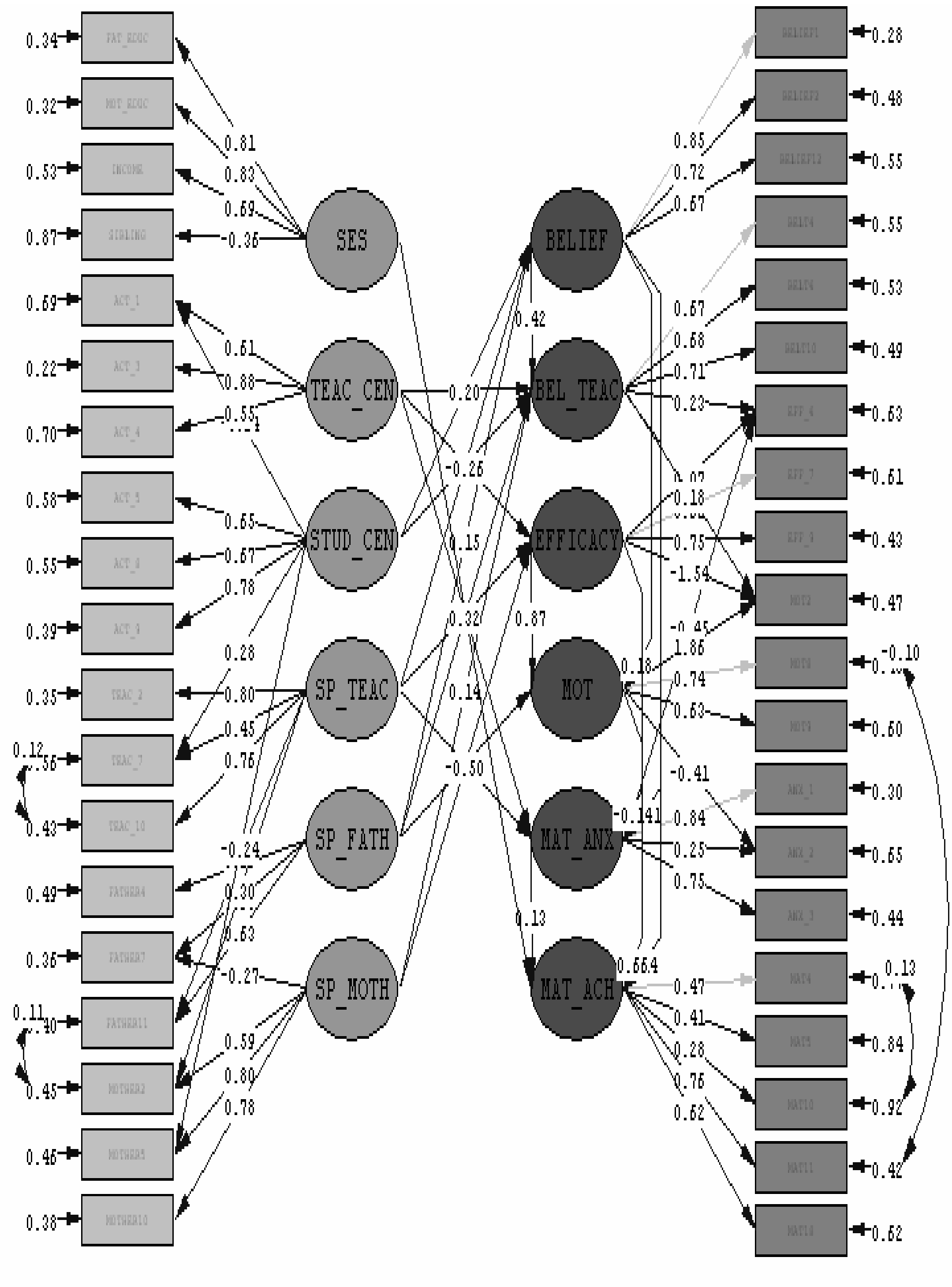
ANATOLIAN HIGH SCHOOL WITH STANDARDIZED COEFFICIENTS



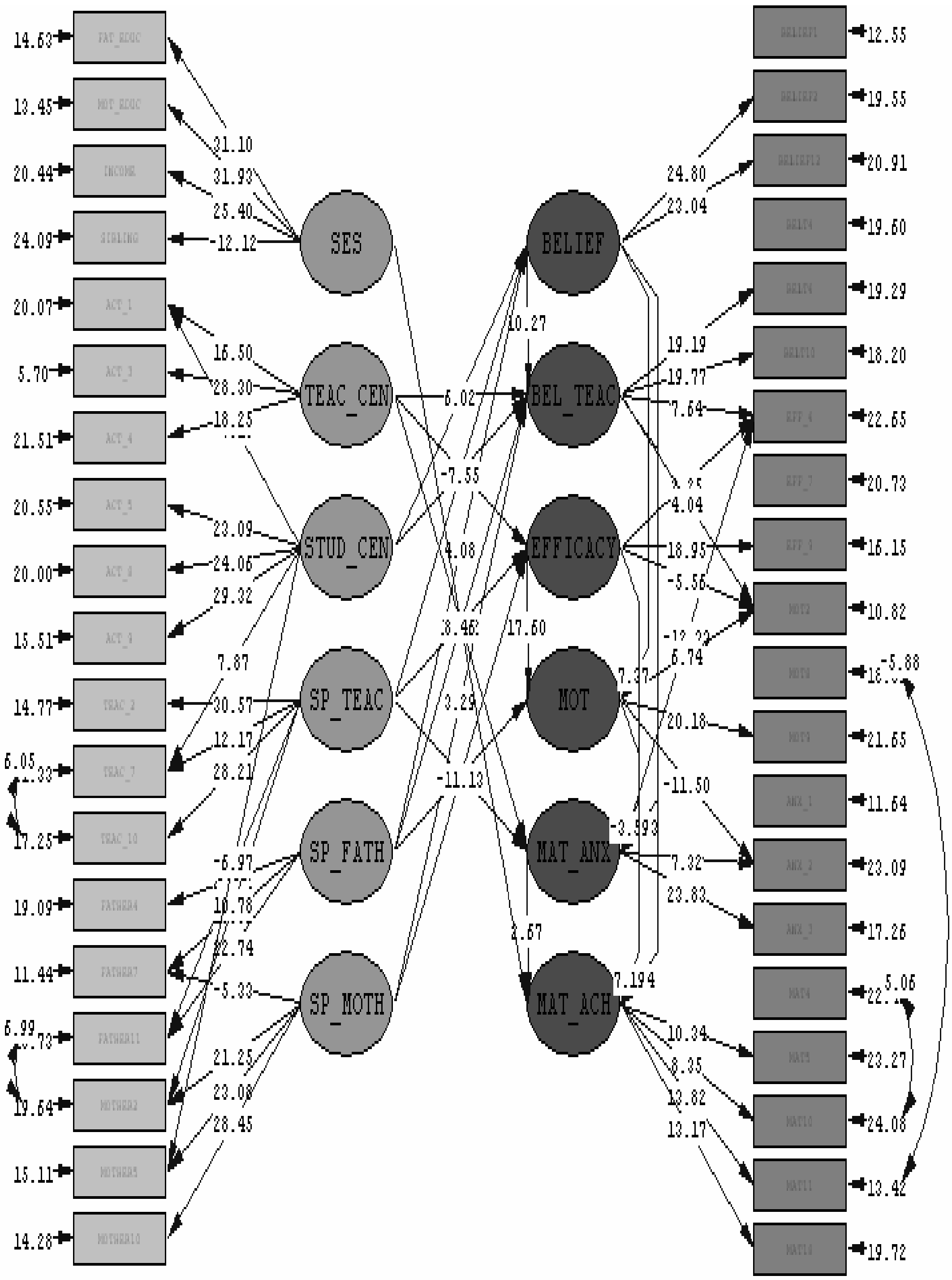
ANATOLIAN HIGH SCOOL WITH t VALUES



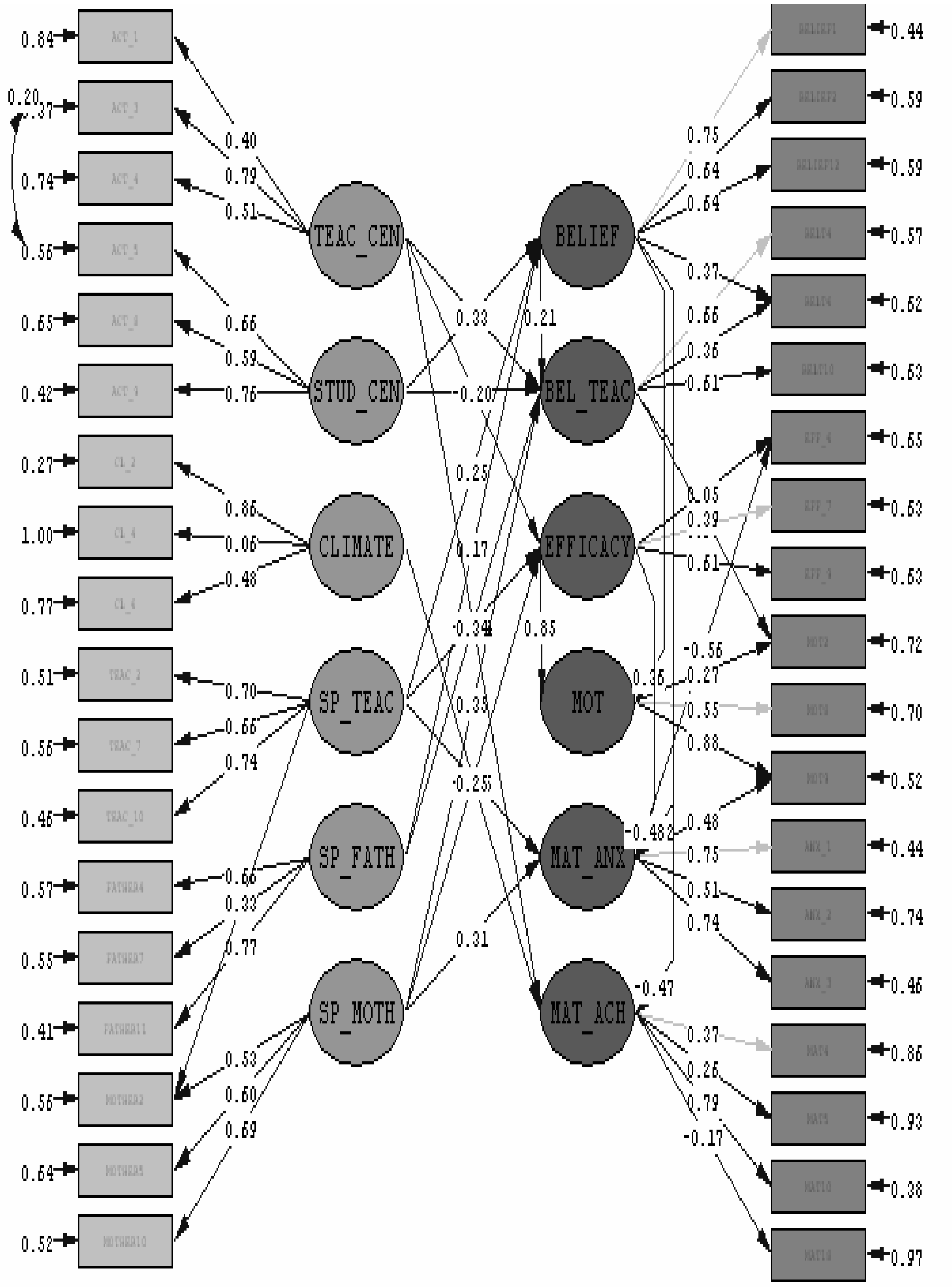
GENERAL HIGH SCHOOL WITH STANDARDIZED COEFFICIENTS



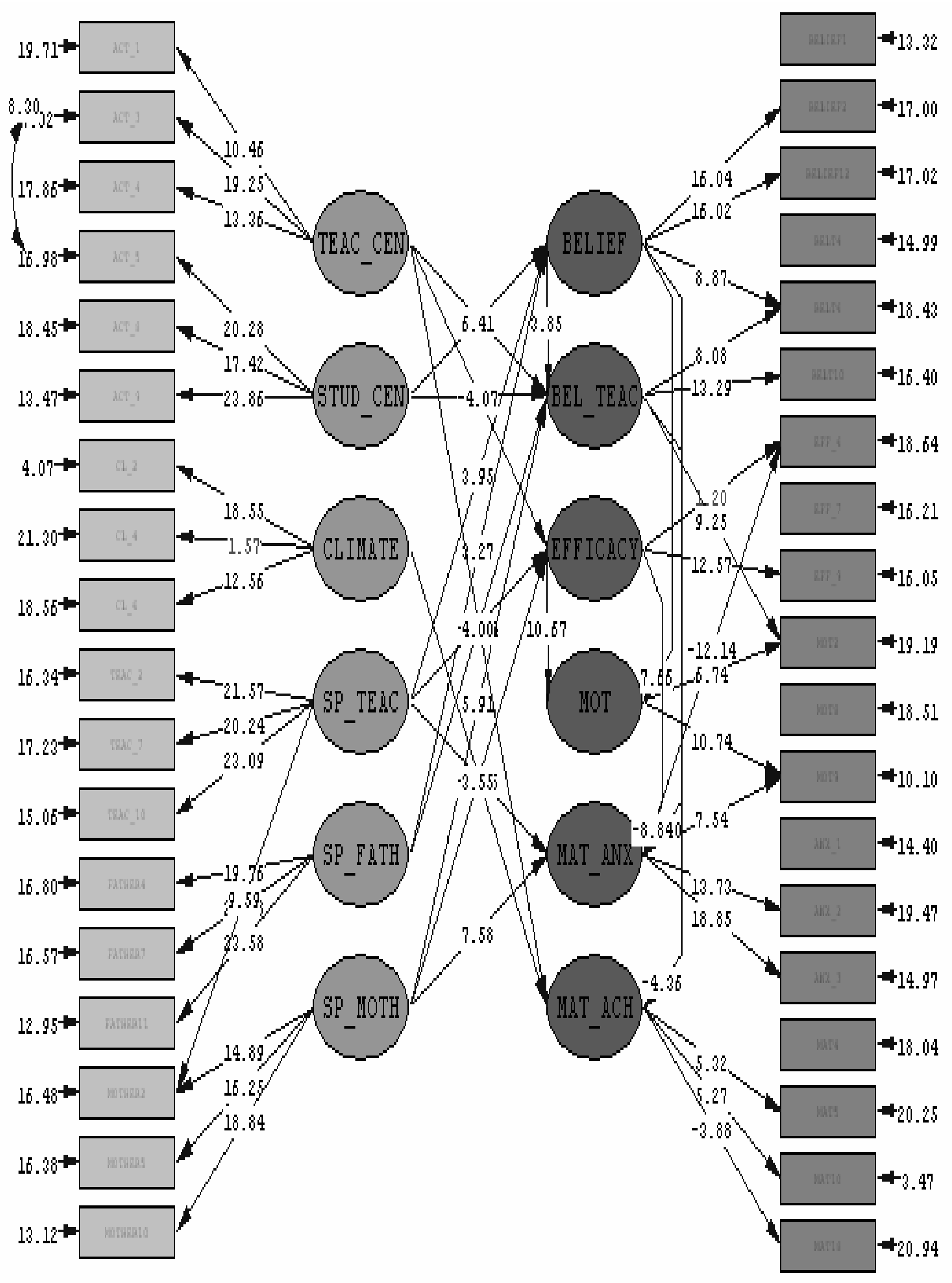
GENERAL HIGH SCOOL WITH t VALUES



VOCATIONAL HIGH SCHOOL WITH STANDARDIZED COEFFICIENTS



VOCATIONAL HIGH SCOOL WITH t VALUES



APPENDIX N
ALL FIT INDICES FOR THE MODELS

ALL FIT INDICES FOR THE MAIN STUDY

Degrees of Freedom = 768
Minimum Fit Function Chi-Square = 5791.39 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 6280.65 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 5512.65
90 Percent Confidence Interval for NCP = (5263.55 ; 5769.01)
Minimum Fit Function Value = 1.87
Population Discrepancy Function Value (F0) = 1.78
90 Percent Confidence Interval for F0 = (1.70 ; 1.86)
Root Mean Square Error of Approximation (RMSEA) = 0.048
90 Percent Confidence Interval for RMSEA = (0.047 ; 0.049)
P-Value for Test of Close Fit (RMSEA < 0.05) = 1.00
Expected Cross-Validation Index (ECVI) = 2.11
90 Percent Confidence Interval for ECVI = (2.03 ; 2.20)
ECVI for Saturated Model = 0.58
ECVI for Independence Model = 44.60
Chi-Square for Independence Model with 861 Degrees of Freedom = 138138.81
Independence AIC = 138222.81
Model AIC = 6550.65
Saturated AIC = 1806.00
Independence CAIC = 138518.45
Model CAIC = 7500.94
Saturated CAIC = 8162.36
Normed Fit Index (NFI) = 0.96
Non-Normed Fit Index (NNFI) = 0.96
Parsimony Normed Fit Index (PNFI) = 0.85
Comparative Fit Index (CFI) = 0.96
Incremental Fit Index (IFI) = 0.96
Relative Fit Index (RFI) = 0.95
Critical N (CN) = 462.32
Root Mean Square Residual (RMR) = 0.18
Standardized RMR = 0.049
Goodness of Fit Index (GFI) = 0.91
Adjusted Goodness of Fit Index (AGFI) = 0.90
Parsimony Goodness of Fit Index (PGFI) = 0.78

ALL FIT INDICES FOR ANATOLIAN HIGH SCHOOL

Degrees of Freedom = 589
Minimum Fit Function Chi-Square = 2830.99 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 2652.80 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 2063.80
90 Percent Confidence Interval for NCP = (1907.72 ; 2227.34)
Minimum Fit Function Value = 2.95
Population Discrepancy Function Value (F0) = 2.15
90 Percent Confidence Interval for F0 = (1.99 ; 2.32)
Root Mean Square Error of Approximation (RMSEA) = 0.060
90 Percent Confidence Interval for RMSEA = (0.058 ; 0.063)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00
Expected Cross-Validation Index (ECVI) = 3.00
90 Percent Confidence Interval for ECVI = (2.84 ; 3.17)
ECVI for Saturated Model = 1.47
ECVI for Independence Model = 43.40
Chi-Square for Independence Model with 666 Degrees of Freedom = 41545.90
Independence AIC = 41619.90
Model AIC = 2880.80
Saturated AIC = 1406.00
Independence CAIC = 41836.98
Model CAIC = 3549.63
Saturated CAIC = 5530.45
Normed Fit Index (NFI) = 0.93
Non-Normed Fit Index (NNFI) = 0.94
Parsimony Normed Fit Index (PNFI) = 0.82
Comparative Fit Index (CFI) = 0.95
Incremental Fit Index (IFI) = 0.95
Relative Fit Index (RFI) = 0.92
Critical N (CN) = 228.57
Root Mean Square Residual (RMR) = 0.20
Standardized RMR = 0.050
Goodness of Fit Index (GFI) = 0.87
Adjusted Goodness of Fit Index (AGFI) = 0.84
Parsimony Goodness of Fit Index (PGFI) = 0.73

ALL FIT INDICES FOR GENERAL HIGH SCHOOL

Degrees of Freedom = 647
Minimum Fit Function Chi-Square = 3227.58 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 2995.18 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 2348.18
90 Percent Confidence Interval for NCP = (2181.81 ; 2522.00)
Minimum Fit Function Value = 2.63
Population Discrepancy Function Value (F0) = 1.91
90 Percent Confidence Interval for F0 = (1.78 ; 2.05)
Root Mean Square Error of Approximation (RMSEA) = 0.054
90 Percent Confidence Interval for RMSEA = (0.052 ; 0.056)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00014
Expected Cross-Validation Index (ECVI) = 2.65
90 Percent Confidence Interval for ECVI = (2.52 ; 2.79)
ECVI for Saturated Model = 1.27
ECVI for Independence Model = 39.05
Chi-Square for Independence Model with 741 Degrees of Freedom = 47916.45
Independence AIC = 47994.45
Model AIC = 3261.18
Saturated AIC = 1560.00
Independence CAIC = 48232.92
Model CAIC = 4074.44
Saturated CAIC = 6329.52
Normed Fit Index (NFI) = 0.93
Non-Normed Fit Index (NNFI) = 0.94
Parsimony Normed Fit Index (PNFI) = 0.81
Comparative Fit Index (CFI) = 0.95
Incremental Fit Index (IFI) = 0.95
Relative Fit Index (RFI) = 0.92
Critical N (CN) = 280.35
Root Mean Square Residual (RMR) = 0.17
Standardized RMR = 0.047
Goodness of Fit Index (GFI) = 0.89
Adjusted Goodness of Fit Index (AGFI) = 0.87
Parsimony Goodness of Fit Index (PGFI) = 0.74

ALL FIT INDICES FOR VOCATIONAL HIGH SCHOOL

Degrees of Freedom = 588
Minimum Fit Function Chi-Square = 2835.09 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 2663.93 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 2075.93
90 Percent Confidence Interval for NCP = (1919.46 ; 2239.86)
Minimum Fit Function Value = 3.12
Population Discrepancy Function Value (F0) = 2.28
90 Percent Confidence Interval for F0 = (2.11 ; 2.46)
Root Mean Square Error of Approximation (RMSEA) = 0.062
90 Percent Confidence Interval for RMSEA = (0.060 ; 0.065)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00
Expected Cross-Validation Index (ECVI) = 3.18
90 Percent Confidence Interval for ECVI = (3.01 ; 3.36)
ECVI for Saturated Model = 1.55
ECVI for Independence Model = 23.02
Chi-Square for Independence Model with 666 Degrees of Freedom = 20854.52
Independence AIC = 20928.52
Model AIC = 2893.93
Saturated AIC = 1406.00
Independence CAIC = 21143.61
Model CAIC = 3562.48
Saturated CAIC = 5492.85
Normed Fit Index (NFI) = 0.86
Non-Normed Fit Index (NNFI) = 0.87
Parsimony Normed Fit Index (PNFI) = 0.76
Comparative Fit Index (CFI) = 0.89
Incremental Fit Index (IFI) = 0.89
Relative Fit Index (RFI) = 0.85
Critical N (CN) = 216.05
Root Mean Square Residual (RMR) = 0.19
Standardized RMR = 0.059
Goodness of Fit Index (GFI) = 0.86
Adjusted Goodness of Fit Index (AGFI) = 0.84
Parsimony Goodness of Fit Index (PGFI) = 0.72

APPENDIX O

COVARIANCE MATRIX FOR THE MAIN STUDY

	BELIEF1	BELIEF2	BELIEF12	BELT4	BELT6	BELT10
BELIEF1	8.93					
BELIEF2	3.46	3.75				
BELIEF12	2.85	1.56	3.53			
BELT4	2.05	1.23	1.13	5.82		
BELT6	2.39	1.54	1.56	2.47	5.33	
BELT10	1.91	1.17	1.21	3.01	2.74	6.27
EFF_6	1.63	0.94	0.95	1.02	1.10	0.94
EFF_7	0.92	0.43	0.64	0.67	0.60	0.67
EFF_9	1.50	0.82	0.90	0.98	1.08	0.95
MOT2	1.74	1.08	1.12	1.14	1.05	1.12
MOT8	1.61	0.84	0.85	0.89	0.89	0.82
MOT9	1.85	0.86	0.99	1.17	1.15	1.19
ANX_1	-1.65	-0.87	-0.96	-0.43	-0.51	-0.22
ANX_2	-1.34	-0.70	-0.78	-0.42	-0.65	-0.52
ANX_3	-1.16	-0.70	-0.75	-0.43	-0.57	-0.31
MAT4	0.48	0.26	0.16	0.45	0.48	0.55
MAT5	0.48	0.32	0.21	0.44	0.47	0.60
MAT10	0.43	0.28	0.13	0.44	0.51	0.67
MAT11	0.60	0.31	0.21	0.52	0.56	0.69
MAT18	0.49	0.26	0.19	0.52	0.53	0.58
FAT_EDUC	0.41	0.65	-0.06	1.34	1.92	1.97
MOT_EDUC	0.02	0.08	-0.05	0.16	0.22	0.26
INCOME	0.11	0.09	0.00	0.27	0.29	0.39
SIBLING	0.10	-0.02	0.15	-0.19	-0.24	-0.21
ACT_1	0.06	-0.02	0.06	0.11	0.02	-0.04
ACT_3	0.50	0.26	0.19	0.76	0.50	0.69
ACT_4	0.35	0.19	0.03	0.59	0.36	0.62
ACT_5	1.83	1.08	1.05	1.28	1.53	1.16
ACT_8	1.66	1.03	0.86	1.23	1.04	1.16
ACT_9	2.01	1.17	1.15	1.38	1.43	1.37
CL_3	0.16	0.11	0.09	0.08	0.02	0.19
CL_4	0.03	0.04	-0.01	0.19	0.23	0.39
CL_6	0.85	0.52	0.57	0.42	0.50	0.28
TEAC_2	1.74	0.92	0.94	0.95	1.06	0.81
TEAC_7	1.27	0.79	0.86	0.80	0.97	0.68
TEAC_10	1.74	1.02	1.09	0.77	0.98	0.71
FATHER4	1.36	0.86	0.85	1.50	1.35	1.62
FATHER7	1.04	0.63	0.65	1.13	1.11	1.17
FATHER11	2.54	1.48	1.26	2.21	2.11	2.14
MOTHER2	1.79	1.04	0.92	1.64	1.48	1.67
MOTHER5	0.47	0.32	0.24	1.01	0.74	1.13
MOTHER10	1.25	0.76	0.79	1.34	1.23	1.53

Covariance Matrix

	EFF_6	EFF_7	EFF_9	MOT2	MOT8	MOT9
EFF_6	2.67					
EFF_7	0.93	2.17				
EFF_9	1.09	1.48	3.40			
MOT2	0.83	0.52	0.75	2.68		
MOT8	0.98	1.09	1.44	0.89	2.81	
MOT9	0.77	0.99	1.51	0.73	1.43	3.54
ANX_1	-1.20	-0.86	-0.98	-0.67	-1.02	-0.68

ANX_2	-0.94	-0.96	-1.19	-0.57	-1.24	-0.91
ANX_3	-1.04	-0.69	-0.76	-0.55	-0.71	-0.49
MAT4	0.29	0.31	0.44	0.08	0.42	0.43
MAT5	0.29	0.31	0.43	0.10	0.45	0.37
MAT10	0.34	0.34	0.48	0.08	0.44	0.37
MAT11	0.39	0.37	0.57	0.23	0.49	0.50
MAT18	0.36	0.35	0.53	0.16	0.47	0.40
FAT_EDUC	1.16	0.86	1.45	-0.17	1.23	1.13
MOT_EDUC	0.14	0.11	0.18	-0.04	0.14	0.13
INCOME	0.26	0.22	0.30	-0.04	0.21	0.19
SIBLING	-0.11	-0.13	-0.29	0.00	-0.18	-0.14
ACT_1	-0.09	-0.24	-0.29	0.02	-0.24	-0.26
ACT_3	0.20	-0.10	0.02	0.61	-0.16	0.01
ACT_4	-0.01	-0.19	-0.11	0.31	-0.13	0.06
ACT_5	0.66	0.39	0.67	1.18	0.69	0.63
ACT_8	0.73	0.46	0.60	0.92	0.59	0.61
ACT_9	0.83	0.67	0.80	1.16	0.90	0.87
CL_3	0.13	0.18	0.37	0.07	0.32	0.33
CL_4	0.12	0.28	0.47	0.00	0.47	0.49
CL_6	0.41	0.23	0.34	0.54	0.45	0.32
TEAC_2	1.14	0.84	1.00	1.08	0.84	0.72
TEAC_7	0.68	0.52	0.67	0.73	0.62	0.65
TEAC_10	1.06	0.75	1.03	1.03	0.88	0.65
FATHER4	0.79	0.54	0.95	0.96	0.72	0.89
FATHER7	0.64	0.38	0.50	0.71	0.60	0.58
FATHER11	1.86	1.15	1.68	1.44	1.50	1.41
MOTHER2	1.25	0.82	1.41	1.25	1.06	1.15
MOTHER5	0.32	0.55	0.99	0.59	0.73	1.06
MOTHER10	0.57	0.22	0.59	0.94	0.51	0.92

Covariance Matrix

	ANX_1	ANX_2	ANX_3	MAT4	MAT5	MAT10
ANX_1	2.31					
ANX_2	1.20	2.26				
ANX_3	1.31	0.89	1.69			
MAT4	-0.18	-0.30	-0.22	1.00		
MAT5	-0.21	-0.30	-0.21	0.61	1.00	
MAT10	-0.21	-0.31	-0.26	0.65	0.64	1.00
MAT11	-0.22	-0.34	-0.21	0.59	0.62	0.62
MAT18	-0.21	-0.35	-0.24	0.56	0.58	0.59
FAT_EDUC	-0.43	-0.69	-0.67	1.89	1.86	1.84
MOT_EDUC	-0.04	-0.09	-0.11	0.23	0.24	0.24
INCOME	-0.12	-0.12	-0.17	0.37	0.33	0.35
SIBLING	0.06	0.07	0.10	-0.24	-0.24	-0.24
ACT_1	0.04	0.18	0.03	-0.09	-0.13	-0.06
ACT_3	-0.03	0.15	-0.07	-0.19	-0.17	-0.22
ACT_4	0.14	0.22	0.11	-0.02	-0.06	-0.06
ACT_5	-0.53	-0.47	-0.52	0.14	0.19	0.07
ACT_8	-0.61	-0.51	-0.60	0.11	0.23	0.20
ACT_9	-0.76	-0.69	-0.67	0.18	0.25	0.20
CL_3	0.01	-0.23	-0.02	0.21	0.19	0.22
CL_4	-0.08	-0.35	-0.07	0.30	0.31	0.31
CL_6	-0.42	-0.29	-0.39	0.17	0.17	0.17
TEAC_2	-1.14	-0.87	-1.03	0.13	0.17	0.20
TEAC_7	-0.67	-0.59	-0.60	0.17	0.15	0.19
TEAC_10	-1.07	-0.82	-0.87	0.14	0.19	0.22
FATHER4	-0.46	-0.57	-0.47	0.38	0.47	0.44
FATHER7	-0.39	-0.46	-0.42	0.38	0.35	0.36
FATHER11	-1.29	-1.09	-1.07	0.71	0.80	0.78
MOTHER2	-1.02	-0.84	-0.82	0.44	0.57	0.46
MOTHER5	-0.03	-0.37	-0.01	0.29	0.37	0.33

MOTHER10	-0.23	-0.32	-0.19	0.27	0.30	0.28

Covariance Matrix

	MAT11	MAT18	FAT_EDUC	MOT_EDUC	INCOME	SIBLING
MAT11	1.00					
MAT18	0.66	1.00				
FAT_EDUC	1.95	1.94	23.30			
MOT_EDUC	0.26	0.26	1.91	0.46		
INCOME	0.39	0.36	2.84	0.39	0.87	
SIBLING	-0.24	-0.27	-2.23	-0.38	-0.41	1.65
ACT_1	-0.13	-0.13	-0.33	-0.03	-0.10	0.04
ACT_3	-0.16	-0.19	-0.54	-0.08	-0.10	0.01
ACT_4	-0.06	-0.05	0.08	0.00	-0.02	-0.05
ACT_5	0.19	0.13	0.12	0.03	0.00	-0.12
ACT_8	0.22	0.23	0.33	0.02	0.04	0.00
ACT_9	0.33	0.25	0.29	0.03	-0.02	-0.05
CL_3	0.25	0.21	0.65	0.08	0.11	-0.04
CL_4	0.34	0.31	1.00	0.15	0.17	-0.14
CL_6	0.15	0.23	0.69	0.08	0.07	-0.08
TEAC_2	0.36	0.26	0.69	0.10	0.12	-0.19
TEAC_7	0.20	0.24	0.53	0.09	0.06	-0.09
TEAC_10	0.28	0.25	0.65	0.06	0.03	-0.12
FATHER4	0.60	0.45	2.18	0.23	0.40	-0.28
FATHER7	0.46	0.37	1.73	0.21	0.34	-0.20
FATHER11	0.90	0.72	3.57	0.40	0.73	-0.51
MOTHER2	0.63	0.51	2.03	0.28	0.39	-0.34
MOTHER5	0.46	0.35	1.48	0.24	0.31	-0.31
MOTHER10	0.44	0.34	1.49	0.20	0.24	-0.23

Covariance Matrix

	ACT_1	ACT_3	ACT_4	ACT_5	ACT_8	ACT_9
ACT_1	1.62					
ACT_3	1.00	3.62				
ACT_4	0.49	1.25	2.57			
ACT_5	0.17	1.39	0.74	6.49		
ACT_8	-0.05	0.57	0.28	1.99	3.63	
ACT_9	0.10	0.96	0.44	3.56	2.36	5.77
CL_3	-0.06	-0.13	-0.04	0.25	0.19	0.36
CL_4	-0.08	-0.12	-0.12	0.12	0.09	0.40
CL_6	0.07	0.17	0.14	1.10	0.73	1.31
TEAC_2	0.16	0.48	0.09	1.41	0.96	1.65
TEAC_7	-0.01	0.22	0.22	1.57	1.08	1.81
TEAC_10	0.00	0.33	0.15	1.44	1.20	1.84
FATHER4	-0.02	0.67	0.53	1.20	0.76	1.12
FATHER7	0.03	0.23	0.28	0.68	0.58	0.71
FATHER11	-0.15	0.51	0.44	1.48	1.30	1.72
MOTHER2	-0.03	0.45	0.39	1.04	0.83	1.14
MOTHER5	-0.20	0.23	0.20	0.48	0.24	0.37
MOTHER10	0.10	0.66	0.50	0.89	0.65	0.93

Covariance Matrix

	CL_3	CL_4	CL_6	TEAC_2	TEAC_7	TEAC_10
CL_3	1.66					
CL_4	1.01	2.12				
CL_6	0.88	0.59	2.88			
TEAC_2	0.09	0.16	0.73	4.25		

TEAC_7	0.20	0.24	0.78	1.82	2.97	
TEAC_10	0.09	0.09	0.75	2.51	1.99	3.93
FATHER4	0.14	0.16	0.23	0.93	0.78	0.93
FATHER7	0.12	0.21	0.36	0.68	0.66	0.80
FATHER11	0.18	0.26	0.54	1.88	1.30	1.68
MOTHER2	0.09	0.15	0.61	1.58	0.93	1.46
MOTHER5	0.27	0.34	0.20	0.19	0.30	0.25
MOTHER10	0.16	0.13	0.46	0.74	0.68	0.76

Covariance Matrix

	FATHER4	FATHER7	FATHER11	MOTHER2	MOTHER5	MOTHER10
FATHER4	5.01					
FATHER7	2.13	2.83				
FATHER11	4.06	2.76	9.06			
MOTHER2	2.20	1.34	3.84	6.15		
MOTHER5	1.22	0.76	1.75	2.38	4.72	
MOTHER10	1.87	1.36	2.55	3.24	2.72	5.79

APPENDIX P

CORRELATION MATRIX OF ETA AND KSI

	BELIEF	BEL_TEAC	EFFICACY	MOT	MAT_ANX	MAT_ACH
BELIEF	1.00					
BEL_TEAC	0.56	1.00				
EFFICACY	0.32	0.36	1.00			
MOT	0.60	0.48	0.85	1.00		
MAT_ANX	-0.48	-0.37	-0.82	-0.78	1.00	
MAT_ACH	0.25	0.38	0.40	0.42	-0.33	1.00
SES	0.11	0.18	0.20	0.20	-0.14	0.60
TEAC_CEN	0.15	0.17	-0.05	0.02	0.02	-0.16
STUD_CEN	0.47	0.45	0.33	0.46	-0.38	0.15
CLIMATE	0.08	0.09	0.20	0.26	-0.16	0.29
SP_TEAC	0.48	0.41	0.52	0.57	-0.57	0.20
SP_FATH	0.41	0.56	0.50	0.52	-0.41	0.39
SP_MOTH	0.30	0.49	0.44	0.44	-0.27	0.32

Correlation Matrix of ETA and KSI

	SES	TEAC_CEN	STUD_CEN	CLIMATE	SP_TEAC	SP_FATH
SES	1.00					
TEAC_CEN	-0.09	1.00				
STUD_CEN	0.02	0.32	1.00			
CLIMATE	0.17	-0.08	0.15	1.00		
SP_TEAC	0.09	0.13	0.60	0.09	1.00	
SP_FATH	0.36	0.16	0.36	0.08	0.41	1.00
SP_MOTH	0.27	0.17	0.28	0.10	0.34	0.66

Correlation Matrix of ETA and KSI

	SP_MOTH
SP_MOTH	1.00

CURRICULUM VITAE

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MS	METU Secondary Science and Mathematics Educ.	2004
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WORK EXPERIENCE

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2006- Present	Çankaya Anatolian High School	Mathematics Teacher
2002- 2006	Kızılcahamam High School	Mathematics Teacher

FOREIGN LANGUAGES

Advanced English

PUBLICATIONS

- Mert, Ö. & Bulut, S. (2006). Relationships between Beliefs about Mathematics and Beliefs about the Teaching of Mathematics for Tenth Grade Students. *"International Workshop on Research in Secondary and Tertiary Mathematics Education"*, p.55-56 (International conference paper).

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- Sancak, İ., Mert, Ö. & Yılmazer, M. (2001). Symmetry. *"Matematik Etkinlikleri 2001"* (poster).

HOBBIES

Books, Movies, Swimming