SEVENTH GRADE STUDENTS' ATTITUDES TOWARD MATHEMATICS IN TERMS OF COGNITIVE, AFFECTIVE AND BEHAVIORAL COMPONENTS: A MODELING STUDY

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

SEVENTH GRADE STUDENTS' ATTITUDES TOWARD MATHEMATICS IN TERMS OF COGNITIVE, AFFECTIVE AND BEHAVIORAL COMPONENTS: A MODELING STUDY

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The purpose of the study is threefold: (1) to examine students' attitudes toward mathematics in terms of cognitive, affective and behavioral components, (2) to examine the relationships among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, some affective variables students have and the time they spent on mathematics at home and (3) to examine the relationships between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics and three components of attitude toward mathematics, namely, cognitive, affective and behavioral components. The subjects of the study consists of 1960 7^{th} grade students enrolled in 19 different public elementary schools in Istanbul. The study was carried out during the fall semester of 2009-2010 academic year.

Structural equation modeling techniques were used to test the hypothesized relationships. The significant level was set to 0.05.

Major findings revealed that (1) Attitude toward mathematics is identified with the three factors namely, cognitive, affective and behavioral, (2) Students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics statistically and significantly explain their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home, and (3) Students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics statistically and significantly explain three components of attitude toward mathematics.

Keywords: Affective variables, structural equation modeling, attitude toward mathematics, components of attitude

ÖZ

YEDİNCİ SINIF ÖĞRENCİLERİNİN TUTUMUN BİLİŞSEL, DUYUŞSAL VE DAVRANIŞSAL BOYUTLARI BAKIMINDAN MATEMATİĞE YÖNELİK TUTUMLARI: BİR MODELLEME ÇALIŞMASI

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Bu çalışmanın üç amacı vardır: (1) öğrencilerin matematiğe yönelik tutumlarını, bu tutumu oluşturan bilişsel, duyuşsal ve davranışsal bileşenleri bakımından incelenmesi, (2) Öğrencilerin matematik öğretmenlerinin öğretmenlik mesleği ile ilgili algıları, öğrencilerin matematik öğretmenlerinin ve ana babalarının onlara yönelik tutumları ve beklentileri ile ilgili algıları, öğrenciye ait bazı duyuşsal değişkenler ve matematiğe evde ayırdıkları zaman arasındaki ilişkilerin incelenmesi ve (3) Öğrencilerin matematik öğretmenlerinin öğretmenlik mesleği ile ilgili algıları, öğrencilerin matematik öğretmenlerinin ve ana babalarının onlara yönelik tutumları ve beklentileri ile ilgili algıları ile matematiğe yönelik tutumun üç boyutu arasındaki ilişkilerin incelenmesidir. Araştırmaya İstanbul ilinde bulunan 19 farklı devlet okulunda öğrenim gören 1960 yedinci sınıf öğrencisi katılmıştır. Çalışma 2009-2010 öğretim yılının güz döneminde gerçekleştirilmiştir.

Varsayılan ilişkileri test etmek için Yapısal Eşitlik Modellemesi (YEM) kullanılmıştır. Anlamlılık düzeyi 0.05 olarak kabul edilmiştir.

Ortaya çıkan ana bulgular: (1) Matematiğe yönelik tutum, bilişsel, duyuşsal ve davranışsal olarak üç faktör ile açıklanmaktadır; (2) Öğrencilerin matematik öğretmenlerinin öğretmenlik mesleği ile ilgili algıları, öğrencilerin matematik öğretmenlerinin ve ana babalarının onlara yönelik tutumları ve beklentileri ile ilgili algıları, onların matematiğin kullanışlılığı ve önemi hakkındaki düşüncelerini, matematik öğrenmede öz güvenlerini, matematiği sevmelerini, matematik kaygılarını, matematiğe yönelik davranışlarını ve matematiğe evde ayırdıkları zamanı istatistiksel ve anlamlı bir şekilde açıklamaktadır ve (3) Öğrencilerin matematik öğretmenlerinin öğretmenlik mesleği ile ilgili algıları, öğrencilerin matematik öğretmenlerinin ve ana babalarının onlara yönelik tutumları ve beklentileri ile ilgili algıları, matematiğe yönelik tutumun üç boyutunu istatistiksel ve anlamlı bir şekilde açıklamaktadır.

Anahtar Kelimeler: Duyuşsal değişkenler, yapısal eşitlik modellemesi, matematiğe yönelik tutum, tutumun bileşenleri

To My Family

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LIST OF ABBREVIATIONS

CONF	Confidence in Learning Mathematics
USEIMP	Usefulness and Importance of Mathematics
LIKE	Liking for Mathematics
ANX	Mathematics Anxiety
MATHBEHA	Learner Behaviors toward Mathematics
TIME	Time Spent on Mathematics at Home
PTECHTP	Students' Perceptions of their Mathematics Teacher's Teaching Profession
PTECHST	Students' Perceptions of their Mathematics Teacher's Attitudes toward and Expectations from them as Learners of Mathematics
PFACHST	Students' Perceptions of their Father's Attitudes toward and Expectations from them as Learners of Mathematics
PMOCHST	Students' Perceptions of their Mother's Attitudes toward and Expectations from them as Learners of Mathematics
COGN	Cognitive Component of Attitude
AFFECT	Affective Component of Attitude
BEHAV	Behavioral Component of Attitude
ATM	Attitude toward Mathematics
ATMQ	Attitude toward Mathematics Questionnaire
MSLQ	Motivated Strategies for Learning Questionnaire
SPSS	Statistical Packages for Social Sciences
SEM	Structural Equation Modeling
CFA	Confirmatory Factor Analysis
GFI	Goodness of Fit Index
AGFI	Adjusted Goodness of Fit Index
SRMR	Standardized Root Mean Square Residual
RMSEA	Root Mean Square Error of Approximation
RMSEA (90% CI)	90 Percent Confidence Interval for Root Mean Square Error of Approximation

CHAPTER 1

INTRODUCTION

In this chapter, the study is introduced by expressing the background of the study, the purpose and research problems of the study, the variables that are used, definitions of the terms, hypothesized mathematics attitude models and significance of the study.

Many researchers and educators have tried to define the construct of attitude (Allport, 1935; Triandis, 1971; Mouly, 1960; Campbell, 1963; Rosenberg & Hovland, 1960; Kerlinger, 1964; Sherif & Cantrel, 1965); however, more recently, several authors have pointed out that further development is needed in theoretical terms (Di Martino & Zan, 2001a; Ruffell, Mason, & Allen, 1998; Hannula, 2002a; Ma & Kishor, 1997).

1.1 Background of the Study

A lot of research studies have been conducted on attitude toward mathematics, but theoretically the concept needs to be developed (Hannula, 2002a). Several researchers (Di Martino & Zan, 2001a; Ruffell, et al., 1998) have pointed out that attitude is an ambiguous construct and that it is often used without proper definition Therefore, they came to the conclusion that a theoretical definition needs to be developed.

At the beginning of the century when Allport (1935) and others were beginning to do research on attitudes, researchers viewed attitudes in a single dimension as either beliefs or feelings. However, a later definition by Rokeach (1968) stated that “Attitude is an organization of several beliefs focused on a specific object or situation predisposing one to respond in some preferential manner” (p. 159). Attitudes are thus psychological entities that can arise from single and multiple experiences, both direct and indirect. Attitudes prompt us to do things and direct us to do them in an orderly and coherent fashion (Rajecki, 1990). According to Hart (1989b), “Attitude is generally defined by psychologists as a predisposition to respond in a favorable or unfavorable way with respect to a given object (that is, person, activity, idea, etc.)” (p. 39). McLeod (1992) refers to attitude as the “affective responses that involve positive or negative feeling of moderate intensity and reasonable stability” (p. 581).

In 1971, Triandis defined attitude claiming that it includes many of the central ideas used by attitude theorists. According to him, “An attitude is an idea charged with emotion which predisposes a class of actions to a particular class of social situations” (p.2). Rajecki (1990) stated that there are three components of attitude implicit in this definition, namely, (a) an affective or emotional reaction to the object such as liking, disliking, fearing, anger and happiness, (b) behavior toward the object such as rejecting, voting for, avoiding and choosing, and (c) cognition of or beliefs about the attitudinal object such as what the objects are, where they come from, and how they may be used. In other words, attitude involves the affective or emotional reaction, which leads to behavior toward the object and results in a belief about or cognition of the object.

In mathematics education, Zan and Di Martino (2003) identified two important types of definitions of attitude toward mathematics used in the different studies:

> “1. A ‘simple’ definition, attitude toward mathematics is just a positive or negative emotional disposition toward mathematics (McLeod, 1992)
>
> 2. A ‘multidimensional’ definition, attitude toward mathematics has three components: the emotional response to mathematics, the beliefs regarding mathematics and the behavior toward mathematics (Ruffell et al., 1998)” (p.3).

Aiken (1971) claimed that many of the early studies in attitudes toward mathematics were limited to one dimension, preferential responding or, the degree of liking or disliking for the subject of mathematics. In the same way, reviews and analysis by Kulm (1980), Leder (1987) and Reyes (1984) use attitudes as a general term that include beliefs about mathematics and about self (McLeod, 1992).

Kulm (1980) suggested that the objects or the situations on which attention is focused for mathematics attitudes could include mathematics content, mathematics characteristics, teaching practices, classroom activities and teachers. For example, in studying students’ attitudes toward mathematics content, they could be asked to respond to statements such as “I like fractions”, “I avoid doing fractions when I can” or “Word problems are hard”. The characteristics of mathematics that normally interest researchers include students’ response to statements such as “There are many ways to solve a problem” or “It makes me nervous to think about doing a math problem”. Other mathematics characteristics that have been the focus of mathematics educators include usefulness, importance, difficulty and interest. Items such as “I am happy in math class” and “ I feel nervous when taking a math test” are included under measures of students’ attitudes toward mathematics classroom activities. Finally, students’ attitudes to teachers can be measured from their responses to statements such as “My math teacher explains ideas well” and “My teacher made me dislike mathematics”.

In the present study, reference to the object on which attention is focused for the attitude is on mathematics in general with no specific mathematics content or classroom activity mentioned. Moreover, only the attitudes of students and not the teachers, toward mathematics are investigated in the current study. In order to understand the influence of teachers and parents on students’ attitudes toward mathematics, students’ perceptions of their mathematics teachers’ and parents’ attitudes toward and expectations from them as learners of mathematics are considered for the study.

A number of scales have been constructed and used in research studies in order to measure attitude toward mathematics. They are generally intended to assess factors such as liking/disliking, usefulness and confidence (Zan & Di Martino, 2003). Besides items about liking/disliking for mathematics, some of these questionnaires included items on mathematics anxiety and beliefs about mathematics and self (Zan, Brown, Evans, & Hannula, 2006).

The most widely used attitude measure has been the set of "Mathematics Attitude Scales" (Fennema & Sherman, 1976). They noted that a set of nine sub-scales were designed to "measure some important and domain specific attitudes which have been hypothesized to be related to the learning of mathematics" (p.325). These sub-scales are: (1) Attitude toward Success in Mathematics Scale, (2) Mathematics as a Male Domain Scale, (3) Confidence in Learning Mathematics Scale, (4) Effectance Motivation in Mathematics Scale, (5) Mathematics Usefulness Scale, (6) Father Scale, (7) Mother Scale, (8) Teacher Scale and (9) Mathematics Anxiety Scale.

Malmivuori (2001) emphasized that this later developed multidimensional attitude scales produced the idea of different domain or object specific mathematics attitudes, hypothesized to act in a mathematics learning context in particular. Likewise, relatively low intercorrelations among test scores obtained through administration of the some of the Fennema-Sherman Mathematics Attitude Scales showed that each scale measure a different construct (Dwyer, 1993).

Zan et al. (2006) argued that the set of Fennema-Sherman Mathematics Attitude Scales includes separate scales for values (e.g. 'Attitude to Success in Math'), beliefs (e.g. 'Math as a Male Domain'), 'Confidence in Learning Math', 'Math Anxiety' and dispositions towards active problem solving (e.g. 'Effectance Motivation'). Another argument by Di Martino and Zan (2001b) is that most studies that use multidimensional approach to measure attitude do not refer to the dimensions of cognitive, affective and behavioral. However, there are some researchers referred to three components of attitude and recommended attitude measurement approaches reflecting those components (Dwyer, 1993). In Turkey, there are also some researchers (Ertem & Alkan, 2003; Alkan, Güzel, & Elçi, 2004; Türker & Turanlı, 2008; Turanlı, Türker, & Keçeli, 2008) who developed mathematics attitude scales having factor structures that stand for cognitive, affective and behavioral components of attitude toward mathematics.

In the present study, accepting the 'multidimensional' definition of attitude toward mathematics has consequences on the choice of measuring instruments to be used. Among the some "domain specific" attitudes toward mathematics, confidence in learning mathematics and usefulness and importance of mathematics represent the cognitive component of attitude toward mathematics. The liking for mathematics and mathematics anxiety stand for the affective component of attitude. Finally, the learner behaviors toward mathematics and the time they spent on mathematics at home correspond to the behavioral component of attitude toward mathematics.

Confidence is one of the most important affective variables studied by mathematics education researchers. Confidence in learning mathematics has to do with how sure a person is of being able to learn new topics in mathematics, perform well in mathematics class and do well on mathematics tests (Fennema & Peterson, 1983; Fennema & Sherman, 1976; Reyes, 1984). Confident students tend to learn more, feel better about themselves and are more interested in pushing mathematical ideas compared to the students who have lack of confidence (Reyes, 1984). She believed that confidence in learning mathematics is related to the classroom processes. It can be hypothesized that students who have high self-confidence interact more with their teachers and spend more time on task than students who have lower self-confidence (Reyes, 1981; Meece, Parsons, Kaczala, Goff, & Futterman, 1982). Hannula, Maijala and Pehkonen (2004) found that the learning of mathematics was influenced by a pupil's mathematics-related beliefs, especially self-confidence. Similarly, Nurmi, Hannula, Maijala and Pehkonen (2003) described pupils' mathematical beliefs in themselves by dividing it into three factors, one of which was self-confidence. Rösken, Hannula, Pehkonen, Kaasila and Laine (2006) obtained seven dimensions structuring the students' mathematics-related beliefs and they found that confidence was one of the seven dimensions. Moreover, Kloosterman (1988) claimed that students who are confident of their ability in mathematics are more comfortable when confronting mathematical situations; thus, developing self-confidence is important in its own right. Therefore, among mathematical beliefs on oneself, the most studied one is self-confidence. Students' self-confidence in mathematics is one of the aspects of students' mathematics-related beliefs in themselves which indeed, belongs to the cognitive component of attitude toward mathematics.

Perceived usefulness of mathematics is an important factor in determining whether students will elect to take mathematics classes (Reyes, 1984). Many of the students elect to take 3-4 year of mathematics in high school, even if they do not particularly like it, if they know that mathematics is necessary for their career goals. Therefore, a better understanding of the importance of mathematics in a wide range of careers and in education beyond high school is decisive for students as they make decisions about how much mathematics to take in high school (Reyes, 1984). Sherman and Fennema (1977) found that high school students' views about the usefulness of mathematics predicted their course election of mathematics courses. Similarly, Armstrong and Price (1982) found that students ranked usefulness of mathematics as the most important factor that might have affected their decision to take more mathematics, followed by confidence in and enjoyment of mathematics. Wilkins and Ma (2003) collected data on the social importance of mathematics construct by use of items related to students' beliefs about the usefulness of mathematics in daily life and on the job for their study. McLeod (1992) stated that some researchers may not see any need to include beliefs such as mathematics is important, difficult and based on rules, as part of the affective domain, and rather he accepted that these beliefs are mainly cognitive in nature. In the present study, the perceived usefulness of mathematics is considered as related to students' beliefs about mathematics and accepted as one of the observable variables that represents the cognitive component of attitude.

The study of mathematics anxiety has probably received more attention than any other variables within the affective domain (McLeod, 1992). Among a variety of definitions of mathematics anxiety, the most commonly used was from Richardson and Suinn (1972): "Mathematics anxiety involves 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.551). Moreover, anxiety has sometimes been characterized as fear, a "hot" emotion, and sometimes as dislike, an attitude (Hart, 1989b). Anyway, anxiety measures have been used extensively in mathematics education research to identify students' attitudes on a positive-negative dimension (Zan et al., 2006).

A student with low ability but high motivation may spend more time than most other students. On the contrary, a student with high ability but low interest may not spend much time on mathematics at home. It can be said that behavior is a function of (a) attitudes, (b) norms, (c) habits and (d) expectancies about reinforcement (Triandis, 1971). To put it differently, the amount of time that students spend on mathematics outside school hours depends partially on their positive or negative attitudes toward mathematics.

There are also some social factors that correlate with students' attitudes toward mathematics. In this study, one important factor that has been considered to be related students' attitudes toward mathematics is parents' attitudes toward and expectations from them as learners of mathematics (Eccles & Jacobs, 1986; Fennema & Sherman, 1976). Fennema and Sherman (1976) found that the relationship between parents' encouragement and expectation with students' self-confidence is quite low. However, Eccles and Jacobs (1986) found that student ratings of parents' perception of mathematics ability have a strong relationship with student ratings of confidence. Both Fennema and Sherman (1976) and Eccles and Jacobs (1986) agreed on the finding that students who reported greater parental support for their endeavors in mathematics tend to rate mathematics as being a useful subject to study.

Teachers can influence a child's attitude in several ways. Haladyna, Shaughnessy and Shaughnessy (1983) suggested that attitude development may have been influenced by factors operating inside school (endogenous) such as teacher and learning environment as well as those outside school (exogenous) such as gender, social class and scholastic aptitude. Therefore, it is important to investigate the roles that parents, teachers, classmates and the society have on the formation of student's attitudes toward mathematics.

1.2 Purpose of the Study

The purpose of the study is threefold: (1) to examine students' attitudes toward mathematics in terms of cognitive, affective and behavioral components, (2) to examine the relationships among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, some affective variables students have and the time they spent on mathematics at home and (3) to examine the relationships between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics and three components of attitude toward mathematics, namely, cognitive, affective and behavioral components.

In this study, the attitudinal variables are selected that are considered to represent the three components of attitude toward mathematics, namely, cognitive, affective and behavioral. As a consequence, confidence in learning mathematics and usefulness and importance of mathematics correspond to the cognitive component of attitude. Liking for mathematics and mathematics anxiety represent its affective component. Lastly, learner behaviors toward mathematics and the time they spent on mathematics at home stand for the behavioral component of attitude. All variables are clearly presented in the study and without them, it is hard to achieve a full understanding of a student's attitude toward mathematics.

1.3 Research Problems of the Study

Based on the given theoretical perspective and assumptions, the following problems investigated in this study:

(1) What is the factor model explaining three components of attitude toward mathematics in 7^{th} grade students?

(2) What is the model explaining relationships among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home?

(3) What is the model explaining relationships between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics and cognitive, affective and behavioral components of attitude toward mathematics?

1.4 Variables of the Study

In the present study variables are categorized as observed and latent variables. Moreover, the observed variables are classified as independent observed variables and dependent observed variables for some path models. In the study, there are ten observed variables; four of them are independent variables which are expected to be related with the three components of attitude, and six of them are dependent variables which are expected to define or infer these components. Moreover, there are four latent variables in the study. These variables are given below:

Independent Observed Variables:

1. Students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics (PFACHST)
2. Students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics (PMOCHST)
3. Students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics (PTECHST)
4. Students' perceptions of their mathematics teacher's teaching profession (PTECHTP)

Dependent Observed Variables:

1. Confidence in learning mathematics (CONF)
2. Usefulness and importance of mathematics (USEIMP)
3. Liking for mathematics (LIKE)
4. Mathematics anxiety (ANX)
5. Learner behaviors toward mathematics (MATHBEHA)
6. Time spent on mathematics at home (TIME)

In addition, there are four latent variables, which are not directly observable or measured but inferred from a set of observed variables or factors. In the study, since all latent variables in the models are related to or defined by some other observed variables, there is no a classification of latent variables whether being independent or dependent latent variable in the present study.

Latent Variables:

1. Cognitive component of attitude (cogn)
2. Affective component of attitude (affect)
3. Behavioral component of attitude (behav)
4. Attitude toward mathematics (attitude)

1.5 Definitions of the Terms

The definitions of the variables and the terms related to modeling are given below to clarify and avoid possible semantic difficulties.

1.5.1 Definitions of the Variables

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

Confidence in Learning Mathematics (CONF): Fennema and Sherman (1976) stated that "it refers to students' confidence in their ability to learn and perform well on mathematical tasks" (p.326). They noted that "the dimensions range from distinct lack of confidence to definite confidence" (p.326). In order to measure students' confidence in learning of mathematics, "Confidence in Learning Mathematics" adapted from Fennema-Sherman Attitude Scales (1976) by Tag (2000) was used in the present study.

Usefulness and Importance of Mathematics (USEIMP): Fennema and Sherman (1976) defined that "usefulness of mathematics refers to students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation or other activities" (p.326). In addition, Tağ (2000) stated that importance of mathematics refers to "students' beliefs about the importance of mathematics in relationship to their lives" (p.68). To measure students' beliefs about the usefulness and importance of mathematics, the statements from "Usefulness of Mathematics Scale" adapted from Fennema-Sherman Attitude Scales (1976) and "Importance of Mathematics Scale" adapted from TIMSS (1999) by Tag (2000) were combined for the current study.

Mathematics Anxiety (ANX): Fennema and Sherman (1976) explained that "it refers to students' feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics" (p.326). They stated that "the dimensions range from feeling at ease to those distinct anxieties" (p.326). So as to measure students' mathematics anxiety, "Mathematics Anxiety Scale" adapted from Fennema-Sherman Attitude Scales (1976) by Tag (2000) was utilized.

Learner Behaviors toward Mathematics (MATHBEHA): Beth and Neustadt (2005) stated that "it refers to students' involvement in mathematics classes, hand rising and participation in mathematics activities" (p.213). In order to measure students' behaviors toward mathematics, "Learner Behaviors toward Mathematics Scale" was adapted for the present study. This scale was developed by Beth and Neustadt (2005) for their study.

Time Spent on Mathematics at Home (TIME): According to Mohamad-Ali (1995), "it refers to students' estimations of the time they spent on mathematics at home" (p.47). To measure the time students spent on mathematics at home, "Time Spent on Mathematics at Home Scale" was adapted for the present study. This scale was developed by Mohamad-Ali (1995) for his study.

Students' Perceptions of their Father's Attitudes toward and Expectations from them as Learners of Mathematics (PFACHST): It refers to students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics (Fennema & Sherman, 1976). They noted that "it also includes father's interest, encouragement and confidence in the students' ability, as well as his attitudes toward mathematics" (p.326). In order to measure this variable, "Father Scale" adapted from Fennema-Sherman Attitude Scales (1976) by Tag (2000) was implemented in the study.

Students' Perceptions of their Mother's Attitudes toward and Expectations from them as Learners of Mathematics (PMOCHST): It refers to students' perception of their mother's attitudes toward and expectations from them as learners of mathematics (Fennema & Sherman, 1976). They stated that “it also includes mother’s interest, encouragement and confidence in the students’ ability, as well as her attitudes toward mathematics” (p.326). “Mother Scale” adapted from Fennema-Sherman Attitude Scales (1976) by Tag (2000) was used to measure this variable.

Students’ Perceptions of their Mathematics Teacher’s Attitudes toward and Expectations from them as Learners of Mathematics (PTECHST): It refers students’ perceptions of their mathematics teacher’s attitudes toward and expectations from them as learners of mathematics(Fennema & Sherman, 1976). They explained that “it also includes teacher’s interest, encouragement and confidence in the students’ ability” (p.326). To measure this variable “Teacher Scale I” adapted from Fennema-Sherman Attitude Scale (1976) by Tag (2000) was utilized.

Students’ Perceptions of their Mathematics Teacher’s Teaching Profession (PTECHTP): Tağ (2000) stated that “it refers to students’ perceptions of their mathematics teacher’s teaching of mathematics (p.61). “Teacher Scale II” adapted from TIMSS (1999) by Tag (2000) was used to measure this variable.

Cognitive Component of Attitude (cogn): It refers to students’ expressions of beliefs, thoughts and knowledge about mathematics as a discipline and about themselves as learners of mathematics (Hart, 1989b).

Affective Component of Attitude (affect): It refers to students’ expressions of positive and negative feelings about mathematics, aspects of the classroom, or about themselves as learners of mathematics (Hart, 1989b).

Behavioral Component of Attitude (behav): It refers to students’ expressions of behavioral intentions toward mathematics (Hart, 1989b).

Attitudes toward Mathematics (attitude): According to Ma and Kishor (1997) “it refers to a measure of a liking or disliking for mathematics, a tendency of engage in or avoid mathematical activities, a perception about usefulness and importance of mathematics, feeling of confidence in learning mathematics, feeling of anxiety and behaviors or behavioral intentions toward mathematics” (p.27).

1.5.2 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.

Path Diagrams: A path diagram is a diagram that gives the structural relations forming the model. The variables are linked by arrows in the path diagram. The unidirectional arrows represent the causal relations and the bi-directional curved arrows represent the noncausal or correlational relationships (Kelloway, 1998).

Observed, Indicator or Manifest Variables: Observed variables are the directly observable or measured variables (Schumacker & Lomax, 2004).

Latent or Unobserved Variables: Latent variables are indirectly observable or measured variables. They are the variables that are not observed or measured directly. Latent variables can be indirectly measured through observable variables (Schumacker & Lomax, 2004).

Latent Dependent Variables: Latent dependent variable is the latent variable which is influenced by some other latent variable in the model. The latent dependent variables are measured on the basis of the observed dependent variables (Schumacker & Lomax, 2004).

Latent Independent Variables: Latent independent variable is the latent variable which is not influenced by any other latent variable in the model. The latent independent variables are measured on the basis of the observed independent variables (Schumacker & Lomax, 2004).

Structural Equation Models: The path models in which the factors are viewed as latent variables are often used in order to diagram the structural equation models (Jöreskog & Sörbom, 1993). The relationship between latent variables or constructs given in a theoretical perspective is established in structural equation models. The measurement model and the structural model are the two parts of the structural equation models. How the latent variables or hypothetical constructs are measured in terms of the observed variables is specified in the measurement model. In addition, the measurement properties of these latent variables such as reliability and validity are described. On the other hand, the structural model gives the direct and direct relationships among latent variables. It also describes the amount of explained and unexplained variance (Schumacker & Lomax, 2004).

Measurement Model: How the latent variables or hypothetical constructs are measured in terms of the observed variables is specified in the measurement model. The relationships between the observed variables and the latent variables are described on the basis of the factor loadings. By the factor loadings, the information about the extent to which a given observed variable is able to measure the latent variable is provided. In addition, the measurement properties of the latent variables such as reliability and validity are described in the measurement model (Schumacker & Lomax, 2004).

Structural Model: The structural model gives the direct and indirect relationships among latent variables. The structural model describes the amount of explained and unexplained variance. Therefore, the indication of the extent to which hypothesized relationship are supported by the sample data is resulted from the structural model (Schumacker & Lomax, 2004).

Structural Equation Modeling: The structural equation modeling is an approach to develop measurement models in order to define latent variables and to establish relationships or structural equations among the latent variables (Schumacker & Lomax, 2004).

LISREL 8.30 with SIMPLIS Command Language: LISREL is a computer program (Jöreskog & Sörbom, 1993) performing structural equation modeling. The SIMPLIS command language has the advantage of moving away from the matrix formulation of the LISREL model. A more national language is used in SIMPLIS language to define LISREL models (Kelloway, 1998).

The Measurement Coefficients: The λ_y (lowercase lambda sub y) and λ_x (lowercase lambda sub x) values indicate the relationships between the latent variables and observed variables. These coefficients are also referred to as factor loadings. These coefficients serve as a validity coefficient.

The ε (lowercase epsilon) and δ (lowercase delta) are the measurement errors for the Ys and Xs, respectively. They serve as a reliability coefficient (Schumacker & Lomax, 2004).

The Structure Coefficients: The β (lowercase beta) values indicate the strength and direction of the relationship among the latent dependent variables. The γ (lowercase gamma) values indicate the strength and direction of the relationship among latent dependent variables and latent independent variables (Schumacker & Lomax, 2004).

1.6 Hypothesized Mathematics Attitude Models

In this section, three models are hypothesized corresponding to three research problems of the study. All paths in the models were taken from the literature review and the theoretical assumptions.

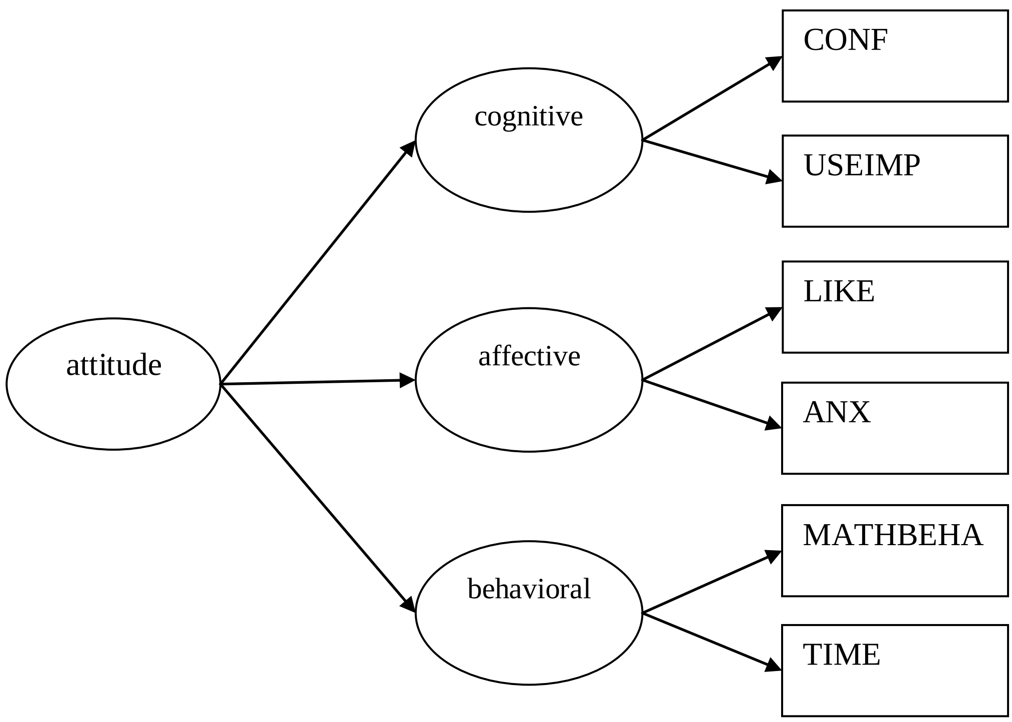

Figure 1.1 Hypothesized Model for First Research Problem

Many researchers pointed out that attitude toward mathematics has three separate components namely; cognitive, affective and behavioral (Hart, 1989b, Ruffell et. al., 1998; Di Martino & Zan, 2001a; Ma & Kishor, 1997; Kağıçıbaşı, 1999; Tavşancıl, 2005; Dwyer, 1993; Ertem & Alkan, 2003; Alkan, Güzel, & Elçi, 2004; Türker & Turanlı, 2008; Turanlı, Türker, & Keçeli, 2008). The relationships among the components of the proposed model are displayed in Figure 1.1.

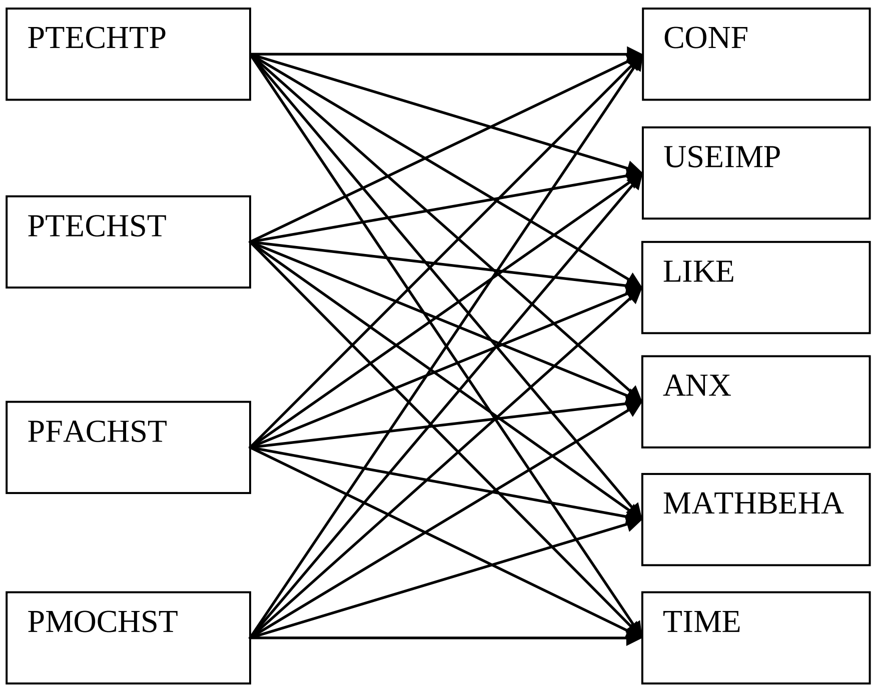

Figure 1.2 Hypothesized Model for Second Research Problem

Research studies emphasized that teachers and parents affect students' attitudes toward mathematics in several ways (Aiken, 1970, 1976; Kulm, 1980; Leder, 1992; Eccles et al., 1983; Fennema & Sherman, 1976; Karp, 1991; Austin & Wadlington, 1992; Carter & Norwood, 1997; Haladyna et al., 1983; McMillan, 1976; Miller, 1988; Adler & Kaczala, 1982; Alkan, Güzel, & Elçi, 2004; Ünlü, 2007). The relationships among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home of the proposed model are displayed in Figure 1.2.

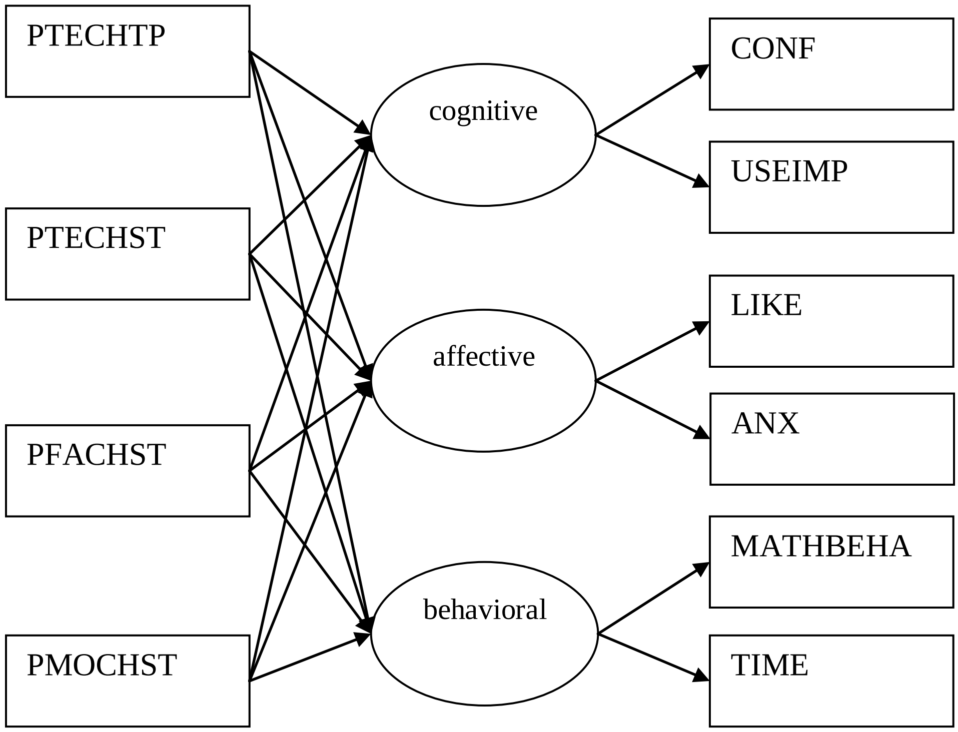

Figure 1.3 Hypothesized Model for Third Research Problem

As explained in the previous hypothesized model, many researchers agreed on the opinion that teachers and parents affect students' attitudes toward mathematics. Leaving from this, the relationships between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, and three components of attitude toward mathematics of the proposed model are displayed in Figure 1.3.

The problems stated in the study were tested with the following hypotheses which are stated in the null form:

(1) H_0: The model between attitude and cognitive, affective, behavioral is not significant.

(2) H_0: The model among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home is not significant.

(3) H_0: The model between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, and cognitive, affective and behavioral components of attitude toward mathematics is not significant.

Significance level is set to 0.05 (t = 1.96) for all relationships in the study.

1.7 Significance of the Study

Applications of structural equation modeling technique are fairly recent both in Turkey and in other countries. Some longitudinal studies of math attitudes and performance have provided with path analyses of the relationships of math attitude related variables (Pajares & Miller, 1994; Meece, Wigfield, & Eccles, 1990; Eccles & Jacobs, 1986; Abu-Hilal, 2000). There are also some modeling studies which are carried out by using data from international studies such as TIMSS and PISA (Akyüz, 2006; Berberoğlu, Çelebi, Özdemir, Uysal, & Yayan, 2003; Tag 2000; Yayan & Berberoglu, 2004; Is-Guzel & Berberoglu, 2005). The proposed models highlighted the attitudinal and affective variables related to mathematics achievement in middle grades. Little research has been conducted to explore the determinants of attitude (Bodur, Brinberg, & Coupey, 2000), particularly in mathematics education few studies exist (Haladyna et al., 1983; Ma, 1997; Ma & Xu, 2004).

Several studies were conducted to explain students' attitudes toward mathematics by means of variables that are commonly measured by the Fennema-Sherman Mathematics Attitudes Scales (Hannula et al., 2004; Kloosterman, 1988; Hart, 1989b; Reyes, 1984; Meece, et al., 1982; Fennema & Sherman, 1978; Nurmi, et al., 2003; Rösken, et al., 2006). They generally reported the results of descriptive statistics and investigated the relationships among the attitudinal variables by correlation and regression analyses. The present study employs advanced statistical techniques while testing various types of models that hypothesize how some sets of attitudinal variables define components of attitude toward mathematics and how these components are related to each other and related to some other social variables.

The present study adapts a rather multidimensional definition of attitude toward mathematics which includes students' beliefs about self and mathematics (i.e. their confidence in learning mathematics and beliefs about the usefulness and importance of mathematics), their feelings about mathematics (i.e. their liking for mathematics and mathematics anxiety) and their behaviors related to mathematics (i.e. their participation in math classes and the time they spent on mathematics at home). Malmivuori (2001) stated that attitude would constitute a single second-order factor while beliefs, affective responses and related behavior alone would operate as first-order affective factors or aspects in pupils' personal learning processes. Therefore, the findings will provide an evidence for a three-component view of attitude toward mathematics including some attitudinal variables selected for the study.

Neale (1969) defined attitude toward mathematics as an aggregated measure of "a liking or disliking of mathematics, a tendency to engage in or avoid mathematical activities, a belief that one is good or bad at mathematics and a belief that mathematics is useful or useless" (p. 632). Ma and Kishor (1997) extended Neale's definition of attitude toward mathematics to include "students' affective responses to the easy/difficult as well as the importance/unimportance of mathematics" (p.27). In this study, we included two additional variables, which were learners behaviors toward mathematics and the time they spent on mathematics, in Ma and Kishor's definition of attitude toward mathematics.

The measurement of attitude in mathematics is done almost exclusively through the use of items that deal with the assessment of beliefs such as usefulness, confidence and emotions such as liking, disliking. However, behaviors do not appear as an explicit component of attitude, in spite of the common idea that attitude emerges as a characteristic of a subject which causes certain behavior (Leder, 1985; Ma & Kishor, 1997). Therefore, in the present study, while measuring the attitudes of students toward mathematics, the items that assess the behavioral component of attitude are also considered.

In Turkey, the mathematics curriculum has been changed for grades 6-8 in the academic year 2006-2007 by the Ministry of National Education (MNE). It is implemented to promote high standards of teaching and learning in mathematics. The new curriculum emphasizes the approaches to teaching mathematics that promote engagement and interactivity. In this respect, there is an implicit acknowledgement of the importance of a pupil's attitudes, motivation and feelings in achieving specific learning objectives. However, the curriculum documentation makes little explicit reference to the importance of developing enduring positive attitudes to mathematics. Moreover, research evidence indicates that there is only a limited relationship between pupils' attitudes to learning mathematics and their performance (Leder & Forgasz, 2006; Zan et al., 2006). There are indications that motivation to do well in mathematics might not depend on a positive attitude. According to Pell, Galton, Steward, Page, and Hargreaves (2007), it may be therefore that pupils accept the need for good results while, at the same time, disliking what they are asked to do in order to achieve them. Consequently, it can be argued that effort spent fostering positive attitudes to learning mathematics is unlikely to make a significant contribution to raising success in the short term. However, beyond the benefits in terms of achievement, there are very important reasons for teachers to pay particular attention to fostering positive attitudes to learning mathematics.

Teachers are encouraged to develop a mathematical society. In order to achieve this, they should make sure that pupils leave school with sound mathematical understanding, knowledge and skills. They must also strive to foster enduring positive attitudes towards learning and doing mathematics. Moreover, if schools make learning mathematics a more fulfilling experience, then students will spend much more time studying mathematics, both in and out of the classroom.

Early evaluations by many mathematics teachers and educators and TIMSS 2007 results indicate that the new mathematics curriculum have been broadly successful in engaging students in mathematical tasks and getting fun from doing mathematics. However, it is difficult to predict which aspects of their attitudes toward mathematics have been changing. It is hoped that the present study provides an indepth understanding of students' attitudes toward mathematics in terms of three components as well as the interrelations between these components in relation to some attitudinal variables. In view of the patterns emerging in this study considerable suggestions can be provided for teachers, parents, instructional designers and education faculties.

In summary, the dimensions of attitude toward mathematics should be taken into account as a whole. It is likely that the present study is important in that it illustrates how the theoretical framework can be useful for understanding the different aspects of attitude toward mathematics, the integration between these aspects and the influence of social context that the student is in.

CHAPTER 2

REVIEW OF LITERATURE

This chapter includes theoretical background and literature review of the present study. First, theoretical background for the variables is summarized. Then, the research studies related to the present study is reviewed and discussed.

2.1 Theoretical Background

The main purpose of the present study is to investigate seventh grade students' attitudes toward mathematics. Their attitudes toward mathematics was evaluated into three components: (a) cognitive, (b) affective and (c) behavioral. The underlying theories based on affect and attitude structured the conceptual framework for this study. Theoretical background and related research studies are stated throughout the chapter. In other words, in order to better understand the framework for this study, the review of the literature focuses on specific areas of investigation based on the research questions namely: Affect in mathematics education, research methodologies on affect in mathematics education, affect in mathematical problem solving, attitude, attitude toward mathematics, emotions, beliefs, behavior and interactions between emotion, cognition and behavior. Moreover, the affective variables in mathematics education such as confidence in learning mathematics, usefulness and importance of mathematics and mathematics anxiety are discussed. Factors that correlate with students' attitudes toward mathematics (i.e. teachers' beliefs and expectations, mother and father) are included in this part. Finally, three models that guide research studies in affective domain and mathematics education are presented in the theoretical background section of the study.

2.1.1 Affect in Mathematics Education

The first part of this chapter starts with the investigation of the "affective domain" since attitude has also been considered as one of the components of the affective domain, the others being beliefs and emotions (McLeod, 1992).

Affect in mathematics education has been studied primarily in order to find variables that might explain and predict future achievement in mathematics (Hannula, 2006). He added that one tradition, especially the early studies from the 1970's, has explored that mathematics anxiety and attitude toward mathematics correlate to overall success in mathematics. Another tradition has been interested in the affective conditions for success and failure in solving mathematical problems. Later, the extensive research on mathematical beliefs has linked these two traditions.

McLeod's (1994) classification of concepts of the affective domain can be described as the foundation for research in the affective domain in mathematics education (Figure 2.1). He described these concepts with different degrees of stability and with in different domains. According to his description, emotions are mostly affective, beliefs are mostly cognitive, and attitudes are somewhere in between. Likewise, emotions are least stable, beliefs are most stable and attitudes are in between.

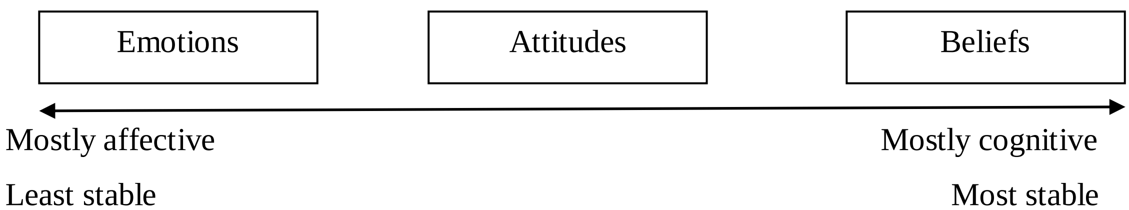

Figure 2.1 Classification of the Concepts of the Affective Domain (McLeod, 1994)

The framework by DeBellis and Goldin (1997) at CERME4 topic study group on affect is concerned with the significance of affective factors in students' problem solving. The study is focused mainly on the question that how global affect influences subjective experiences. In this framework a tetrahedral represents affective domain of an individual with four facets of affective states: emotions, attitudes, beliefs and values/morals/ethics are represent the whole domain of affect. In their tetrahedron model of affective domain each element is different from others, but closely related to them. Additionally, it is apparent that one of which cannot be separated from the other three elements.

DeBellis and Goldin's (1997) classification of affect into emotions, beliefs, attitudes and values/morals/ethics constitutes the basis of many researches on affect in mathematics education. Hannula (2006) mentioned that in the elaboration of these concepts, the first distinction was between cognition and emotions as aspects of affect. He claimed that literature on emotion indicated the importance of goals in relation to emotions and thus pointed to the concept of motivation (Hannula, 2002a, 2004).

Hannula (2004) claimed that there are many concepts other than the four vertices (attitudes, beliefs, emotions and values) of tetrahedron model of affective domain of DeBellis and Goldin's (1997). Motivation, feeling, mood, conception, interest, anxiety and view are only a few of terms that have also been used in the field of affective domain and needs to be studied. Throughout this study, only the 'attitudes' which are moderately stable and balance of affect and cognition was studied.

2.1.1.1 Research Methodologies on Affect in Mathematics Education

In 1970, Aiken published a comprehensive review of research on attitudes toward mathematics covering the decade of the 1960's. During the five years since his review, he observed more dissertations and articles pertaining to this topic than in the entire preceding ten year. Because these investigations pointed to interesting new research directions, in 1976 Aiken published another review which updates the earlier review at this time.

In his article, Aiken (1976) complained about that although there is an overwhelming increase in quantity of researches on attitudes toward mathematics since 1970, there is a slight improvement in quality that has been observed. He recommended that further improvements in measurement and methodology are needed if research in this area is to have an impact on instruction. Specifically, Aiken (1976) stated that designers of attitude instruments should begin to provide evidence of the extent to which an instrument is a precise measure of attitude and is sensitive to changes in attitude. Moreover, concerning the generalizability of the findings of any investigation to other classroom situations, he advised that researchers should take into account the various sources of changes in attitude toward mathematics which involve a complex interaction among student and teacher characteristics, course content, method of instruction, instructional materials, parental and peer support and methods of measuring these changes.

McLeod (1994) reviewed studies on affect and mathematics learning in the Journal for Research in Mathematics Education (JRME) in the past 25 years. He stated that in the early years of the JRME, research on affect focused on attitudes toward mathematics, especially student responses to the subject as taught in schools. Afterward, he pointed out that studies of attitudes broadened to include research on beliefs about mathematics and more intense emotional reactions to the subject. He indicated that these changes in research emphasis were accompanied by changes in the methodology and theoretical foundations for the research, as well as changes in the views of teaching and learning that provide support for the current reform effort in mathematics education.

It is evident that many researches on attitudes during 1970s, had some success in identifying important patterns of student responses to mathematics, particularly in the area of gender-related differences (Fennema & Sherman, 1978). On the other hand, many researchers disagree with the results since they believed that the theoretical background for the studies were insufficient which sometimes ran contrary to expectations, and complicated statistical analyses of questionable questionnaire data were not necessarily reflecting accurately what students were thinking and feeling (McLeod, 1994).

To sum up, McLeod (1994) stated that research has provided many insights and occasionally some reliable data on affective issues in mathematics education over the last 25 years, but it continues to make rather small contributions to our understanding of the differences in achievement. Although research on beliefs has made substantial contributions to our understanding of the difficulties students have in solving nonroutine problems, research community is still struggling to build a suitable framework for the study of beliefs and attitudes related to mathematics learning.

More recently, Hannula (2006) introduced two main traditions of research on affect in mathematics education which were concerned with measuring different elements of affect to identify characteristics of affect that predict future achievement and analyzing the role of different affective states in the process of mathematical learning and problem solving. He stated that both relatively stable emotional traits as well as rapidly changing emotional states have an important role in mathematical thinking and learning. Moreover, he emphasized that a single theory of affect in mathematics would not accurately represent all relevant aspects of affect. Instead, it was claimed that researchers can build theories for understanding affect in mathematics education that can inform practice and future research.

Moreover, Hannula (2006) proposed that there are two main improvements needed in future research. One is the need to go beyond simplistic positive-negative distinction of affect. He gave the example that although both fear and boredom are negative emotions, they develop under very different conditions and influence mathematical behavior differently. The other improvement is the need to pay attention to emotional reactions that may reveal things that are inaccessible to consciousness or purposefully hidden from the observer. However, it should be considered that not all emotions have distinctive facial expression (e.g. interest). It is widely accepted by many researchers that in order to study affect there is a further need to focus on emotional reactions of students in mathematics classes.

In terms of the research methodologies applied, Hannula (2006) pointed out that research on affect can be divided into three approaches: observation, interviews and questionnaires. Some research methods that combine several of these approaches are highly recommended for the methodological triangulation. According to Hannula (2006), the most natural way to study affect in classrooms is to use a human observer. He illustrated that facial expressions, posture and tone of voice tell about emotions in ways that humans are able to interpret more or less naturally. He also noted that although the accuracy of interpretation may differ from culture to culture around the world, it can be increased through training. According to him, the other form of observation would be to audio- and video record the events in the classroom and then define exact rules for interpreting the recorded data. For example, DeBellis and Goldin (1997) used a coding system whose name was the Maximally Discriminative Facial Movement Coding System developed by Izard (1983). The coding system includes a score for each of three areas of face: an eyebrow/forehead movement code, an eyes/nose/cheeks movement code, and a mouth/lips movement code for every hundredth of a second of time on video. There are some other frequently used behavioral measures of emotion which are Ekman’s Facial Action Coding System (FACS; 2003) and Gottman’s Specific Affect Coding System (SPAFF; 1993). Moreover, by the development of technology, new measurement instruments were introduced into classrooms. For example, Isoda and Nagagoshi (2000) used a heart rate monitor to measure a volunteering student’s changing heart rate during mathematics lesson.

The other common way to study affect in mathematics education is to make interview. Hannula (2006) stated that in interviews the researcher typically focus on the content of the talk. The student may talk about emotions, beliefs and behaviors. However, he noted that this measurement approach is restricted to what the student is aware of and is willing to tell. In an interview, the researcher can also observe the interviewee’s facial expression, posture, tone of voice, which can tell us about either their emotion in the interview situation or their emotions associated with the content.

The most common way to study affect is still to use questionnaires and they are the most efficient tools for collecting information from a large group of respondents. According to Hannula (2006), one problem with questionnaire studies is that typically, these tools provide us only with the respondents’ surface. However, he pointed out that with a well-designed instrument, it is possible to reach the hidden dimensions of affect, at least on a general level of a large sample. Another problem is that over- or misinterpreting data collected through a questionnaire is easy. Lastly, questionnaire studies typically reach only the relatively stable affective traits, not more rapidly changing affective states. He mentioned that it is possible to collect data with a questionnaire during any process such as problem solving. Moreover, with on-line questionnaires, it is possible to collect data of the rapid emotions and changing goals in the process.

Hannula (2006) argued that regarding affective traits, there is a need for new longitudinal studies with measurement instruments that would take into account the synergistic relationships between cognition, emotion, and behavior. Since simple answers cannot satisfy the complexity of classrooms, more attention should be paid to three main elements in order to study affect in mathematics education: cognition, emotion and behavior. He further stated that questionnaires were the first main tool of research on affect in mathematics education and they still are one of the tools that are used frequently to measure affective traits in mathematics education. However, there is a shift toward more qualitative methods, especially in the 1990's, such as interviews and observations.

In summary, the vast majority of the past studies of affective issues have involved the use of questionnaires, quantitative methods and positivist traditions. However, future studies should emphasize qualitative methods and interpretivist assumptions much more than we see currently (Eisenhart, 1988).

2.1.1.2 Affect in Mathematical Problem Solving

In his review, McLeod (1994) stated that research on mathematics problem solving was heavily influenced by the theories and methods of cognitive science during the 1970's and 1980's. According to McLeod, cognitive science methods revealed in a way the importance of students' beliefs about mathematics.

Although students' beliefs about mathematics have received the most attention in research on problem solving, studies of other kinds of beliefs have always played a central role in research on affect (McLeod, 1994). He claimed that confidence about learning mathematics (Fennema & Sherman, 1976) has frequently been discussed as an attitude, but it may be useful to consider it as a belief about oneself. There are other beliefs that were considered part of affective domain include self-concept (Bachman, 1970; House, 1975), self-efficacy (Hackett & Betz, 1989), causal attributions (Schoenfeld, 1989; Wolleat, Pedro, Becker, & Fennema, 1980), and a variety of motivational variables (Leder, 1982; Nichools, Cobb, Wood, Yackel, & Patashnick, 1990).

Hannula (2006) mentioned that regarding affect in mathematical problem solving, there is a reasonably clear picture of the conditions for success and failure. He claimed that the critical moment while solving the problem is typically when the process is not straightforward, and a student encounters an initial in implementation of his approach. In other words, a student who has confidence and can control the intensity of frustration will more likely continue efforts and ultimately succeed. On the other hand, lack of confidence and emotion control will lead to wasting cognitive resources on anxiety and more likely to failure.

It is widely accepted that there are some clear affective traits that lead to success in mathematics (Hannula, 2006). He gave the example that an optimal student enjoys mathematics and has confidence in it, perceives mathematics as a sense-making activity and considers effort to be the essential element of success. Then, in problem solving, there is a complex relationship between the type of task and the optimal emotional state (nature and intensity of emotion). Moreover, positive affective disposition and success do not always go hand in hand, and even in the case of high correlation, it is seldom known the direction of causality.

2.1.2 Attitude

In a set of situations that have some social objects in common, there is also a set of social behaviors that a person shows as a consequence of these situations. If there is similarity among these social behaviors, then we say that the person has an *attitude* toward the social objects (Triandis, 1971). He stated that "this widespread thought was also supported by Campbell (1963) saying that attitudes represent consistency in response to social object" (p.2).

Although the definition of the term attitude has been varied over a long period of time by many psychologist and sociologist, the common point among those definitions is "the readiness to respond" to a situation. According to Triandis (1971), Allport's (1935) definition is still the most influential:

> "An attitude is a mental and neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with which it is related" (p.2).

Triandis (1971) made the definition of attitude which included many of the central ideas used by attitude theorists. According to his definition, "an attitude is an idea charged with emotion which predisposes a class of actions to a particular class of social situations" includes many ideas used by attitude theorists" (p.2). The definition was suggested that attitudes have three components:

> "(a) A cognitive component, that is, the *idea* which is generally some category used by humans in thinking. Categories are inferred from consistencies in responses to discriminably different stimuli. The category *cars* can be inferred, for example, by determining that people make similar responses to Fords, Chevrolets, etc., and other stimuli that they are capable of discriminating. Statements of the form "cars are …" cars have …" are also part of this component.
>
> (b) An *affective* component, that is, the emotion which charges the idea. If a person "feels good" or "feels bad" when he thinks about the category we would say that he has positive or negative affect toward the members of this category. For example, if he feels good when he thinks about cars he has a positive affective component of toward them.
>
> (c) A behavioral component, that is, a *predisposition to action*, such as driving, using, buying, or admiring cars" (p.3).

The words 'idea', 'emotion', and 'a class of actions' in the above definition corresponds to three components of the concept of attitude, respectively cognitive, affective and behavioral components, all of which depend on the interaction of the individual and his environment. Moreover, Triandis (1971) emphasized that affect is acquired through classical conditioning, when a category is paired with pleasant or unpleasant events and cognitive structures are acquired when categories are frequently paired with other categories or events in the particular environment in which a person grows up.

Although the three components are generally closely related, Triandis (1971) illustrated circumstances that can produce inconsistent components. He exemplified that a person who has just been in an automobile accident may have a negative affective component (fells "bad" when he thinks about cars), but he may realize that he cannot get around in his town without using cars and, therefore, has a positive behavioral component- is predisposed to use them.

In 1960, Rosenberg and Hovland represented attitudes as in Figure 2.2. In their schematic conception of attitudes, the stimuli are grouped in a category that represents the attitude object. Moreover, the attitude has three aspects and each aspect is measured by a variety of subject responses.

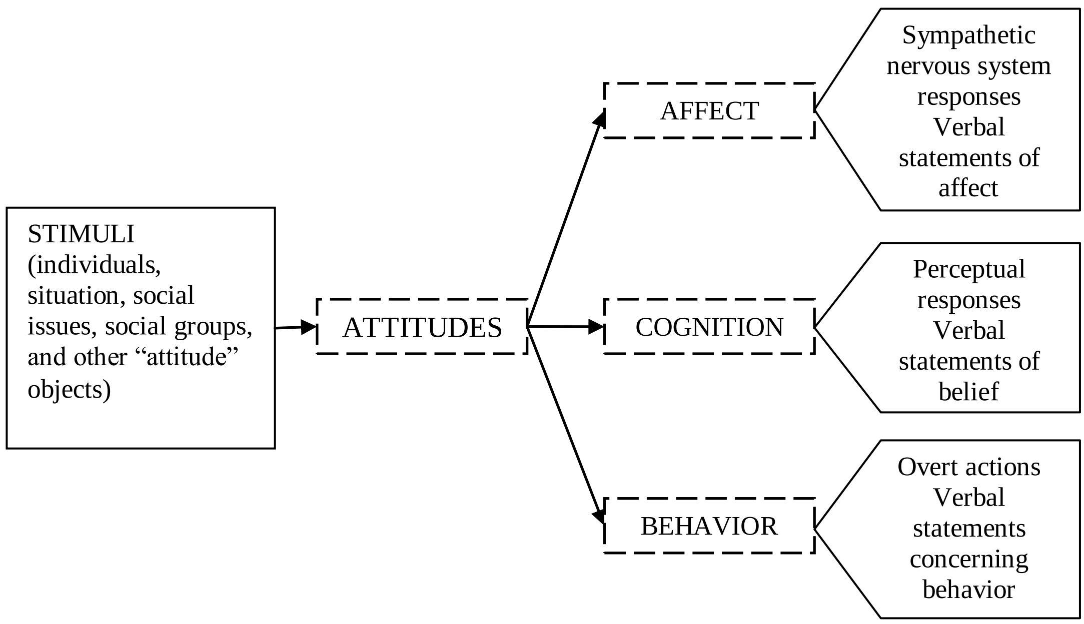

Figure 2.2 A Schematic Conception of Attitudes (Rosenberg & Hovland, 1960)

More recently, several authors (e.g. Di Martino & Zan, 2001a; Ruffell, Mason, & Allen, 1998) indicated that attitude is an ambiguous construct, it is often used correctly, and further development is needed in theoretical terms. However, in everyday life speaking, the term attitude is used as a person’s basic liking or disliking for a familiar object. Mouly (1960) claimed that attitudes are learned patterns of behavior which incline an individual to behave in specific ways when confronted with any situation. According to Kerlinger (1964) attitudes represent a predisposition to think, fell, value and act toward a cognitive target. Sherif and Cantrel (1965) suggested that attitudes determine how individual will react to specific stimuli. Lastly, McLeod (1992) stated that attitude refers to affective responses that involve positive and negative feeling of moderate intensity and reasonable stable.

The concept attitude in McLeod’s (1992) classification of the concepts of affective domain placed in the middle of the concepts emotions and beliefs. In social psychology, attitude has been divided into beliefs, emotions and behavior (Figure 2.3) (Hannula, 2002a, 2006; Di Martino & Zan, 2001a).

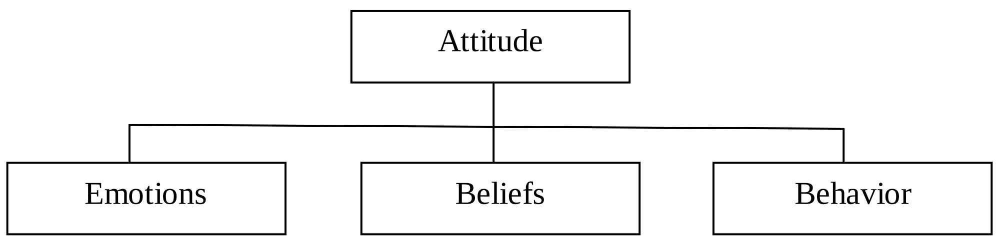

Figure 2.3 Classification of Sub-Constructions of Attitude (McLeod, 1992)

Attitude has also been considered as one of the subsets of the affective domain, the others being beliefs and emotions (McLeod, 1992), although it has some cognitive evaluations. Then, according to McLeod (1992) attitudes toward mathematics include anxiety, confidence, liking or disliking for mathematics, beliefs about self and attributions for success or failure. Therefore, this study completely differs from the previous studies in that the attitude does not include only affective evaluations of the situations such as emotions; on the other hand, it includes some behavioral and cognitive evaluations of them. Besides, in the present study, different aspects of attitude are carefully described.

Hannula (2006) emphasized that combining McLeod's (1992) approach and the one above is problematic. He stated that this is because that emotions and beliefs are sub-constructs of affect together with attitude in one approach whereas, in the other approach emotions are beliefs are sub-constructs of attitude. Therefore, they emphasized clearly that more coherence is needed.

Many surveys and meta-analyses have studied on the issue of the development of attitudes which portray a general overview of it. Similarly, there are basically two efforts for promoting positive attitudes. The first effort is systematic desensitization which reduces mathematics anxiety in of students (Hembree, 1990). In systematic desensitization the student would engage in mathematical situations in a safe environment. A first sign of anxiety should be removed with a relaxation of student. More cognitive beliefs, such as personal theories on intelligence, can be influenced more directly through teaching. However, efforts to improve teaching to encourage the desired attitude have not generally been successful on whole class level (McLeod, 1994). A common belief that being mathematically talented is innate therefore, hard work is an indication of lack of talent can be accomplished by effective teaching methodologies. Carefully designed collaborative activities provide opportunities for all kinds of social needs of each student (Boaler, 1997a, 1997b, & 1998; Ridlon, 1999). Indeed, boring routines during the mathematics lessons can be accomplished by enjoyable games.

McLeod (1994) claimed that attitudes tend to become more negative as pupils move from elementary to secondary school. Haladyna et al. (1983) stated that the general attitude of the class toward mathematics is related to the quality of the teaching and to the social-psychological climate of the class.

In this study, attitude is not seen as a unitary psychological construct, but as a category of behavior which is constructed by different evaluative processes. Students may express their liking or disliking for mathematics because of emotions, beliefs or behaviors. The three components are very strongly related with social environment that the student is in and his or her cognitive interpretations of the situation.

2.1.2.1 Attitude toward Mathematics

Attitude and attitudes in education, particularly in mathematics is a rich field of study. Prescott (1938) claimed that the primary goal of educators is assisting a student with the organization of his own experiences which accomplishes the development of attitudes throughout the school years. Therefore, it is certain that a lot of research has been done on attitude in education, but the concept needs to be developed.

With in the field of affect, research on attitude has probably the longest history, but also the most ambiguous theoretical framework. According to many researchers (Kulm, 1980; Leder, 1985; McLeod, 1992; Ruffell et al., 1998), one of the reasons that have hindered the development of an adequate theory is the fact that most studies have concentrated on the creation of measurement instruments, rather than on the development of a theoretical base.

The definition of attitude toward mathematics is not as definite as its importance in mathematical thinking and learning. Hannula (2006) claimed that attitude toward mathematics is often defined as an inclination to evaluate mathematics favorably or non-favorably ('I like …', 'It is important' …) which is actually the 'simple' definition of attitude toward mathematics. Moreover, he pointed out that attitude which is defined as liking may be affected by situation variables (e.g. teacher behavior), automatic emotional reactions of the student (based on some traumatizing event(s) in the past), expectance of outcome (beliefs), goals of different student (e.g. career aspirations), or social variables (attitudes of family).

Di Martino and Zan (2001b) claimed that among the various definitions of attitude, two are most used in mathematics education:

> "1. A 'simple' definition of mathematics attitude is the degree of affect associated with mathematics; i.e. attitude is an emotional disposition toward mathematics (Halanyna, Shaughnessy & Shaughnessy, 1983; McLeod, 1992)

> 2. A three-component definition of attitude toward mathematics distinguishes emotional response, beliefs and behavior as components of attitude (Leder, 1992; Ruffell et al., 1998)" (p.18).

Although these two definitions of attitude are not in contradiction with each other, most researchers assume the first one as definition and the second one as specification, since those researchers believe that there are three classes of responses elicited by attitude object: cognitive, affective and behavioral (Di Martino & Zan, 2001b).

The first approach of attitude toward mathematics ignores the cognitive component of attitude hence those people use this kind of definition get trouble in distinguishing emotional disposition from beliefs. On the other hand, the second kind of definition conflicts with the widely accepted view of definition of attitude i.e. attitude is emotional disposition (McLeod, 1992, DeBellis & Goldin, 1997), since it accepts emotions and beliefs as including in the affective domain.

Hannula (2002a) claimed that to get the whole understanding of aspects of attitudes toward mathematics, those affective variables are not enough. He analyzed student's attitude toward mathematics with a new conceptualization for attitude different from a number of studies conceptions of attitude. The foundation of his presented framework was built from the background of psychology of emotions. According to Hannula, four different evaluative processes construct a student's attitude toward mathematics: 1) the emotions the student experiences during mathematics related activities, 2) the emotions that the student automatically associates with the concept of 'mathematics', 3) evaluation of situations that the student expects to follow as a consequence of doing mathematics and 4) the value of mathematics-related goals in the student's goal structure. He claimed that these four evaluations produce attitude. However, all these evaluative processes are strongly influenced by the social setting that the student is in and by the student's cognitive interpretations of the situation.

Many reviews and analyses on attitude toward mathematics use attitudes as a general term that includes beliefs about mathematics and about self (McLeod, 1994).

However, in McLeod's paper on research on affect in mathematics education (1992), attitude was referred to affective responses that involve positive or negative feelings of moderate intensity and reasonable stability. At this point the definition of attitude is somewhat incomplete since it ignores the cognitive and behavioral responses to an attitudinal object. Therefore, the existence of an attitude is proved by the general view of the term of attitude which is referred as consistencies in "thinking, "feeling" and "acting" (Triandis, 1971).

Halanyna, Shaughnessy, and Shaughnessy (1983) claimed that attitude toward mathematics is not to be confused with attitude toward the field of mathematics, toward one's ability to perform in the field of mathematics or toward some specific area within mathematics (e.g. geometry, word problems). They emphasized that generally, a positive attitude toward mathematics is valued 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 elect mathematics courses in high school and college and possibly one's tendency to elect careers in mathematics or mathematics-related fields" (p.20).

2.1.3 Emotions

Mathematics evokes intensive emotions in many people; they like or dislike it, even they love or hate it. It is certain that there is a strong relationship between affect and mathematical thinking and learning. A negative affect can seriously damage student's academic goals.

Researchers have not agreed upon what they mean by emotions, but there is a large agreement on certain aspects (Hannula, 2006). This characterization has been used as a framework for most of the researchers on emotions in mathematics education (Buck, 1999, Damasio, 1995; Lazarus 1991, LeDoux, 1998, Mandler 1989, Pekrun, Goetz, Titz, & Perry, 2002; Power & Dalgleish, 1997). Primarily, emotions are seen in connection to personal goals: they code information about progress toward goals and possible blockages, as well as suggest strategies for overcoming obstacles. Secondly, emotions are also seen to involve a psychological reaction, as distinction from non-emotional cognition. Thirdly, emotions are also seen to be functional, i.e. they have an important role in human coping and adaptation. In other words, Hannula (2006) mentioned that emotions consist of three processes: psychological processes that regulate the body, subjective experiences that regulate behavior and expressive processes that regulate social coordination (e.g. Buck, 1999; Power & Dalgleish, 1997; Schwarz & Skrunik, 2003). However, the basic approach with emotions is that there are only a few basic emotions that differ in their psychology: happiness, sadness, fear, anger, disgust and interest. Furthermore, the more complex emotions are based on these emotions and there are some other basic emotions apart from these (Buck 1999; Power & Dalgleish, 1997).

Another characterization of emotions that Hannula (2006) pointed out that according to Buck (1999), emotions have three mutually independent readouts: adaptive-homeostatic arousal responses (e.g. releasing adrenaline in the blood), expressive displays (e.g. smiling) and subjective experience (e.g. feeling excited) (Table 2.1). Hannula (2006) pointed out that all these readouts are regarded as part of the emotional state. Moreover, the term emotion was not restricted to intensive, ‘hot’ emotions in contrast to its use in mathematics education, instead a mildly sad mood was considered as an emotional state. However, researchers have not agreed upon three major issues which are the borderline between emotion and cognition, the number of different emotions, and whether emotions are always conscious (Hannula, 2006).

Table 2.1 Three Readouts of Emotion (Buck, 1999)

Readout target	Readout function	Accessibility	Learning
I Autonomic/ endocrine/immune system responding	Adaptation/ homeostatic	Not accessible	Psychological adaptation
II Expressive behavior	Communication/ social coordination	Accessible to others (and self)	Social development
III Subjective Experience	Self-regulation	Accessible to self	Cognitive development

Similarly, Hannula (2006) pointed out that there are two main routes for emotions to arise. The first route is an automatic, preconscious emotional reaction (often fear) to a relatively simple stimulus (e.g. a sound, an object or a concept). According to Hannula (2006) such automatic emotional reactions form a basis for some emotional traits and they are based on earlier experiences. These earlier experiences have left an association (a memory trace) between the emotion experienced in a situation and a specific element of the situation. If this automatic, preconscious emotional reaction would be thought in the mathematics classroom, it might be, for example, anxiety generated by the tone of voice of the teacher, by peer's laughter, or through identifying the concept 'fraction' (Hannula, 2006). In general, such emotional reactions are assumed to be fast and have evolutionary provided shorter reaction times to possible treats. However, they lack flexibility and are difficult to change once formed (Power & Dalgleish, 1997). The other route to an emotional reaction is based on analyses of personal goals and elements in the situation. Hannula (2006) stated that even though this emotional reaction is more flexible and possible to affect through conscious deliberations, if one's goals and beliefs are relatively stable, the emotional reaction will also remain stable.

2.1.4 Beliefs

Belief is one of the most frequently used concepts in mathematics education. Furinghetti and Pehkonen (2002) analyzed the different characterizations used by researchers in this field, and they concluded that there is a lack of agreement on what beliefs are (Hannula, 2006). They added that there are different views about how much are emotions part of beliefs.

Hannula (2006) pointed out that belief research has distinguished different objects of beliefs (e.g. McLeod, 1992) and emphasized each of these has its own significance. Hannula (2006) claimed that beliefs about self (e.g. self-efficacy beliefs) are psychologically centered and often difficult to change once formed. On the other hand, on the part of beliefs about the nature of mathematics, he stated that students often hold different views about different domains of mathematics, such as algebra or problem solving.

2.1.5 Behavior

In the 9th International Congress on Mathematics Education (ICME9), Vinner (2000) pointed to the core of all human behavior: "… human behavior, as well as human thought, is determined by human needs" (p.6). According to Hannula (2006), needs are specified instances of the general 'potential to direct behavior'. In the existing literature (Boekaerts, 1999; Covington & Dray, 2002), psychological needs that are often emphasized in educational settings are autonomy, competency, and social belonging. In addition, Nuttin (1984) claimed that the difference between needs and goals is in their different levels of specificity. Hannula (2006) clarified the claim of Nuttin (1984) by giving an example in the context of mathematics education; a student might realize a need for competency as a goal to solve tasks fluently or, alternatively, as a goal to understand the topic taught. A social need might be realized as a goal to contribute significantly to collaborative project work and a need for autonomy as a goal to challenge the teacher's authority. In other words, goals are devices in order to achieve the needs of an individual. Moreover, an individual might choose different goal or goals in order to accomplish same need.

2.1.6 Interactions between Emotion, Cognition, and Behavior

2.1.6.1 Emotion-Cognition Interaction

There are many researches documented on the interaction with emotion and cognition. However, there are at least two fundamentally different ways of emotion generation (Power & Dalgleish, 1997). The first way is the cognitive analysis of the situation with respect to one's view of self the worlds and one's goals. Another way is the prior experiences that have indicated the association between a specific stimulus and an emotion. The second way is very important with respect to the simple definition of attitude as an emotional disposition which is automatic one.

Emotion and cognition are two complementary aspects of mind. However, there are some phenomenological differences between them (Hannula, 2002a). The most basic difference is that cognition is neuron-based information processing, whereas emotions include other physiological reactions, too. Another difference is that there is a less agreement on the definitions of emotions and theories of it than cognition is. Lastly, emotions are more central to attitudes comparing with cognition. Although there are some important differences between them the interaction between two is so intense that they cannot be fully understood by separating one from the other.

Hannula (2006) pointed out that advances in the neuropsychological basis of affect (Damasio, 1995; LeDoux, 1998) have radically changed the prevalent view of the relationship between emotion and cognition. Emotions had been seen as peripheral to cognitive processes or 'noise' to impede rationality. However, they have been accepted as necessary for rational behavior. Moreover, it has been accepted that emotions guide an individual's self-regulated behavior toward the goals he or she has (Hannula, 2006).

Hannula (2006) stated a general view that emotions direct attention and bias cognitive processing. An example showing how emotions direct attention and how they bias cognitive processing could be that fear (anxiety) directs attention toward threatening information and sadness (depression) biases memory toward a less optimistic view of the past. He added that emotions also activate action tendencies (e.g. fight or fight-response).

Linnenbrink and Pintrich (2004) claimed in their article that certain emotions facilitate certain type of processing. They concluded that:

> "As we are yet unsure exactly how moods and emotions relate to cognitive processing in a broad variety of tasks it is difficult to make recommendations for educators regarding the types of affect that may be beneficial for processing." (p.84).

Hannula (2006) stated that some general principles have been widely accepted. Firstly, effective regulation of emotions has been identified as essential for good mathematical problem solving. Secondly, research has confirmed that there is a positive relationship between positive affect and achievement. Thirdly, a general principle for promotion of positive affect would be awareness to students' needs. In a teacher-centered mathematics classroom, there is little opportunity to meet the students' needs for autonomy and social belonging since rules and routines and individual drilling were emphasized. On the other hand, a classroom that reflects social-constructivist view of learning provides plenty of opportunities to meet different needs of students and actually relies on students exhibiting their autonomy and social interactions. Therefore, if teachers find tasks that are engaging and create a learning context where engagement can be sustained, then the students will not only stay on task, but they will also work more intensively.

2.1.6.1.1 Attitude in Cognitive-Emotional Terms

Emotions are the most fundamental processes which underlies every expression of evaluation in one way or another. In mathematics courses, a student evaluates the situation engaged in either consciously or unconsciously with respect to personal goals. Moreover, Buck's (1999) analysis of different readouts for emotions can produce some expression of an evaluation of mathematics.

With respect to different researches on attitude and changes in attitude Hannula's (2002a) research is of particular importance. In his research, he used a similar distinction of different aspects of mental states that underlie attitudes as DeBellis and Goldin's (1997). However, his terminology and underlying theoretical foundation have some differences from the work by DeBellis and Goldin. In his study, student's attitude toward mathematics was observed with a new conceptualization for attitude. Actually, the foundation of his framework was built from the background of psychology of emotions. According to Hannula's framework, four different evaluative processes construct a student's attitude toward mathematics: 1) the emotions the student experiences during mathematics related activities, 2) the emotions that the student automatically associates with the concept of 'mathematics', 3) evaluation of situations that the student expects to follow as a consequence of doing mathematics and 4) the value of mathematics-related goals in the student's goal structure. He also conducted a case study followed by his framework which also provides a valuable insight into the development of attitude.

There were some limitations to Hannula's study, however. First of all, although he concluded that attitudes can change dramatically, in relatively short time, he did not identify the factors that are influential for changing attitude. As Boaler (1997a, 1997b, & 1998) concluded in his studies that understanding is a key factor in attitude change, there can be some other factors such as a high test performance that is a key factor of attitude change. The second limitation of the study is that only one case study is presented as an example of his proposed framework. Lastly, since there is only one student's attitude is analyzed with the respect to the presented framework; there is no evidence that it can be assignable to any age, topic or culture.

2.1.6.2 Cognition-Behavior Interaction

Hannula (2006) pointed out that in mathematics classrooms, students derive goals from their needs which is greatly influenced by their beliefs about themselves, mathematics, learning and the social environment. In other words, deriving goals from needs is mediated by individual's personal beliefs. He described that in some circumstances a single goal may satisfy multiple needs or a need to be satisfied through multiple goals. Moreover, one goal may prevent achieving another goal. Hannula (2006) stated that for example, mastery and performance are usually seen as competing goals (e.g. Linnenbring & Pintrich, 2000; Lemos, 1999). However, his analysis of two students, Maria and Laura (Hannula, 2002b), indicated that mastery and performance were goals that supported by each other. He found that Maria had a need for competence and her primary goal was mastery of mathematics. However, performance in mathematics tests was an important sub goal for her evaluation of reaching mastery goal. On the other hand, Laura had a desire to gain high status in mathematics class. As a result, performance was her main goal, while mastery of mathematics was an important sub-goal for her.

The case study of Rita (Hannula, 2002a) presented that in the beginning, her self-defensive goals were dominating her behavior. However, later her self-defensive goals were replaced by her performance goals. Furthermore, she possessed a new awareness of the importance of school success in general, together with more positive self-efficacy beliefs. Therefore, the analysis of Rita showed that a radical change in beliefs may affect behavior of student.

2.1.7 Affective Variables in Mathematics Education

Students' attitudes toward mathematics are thought to be important factors in learning the subject. Early studies in this field typically were limited to an assessment of students' interests in or liking for the subject, the class or the teacher (Dutton, 1956 & 1968). However, current research has identified many facets of student attitudes toward mathematics and has examined them in a variety of context (Aiken, 1970, 1972a, & 1976).

A well-known review by Aiken (1976) cited studies which investigated one or more of the following: perceptions of teaching, perceptions of the teacher, anxiety (math phobia) and value of mathematics in society, enjoyment and interest in mathematics. In these studies, the facets of attitudes toward mathematics were examined in relation to student development, sex of student, student self-concept, achievement, personality attributes and certain instructional and curricular factors.

Aiken’s review concluded that attitude toward mathematics is significantly related to a number of personality variables indicative of good adjustment. He identified some of the personality characteristics related to mathematics attitude as a high sense of personal worth, a greater sense of responsibility, high social standards, high academic achievement motivation and greater freedom from withdrawing tendencies. He further claimed that students with positive attitudes toward mathematics tend to like detailed work, to view themselves as more persevering and self-confident and to be more “intuitive” than “sensing” in their personality type.

It is well recognized that in partially explaining individual differences in the learning of mathematics, affective factors are very important (Fennema & Sherman, 1976). In a review of related literature, The Fennema-Sherman Attitude Scales with well-defined dimensions that are related specifically to the learning of mathematics seem to be the most recent and acceptable instrument that have been used in studies dealing with attitudes toward mathematics. These scales were developed as a grant from the National Science Foundation and the main purpose of this project was to gain more information concerning females’ learning of mathematics as well as information concerning variables related to the election of mathematics courses. To accomplish this purpose, Fennema and Sherman developed nine domain-specific, Likert-type scales that measure important attitudes related to mathematics learning. They emphasized that the scales may be used as a group, individually, or in any combination desired. The nine attitude scales were The Attitude toward Success in Mathematics Scale (AS), The Mathematics as a Male Domain Scale (MD), The Mother Scale (M), The Father Scale (F), The Teacher Scale (T), The Confidence in Learning Mathematics Scale (C), The Mathematics Anxiety Scale (A), The Effectance Motivation Scale in Mathematics (E) and The Usefulness Scale (U).

In his article, Reyes (1984) discussed four important affective variables: confidence in learning mathematics, perceived usefulness of mathematics, mathematics anxiety and attributions of success and failure in mathematics. However, only the first three variables were discussed in this study.

2.1.7.1 Confidence in Learning Mathematics

Confidence is an important affective variable in mathematics education. Reyes (1984) defined confidence in learning mathematics as one's self-concept specific to mathematics. In other words, how sure students is of being able to learn new topics in mathematics, perform well in mathematics class and do well on mathematics tests describes one's confident in learning mathematics. She claimed that confident students tend to learn more, feel better about themselves and be more interested in pursuing mathematical ideas than students who lack confidence. Moreover, students who are sure of their ability in mathematics will probably choose tasks involving mathematics more often and persist longer than those who are not sure they will succeed.

Fennema and Sherman (1976) selected the attitude, confidence in learning mathematics as one of the variable that was related to the learning of mathematics, either by all students or specifically important for females in their study. The scale named "The Confidence in Learning Mathematics Scale (C)" was intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. They emphasized that the scale was not intended to measure anxiety or mental confusion, interest, enjoyment or zest in problem solving. Moreover, in the scale the dimension ranges from distinct lack of confidence to definite confidence.

Crosswhite (1972) first studied confidence in learning mathematics in the National Longitudinal Study of Mathematical Abilities (NLSMA). He investigated the relationship between confidence in learning mathematics and mathematics achievement and found correlations between confidence and mathematics achievement scores ranging from 0.19 to 0.37.

Since Crosswhite (1972) many researchers examined correlations between confidence and mathematics achievement but the present study is not concerned with the mathematics achievement at all. Other studies investigated the variables that predict students' election of optional mathematics courses found that confidence in learning mathematics is an important predictor. Perl (1979) reanalyzed the NLSMA data in his doctoral dissertation and found that confidence was a strong predictor of election of high school mathematics courses.

Sherman and Fennema (1977) obtained similar results that of Perl's. They examined the degree to which a variety of affective variables predicted high school students' plans to take more mathematics courses. It was found that confidence was the strongest predictor of all the affective variables included in the analysis, although other variables were significant predictors.

To sum up, considerable research about confidence in learning mathematics indicates the importance of this variable in relation to student election of mathematics courses, classroom processes and gender-related differences in mathematics achievement. Other studies examining the relationship between confidence and other affective variables were presented in the previous studies section of the present chapter.

2.1.7.2 Usefulness and Importance of Mathematics

Reyes (1982) defined the perceived usefulness and importance of mathematics as students' views about the usefulness and importance of mathematics both for their current needs and for the future. Students vary in their perception of the usefulness and importance of mathematics both for their current and for the future. Their perceptions of the usefulness and importance of mathematics is an important factor for determining their election of taking mathematics classes for their future education.

In Fennema-Sherman Mathematics Attitude Scales (1976), the scale named "The Mathematics Usefulness Scale (U)" was designed to measure students' beliefs about the usefulness of mathematics currently and in relationship to their future education, vocation or other activities.

Normally, some students enjoy learning and studying mathematics, whereas others do not. However, many of the high school students elect to take mathematics classes even if they do not particularly like it. It is because mathematics is necessary for their career goals. Others who do not need to mathematical knowledge for reaching their career goals take only the compulsory mathematics classes in high school. As a result, they limit their career choices for the future. Therefore, it is very important for students to understand the importance of mathematics especially when they make decisions about how much mathematics to take in high school for their career goals and education beyond high school.

According to Reyes (1984), a few studies have examined students' perceptions of the usefulness of mathematics. Some of the studies investigated the correlations between students' perception of usefulness of mathematics and their mathematics achievement (Armsrong, 1980; Brush 1980; Fennema & Sherman 1977, 1978; Fox, Brody, & Tobin, 1980; Haven, 1971; Hilton & Berglund 1974). Others examined the degree to which students' perceptions of the usefulness of mathematics predict their election of more mathematics courses (Sherman and Fennema, 1977; Perl, 1979). They found that students who perceived mathematics as useful tended to elect more mathematics courses. Further, Armstrong and Price (1982) studied the effects of several affective variables on students' decisions to take more mathematics. They found that usefulness of mathematics is the most important factor in their decisions. Students' career plans is an important aspect of usefulness of mathematics and usefulness is the most important factor in their course decisions even they liked or disliked mathematics and perceived themselves good or bad at mathematics.

Perceived usefulness can be understood better within the framework of task value (Meece, Parsons, Kaczala, Goff, & Futterman, 1982) and achievement motivation. The model emphasizes that the student confidence, and therefore his expectancy of success, can be low, but a strong perception that mathematics is useful, and therefore valuable, will result in the motivation to continue, despite difficulty. Moreover, considerable research about the usefulness and importance of mathematics indicates that this variable is the most important factor for students' decisions about learning and studying mathematics and, of the all affective variables usefulness may be the easiest to change in students' views.

In 1974, Aiken complained about investigations concerned with the developing and influencing of attitude toward mathematics has dealt almost exclusively with enjoyment of the subject or anxiety in its presence. To correct that shortcoming, he constructed two scales of attitude toward mathematics which measure the objective "enjoyment of mathematics" (E Scale) and the objective "recognized importance," or value, of mathematics (V Scale). He randomly arranged the 12 items of the initial E Scale and the 11 items of the initial V Scale in a format of the Likert type, together with 17 other items concerned with interests, achievement, and other biographical information. The resulting 40-item opinionnaire was administered to 100 woman and 90 men in the freshman class at a south-eastern collage during the fall semester of 1972. Completed, usable opinionnaires were handed in by 98 woman and 87 men. He found that the variance of total scores on the E Scale was significantly higher (${s_E}^2$ = 122.25) than the variance of total scores on the V Scale (${s_V}^2$ = 37.85). However, although the E Scale was composed of 11 items and the V Scale of only 10 items in their final forms, the mean score on the latter ($\overline{V}$ = 27.24) was substantially higher than the mean score on the former scale ($\overline{V}$ = 21.94). Furthermore, the mean scores of men were not significantly different from those of women on either of the two scales. As a final finding, the correlation between E and V Scales for all 185 students was 0.64, indicating that although there was a considerable overlap between the two scales, they were not measuring identical variables.

2.1.7.3 Anxiety in Mathematics

The definition of mathematics anxiety is a problematic one as with that of many affective variables. In order to understand the mathematics anxiety that is, the anxiety about mathematics, it is useful to review the psychological term anxiety.

Anxiety is a psychological construct and there are many definitions of it in the psychological literature. Spielberger (1972) classified anxiety into two category as state anxiety and trait anxiety. He defined state anxiety as the unpleasant emotional state or condition which is characterized by activation or arousal of the autonomic nervous system. Whereas, trait anxiety is a personality trait of being prone to anxiety. State anxiety is time and situation specific however, trait anxiety is not.

Stressor → Perception of Threat → A-State Reaction → Cognitive Reappraisal

→ Coping

Figure 2.4 Anxiety as Process (Bryd, 1982)

Byrd (1982) presents a model of process of anxiety (Figure 2.4). This model was adapted from Spielberger's (1972) work on anxiety. The model shows the sequence of responses with which an individual reacts to an anxiety-arousing situation. First, the individual has a stressful experience, which is subsequently perceived as threatening in some way. The perception of threat may come immediately after the stressor or after some time has passed. No anxiety is produced unless the individual is aware of the stressful experience or perceives it as a threat. The anxiety reaction itself consists mainly of psychological and behavioral signs associated with the reaction to the stressor. The psychological reaction may include a speeding of hearth and breathing rate, tensing of muscles, sweaty palms, dilation of pupils or other responses of the autonomic nervous system. Behavioral reactions are more subject to conscious control by the individual than the psychological ones, and may include trembling of the voice, biting of fingernails, or fidgety behavior. Cognitive reappraisal comes after the A-state reaction begins, though the anxiety reaction does not necessarily end when cognitive reappraisals begin. This state consists of selecting a method of coping with the stressor. Coping with the stressor may take a variety of forms, involving actions to combat the threat, inaction, or defense mechanisms such as repression and rationalization. Some forms of coping may actually improve an individual's performance. This often occurs when the arousal from anxiety is great and the individual takes positive action to reduce the unpleasant state. More frequently, however, the methods of coping decrease performance or have a negative effect on the individual. When the consequences of anxiety are positive, the anxiety is facilitative; when the consequences are negative, the anxiety is called debilitative.

There is a connection between mathematics anxiety and general anxiety. However, there are few studies that indicate the direction of this connection. Betz

(1978) studied a large sample of 652 undergraduate college students and found that students high in mathematics anxiety tended also to be high in trait and test anxiety specifying correlations of −0.28 between scores on the Fennema-Sherman Mathematics Anxiety Scale (MAS) (1976) and the A-trait scale of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene 1970) and −0.42 between MAS scores and responses to Spielberger's Test Anxiety Inventory (Spielberger, Gonzalez, Taylor, Algaze, & Anton, 1978).

Another study by Hendel (1980) examined the relationship between mathematics anxiety and test anxiety for a group of 69 adult women. In the study, the correlation between scores on the Mathematics Anxiety Rating Scale (MARS) (Richardson & Suinn 1972) and the Suinn Test Anxiety Behavior Scale (STABS) (Suinn, 1969) was found 0.65. Both studies point to a positive relationship between mathematics anxiety and general trait test anxiety. Besides, they suggest that mathematics anxiety may be more strongly related to test anxiety than to trait anxiety.

As that of the definition of it, there is a variety of definitions of mathematics anxiety. The most commonly used of these is from Richardson and Suinn (1972):

> "Mathematics anxiety involves 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.151).

Byrd (1982) preferred to expand the anxiety portion of the Richardson and Suinn definition to include both facilitative and debilitative anxiety and to expand the concept of mathematics to include any situation in which mathematics is confronted. However, both of the definitions assume that mathematics anxiety is an A-state aroused in mathematical situations.

Apart from a variety of definitions of mathematics anxiety, Bryd (1982) and Buxton's (1981) studies on the nature of mathematics anxiety build a model or theory of mathematics anxiety. Byrd (1982) used a naturalistic research paradigm and conducted a series of in-depth, semi structured, individual interviews with six college students. A major purpose of her study was to develop a detailed description of the nature of mathematics anxiety as perceived by mathematics-anxious individuals. She found that mathematics anxiety manifests itself in many ways. It tends to be more of a state than a trait anxiety. Those interviewed experienced mathematics anxiety both during mathematics tests and in nonevaluative situations, and in nearly all cases they viewed this anxiety as debilitating. Students mentioned mathematics anxiety as a cause of avoiding not only mathematics courses but certain jobs, science courses, some careers, tests, balancing the checkbook and colleges with heavy mathematics requirements. In turn, a few students saw avoidance of mathematics as a cause of mathematics anxiety.

Buxton (1981) did a qualitative study of what he calls "panic" about mathematics. The outcome research was a model of how panic, a form of mathematics anxiety, can block thinking. According to Buxton, reason has three parts; delta one, delta two, and delta three, which work on different aspects our world. Delta one works on sensory information from the physical world, delta two works on the mental world within the individual, and delta three deals with how delta one and delta two work. Buxton posits that whenever an individual works on a mathematical task there is a interaction and feedback between reason and emotions. It may happen that delta one solves the problem routinely or that delta one goes to delta two for a solution plan, producing at the same time a positive emotion that may help in completing the solution. However, for some people in some situations, a threat of impending failure arouses negative emotions, which causes delta one to go to delta two with such urgency that delta two is unable to provide a solution plan. This results in delta two switching back to delta one, leading to an unending loop between delta one and delta two with much negative response from the emotions. The repeated switching from delta one to delta two and back produces a metal paralysis that is called panic. In this scenario the emotions limit performance, perhaps to the degree of stopping all productive thought about the problem's solution. Though Buxton has very little knowledge of the psychological literature on anxiety, his model deserves attention by both teachers and researchers. In summary, Buxton and Byrd provide the beginning of a theoretical foundation for research and interventions dealing with mathematics anxiety.

Lastly, Fennema and Sherman (1976) developed "The Mathematics Anxiety Scale" in order to measure feelings of anxiety, dread, nervousness, and associated bodily symptoms related to doing mathematics. They emphasized that the scale is not intended to measure confidence in, or enjoyment of, mathematics. Moreover, in the scale the dimension ranges from feeling at ease to feeling distinct anxiety.

2.1.8 Models for Research in Mathematics Education

There are three models that guide research studies in affective domain and mathematics education: Kulm's Model, Fennema and Petersons' Model and Eccles and his Colleagues' Model.

2.1.8.1 Kulm's Model

Kulm (1980) presents a model for the relationship between attitudes and behavior. The model (Figure 2.5) was developed as a source of hypotheses for research on attitudes toward mathematics (Reyes, 1984).

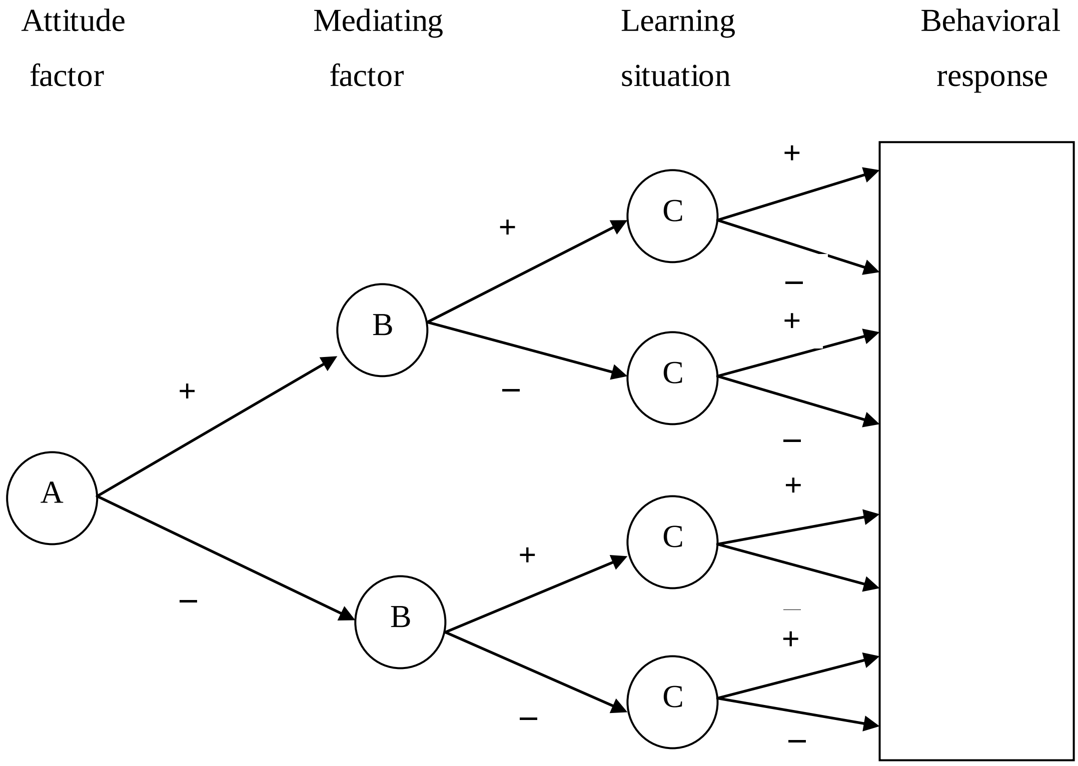

Figure 2.5 Model for Attitude-Behavior Relationships (Kulm,1980)

In the model the attitude factor, represented by a, may be either positive or negative. An example of a positive attitude factor is “enjoys mathematics”. B represents a mediating factor such as liking the mathematics teacher (positive factor) or feeling that mathematics is an inappropriate are of study (a negative factor). The learning situation, C, is concerned with factors such as the difficulty of the learning task, the importance of the task, or the length of time needed to complete the learning task. The behavioral response might be spending time on task, being persistent in working on mathematics assignments, or completing difficult assignments (Reyes, 1984).

Reyes (1984) stated that in Kulm’s Model for attitude-behavior relationships, the general form of hypotheses generated from the model:

“*Hypothesis:* Given attitude factor A (+ or −), mediating factor B (+ or −), and learning situation C (+ or −), the subject’s

> response will be (positive or negative). Some examples of hypotheses formed from the model as follows.
>
> *Hypothesis:* Students who perceive mathematics as useful will show more persistence on an important assignment than students who do not perceive mathematics as useful, when the assignment is difficult and the teacher is disliked.
>
> *Hypothesis:* Students who believe the study of mathematics is not appropriate to their sex role will take fewer optional courses, regardless of learning situations and how much they enjoy mathematics, than students who believe that mathematics is an area of study congruent with their sex role" (p. 575).

She explained that in Kulm's model even though the arrows point from attitude toward behavior, attitudes are important both as independent and dependent variables. She gave the example that the hypothesis: Students who are frequently assigned tasks too difficult for them will not enjoy mathematics, regardless of other mediating and learning situation factors. Therefore, it is an example of a hypothesis with attitude as a dependent variable.

Reyes (1984) emphasized the major benefit of the Kulm model as it requires the researcher to think carefully about not only attitude and behavior but also about the details of the learning situation and mediating factors. Therefore, more systematic and carefully designed studies must be performed for having a better understanding of the relationship between attitude and behavior in mathematics.

2.1.8.2 Fennema and Petersons' Model

Fennema and Peterson (1983) developed a model that provides direction for research on gender-related differences in mathematics achievement. (Figure 2.6). It is concerned with several affective variables (Reyes, 1984).

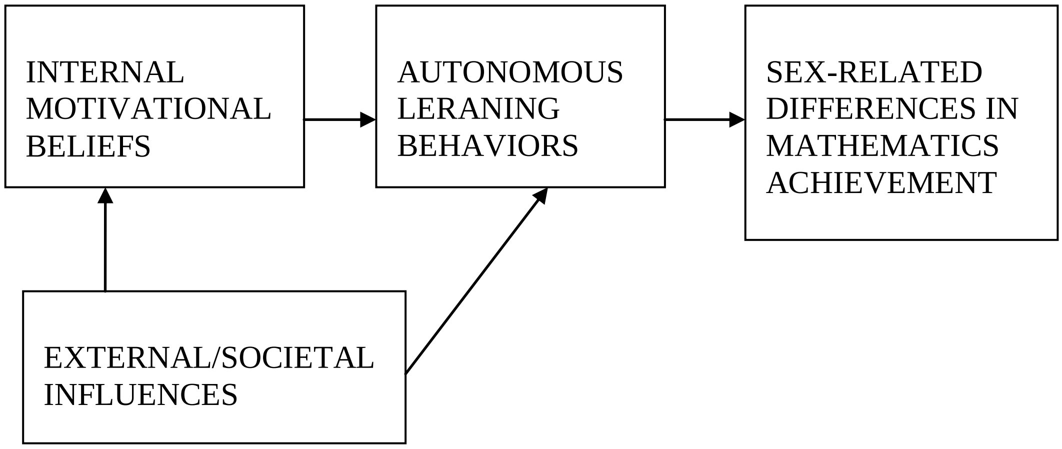

Figure 2.6 Autonomous Learning Behavior Model (Fennema & Peterson, 1983)

Fennema and Peterson hypothesize that certain behaviors are crucial for success on problem-solving tasks in mathematics. In order to solve complex mathematical tasks, the student must be able to work independently, must persist, must choose such tasks to work on and must succeed in solving the tasks. Fennema and Peterson call these behaviors "autonomous learning behaviors" (ALB). The model suggests that ALB is influenced by both internal and external factors, and in turn, differential use of ALB by females and males produces gender-related differences in mathematics achievement. In this model, internal motivational beliefs include several interrelated components: confidence in learning mathematics, perceived usefulness of mathematics, pattern of causal attribution for success and failure in mathematics and perception of how mathematics achievement fits one's sex role identity. The major external influence discussed by Fennema and Peterson is the mathematics classroom, including all the interactions between teacher and student.

According to Reyes (1984) the Fennema-Peterson autonomous learning behavior model is important in research on the affective domain for several reasons. Firstly, the model suggests new behaviors such as persistence, independence, and choice to which affective variables may be related in mathematics. Secondly, the model encourages study of the link between the affective domain and problem solving. Lastly, the model provides new directions for research on affective variables relevant to the important area of gender-related differences in mathematics.

2.1.8.3 Eccles and His Colleagues' Model

The third model developed by Eccles, Adler, Futterman, Goff, Kaczala, Meece and Midgley (1983) views mathematics education from the perspective of achievement motivation and is concerned specifically with students' decisions about enrolling in advanced mathematics courses. This model of achievement behavior integrates a broad range of research on gender-related differences in mathematics and achievement motivation (Figure 2.7). Moreover, it builds on the expectancy/value theories of achievement and hypothesizes that expectancy for success on a task and the subjective value of the task for the individual are crucial in students' mathematics course enrollment decisions (Reyes, 1984).

The Eccles model combines confidence, usefulness, attribution, anxiety and several other affective variables to explain enrollment decisions. Besides, Eccles model represents the most detailed, comprehensive framework for viewing the complex relationships among those variables.

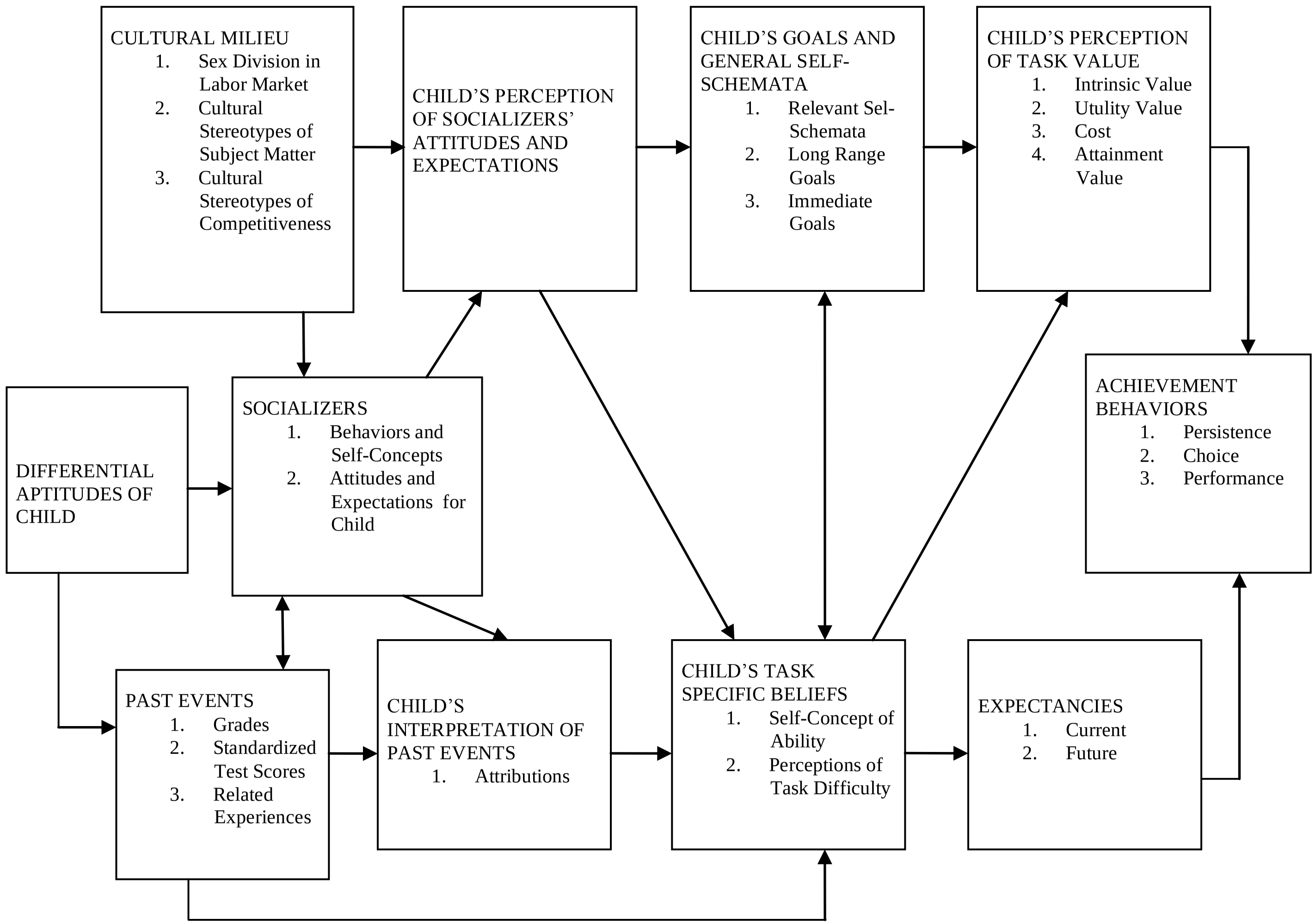

Figure 2.7 Achievement Behavior Model (Eccles & His Colleagues, 1983)

All three models are important in research in affective domain. The use of theoretical models in researches has provided the improvement of the affective domain in mathematics education.

The Kulm's model for research draws the researcher attention on not only attitude and behavior but also about the mediating factors such as liking the mathematics teacher or feeling that mathematics is an inappropriate area of study and the details of the learning situations such as the difficulty of the learning task, or the length of time needed to complete the learning task. On the other hand, the Fennema and Peterson model stresses mainly on the curial role of certain behaviors for success on problem-solving tasks in mathematics, it is also concerned with several affective variables such as confidence in learning mathematics, perceived usefulness of mathematics, pattern of causal attribution for success and failure in mathematics, and perception of how mathematics achievements fits with one's sex role identity. Lastly, the Eccles model combines confidence, usefulness, attribution, anxiety, and several other affective variables to explain student's enrollment decisions. All three of the models represent the complex interrelationships among those affective variables and it is vital that more variables should be included in future researches in order to improve the learning and interest in mathematics.

2.1.9 Teachers' Beliefs and Expectations

Many factors correlate with students' attitudes toward mathematics, and studies have been conducted to find the extent of these relationships. One of these factors is teacher influence in learning mathematics. Banks (1964) stated that:

> "By far the most significant contributing factor is the attitude of the teacher. The teacher who feels insecure, who dreads and dislikes the subject, for whom arithmetic is largely rote manipulation, devoid of understanding, cannot avoid transmitting her feeling to children … On the other hand, the teacher who has confidence, understanding, interest and

enthusiasm for arithmetic has gone a long way toward insuring success" (p.16-17).

Aiken (1970) supported this view when he said that "It is generally held that teacher attitude and effectiveness in a particular subject are important determinants of student attitudes and performance in that subject" (p.572). Aiken also pointed out that a study by Aiken and Dreger (1961) found that "College men who disliked mathematics, as contrasted to those who liked mathematics, stated that their previous mathematics teachers had been more impatient and hostile" (p.573). From the same study, Aiken stated that "College women who disliked mathematics, in contrast to those who liked mathematics, tended to view their previous mathematics teachers as more impatient, not caring, grim, brutal, dull, severely lacking in knowledge of the subject and not knowing anything about how to teach mathematics" (p.573). However, according to Aiken, "It is also true that students who do not do well in a subject may develop negative attitudes toward that subject and blame the teachers for their failures, even when the teachers have been conscientious" (p.572).

It is widely accepted that teachers' attitudes toward mathematics are especially important because of their potential influence on pupils. However, the belief that teachers' attitudes affect students' attitudes toward mathematics has not been as easy to confirm as might be supposed (Aiken, 1976).

To sum up, the effect of teacher attitude and behavior on student attitude varies greatly from teacher to teacher, even with the same teacher the effect changes from occasion to occasion. However, it is easy to predict that some particular teacher behaviors have similar effects on student attitudes and behaviors.

2.1.9.1 Teachers' Beliefs

Over the past 15 years, there has been a considerable amount of research on teachers' beliefs based on the assumption that what teachers belief is a significant determiner of what gets thought, how it gets thought, and what gets learned in the classroom (Wilson & Cooney, 2002).

Fennema, Carpenter and Peterson (1989) have developed a model that shows how teachers' knowledge and beliefs influence students' learning (Figure 2.8). 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.

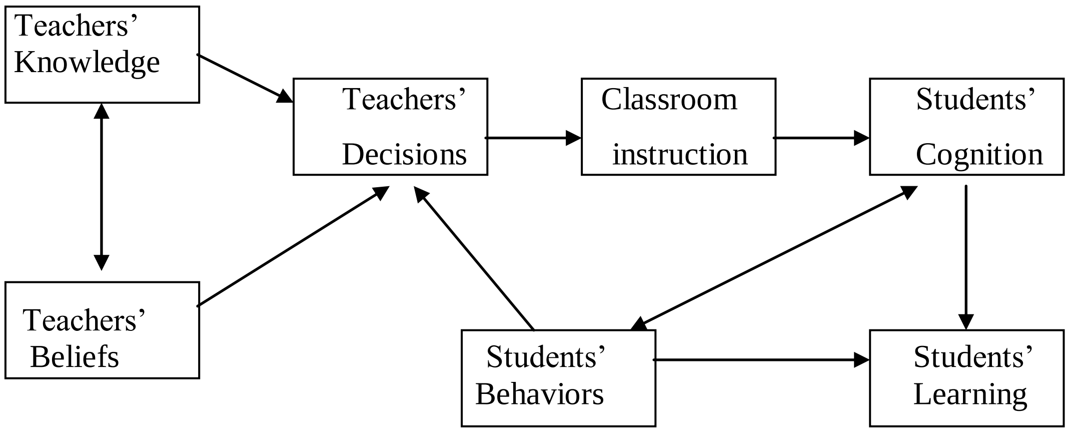

Figure 2.8 The Model of Teachers' Influences on Students' Learning (Fennema, Carpenter, & Peterson, 1989)

Since mathematics educators become aware of the significant roles that teachers' beliefs play, the study of beliefs increased in recent years (Karp, 1991; Austin & Wadlington, 1992; Carter & Norwood, 1997). They have pointed out that the form and intensity of the influence of beliefs varied by individual, but teachers' beliefs shape the way they in which they teach mathematics. How children perceive mathematics is based on what teachers do in the classroom. Students' beliefs about learning and beliefs about the nature of the subject matter affect their learning.

2.1.9.2 Teachers' Expectations

Another important factor that has been discussed in relation to students' attitudes toward mathematics is the effect that the teachers have.

Aiken (1976) mentioned that there are several studies at the elementary school level (e.g. Caezza, 1970; Van de Walle, 1973; Wess, 1973) have found no statistically significant relationships between teacher attitudes and either the attitudes or changes in attitudes of their pupils. However, he said that the study of Phillips's (1973) which dealt with the influences on student attitudes of teacher attitudes encountered during the preceding three years, were more positive. In his study, Phillips found that type of teacher attitude for two of the past three years, and especially most-recent-teacher attitude, was significantly related to students attitude toward arithmetic.

Braun (1976) has developed a model to explain the origins of teacher expectations and the ways in which these expectations are communicated to students and then perpetuated by student behavior. In this model, teachers' expectations influence their behaviors that shape instruction this leads to students' behavior and self-evaluation (Figure 2.9).

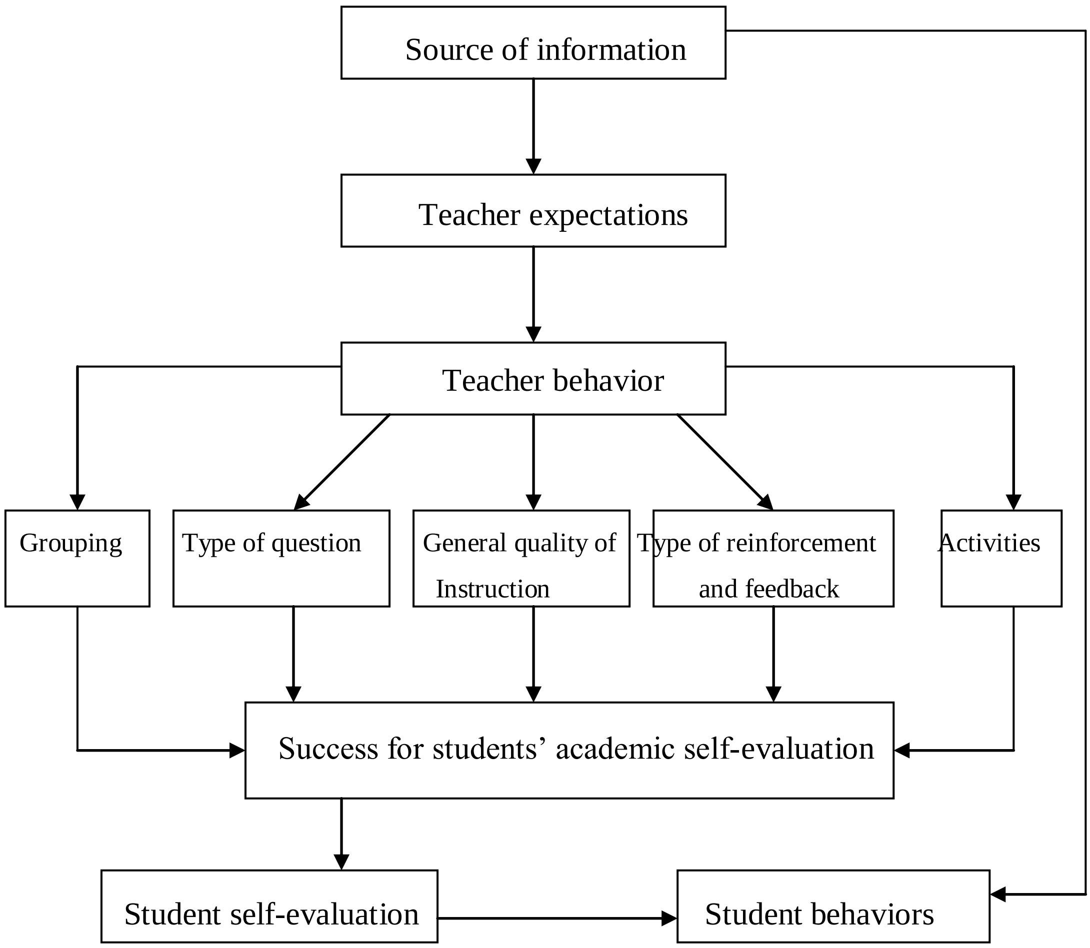

Figure 2.9 Effects of Teacher' Expectations on Instruction, Students' Behaviors and their Self-Evaluation (Braun, 1976)

He listed ten possible sources of teacher expectations. Intelligence test scores are an obvious source, especially if teachers do not interpret the sources appropriately. Sex also influences teachers; most teachers expect more behavior problems from boys than from girls. The notes from previous teachers and the medical or psychological reports found in cumulative folders are another obvious source of expectations. Previous achievement, socioeconomic class and the actual behaviors of the students are also often used as source of information.

In the present study, the effects of students' perceptions about their teacher's attitudes toward and expectations from them are investigated.

2.1.10 Mother and Father

Aiken (1976) stated that it has been reported that children who do well in mathematics have more possessive parents (Neale, 1969). He further reported that the influence of the parents is demonstrated by the fact that pupils' attitudes in mathematics are positively related to the attitudes of their parents. However, the interactions of the attitudes of mothers and fathers with those of their daughters and sons are not entirely clear from the research evidence (Aiken, 1976).

Miller (1988) presented a paper that used the preliminary results from the Longitudinal Study of American Youth (LSAY) base year 7th-grade data set to examine the origins of student interest in science and mathematics, using a set of multivariate log-linear models to examine the structure of parental and peer influences on the student's attitude. In the LSAY, in order to measure a student's attitude toward mathematics, each student's liking for mathematics, anxiety about mathematics, perceptions of utility, sense of competence and a variety of attitudes toward specific courses were measured. The Attitude toward Mathematics Index was scored using a Likert method and then dichotomized into the top third and the bottom two-thirds for the model building analyses. An examination of the distribution of 7th-grade students on this index indicated that the level of parental education was weakly associated with attitude toward mathematics. In the model building of attitudes toward mathematics among 7th-grade students, Miller used the relative contribution of the student's gender, the parent's formal education, the educational aspiration of the student, the level of parent academic push, and the level of parent mathematics push and he briefly examined their relationship to the student's attitude toward his or her mathematics course. In the study, Parent Academic Push referred to general parental encouragement to value education and to do well in school and found that this variable is positively associated with attitudes toward mathematics in the LSAY data. Parent Mathematics Push referred to specific parental actions focused on or closely related to mathematics, in contrast to the more general academic encouragement and found that this variable is positively and strongly associated with attitudes toward mathematics in the LSAY data. Peer Academic Push referred to peer encouragement of school and learning generally and found that this variable is positively associated with attitudes toward mathematics in the LSAY data. Lastly, Peer Mathematics Push refereed to specific peer encouragements of the study of mathematics and found that this variable is positively associated with attitudes toward mathematics in the LSAY data.

To better understand the distribution of student attitudes toward mathematics and the relative contribution of each of the several parental and peer activities, a set of log-linear logit models using the techniques developed by Lec Goodman and described by Stephen Feinberg were utilized. The path model (Figure 2.10) indicated that parental education and gender are associated with student educational aspirations. The level of parental education is positively associated with the level of parent academic push and the level of parent mathematics push. Both the level of student educational aspiration and parent mathematics push are positively associated with the student's attitude toward mathematics. The absence of a direct path from either gender or parental education to math attitude indicated that the influence of these two variables was fully accounted for in the levels of student educational aspiration, parent academic push, and parent mathematics push. There was no residual direct influence on math attitude.

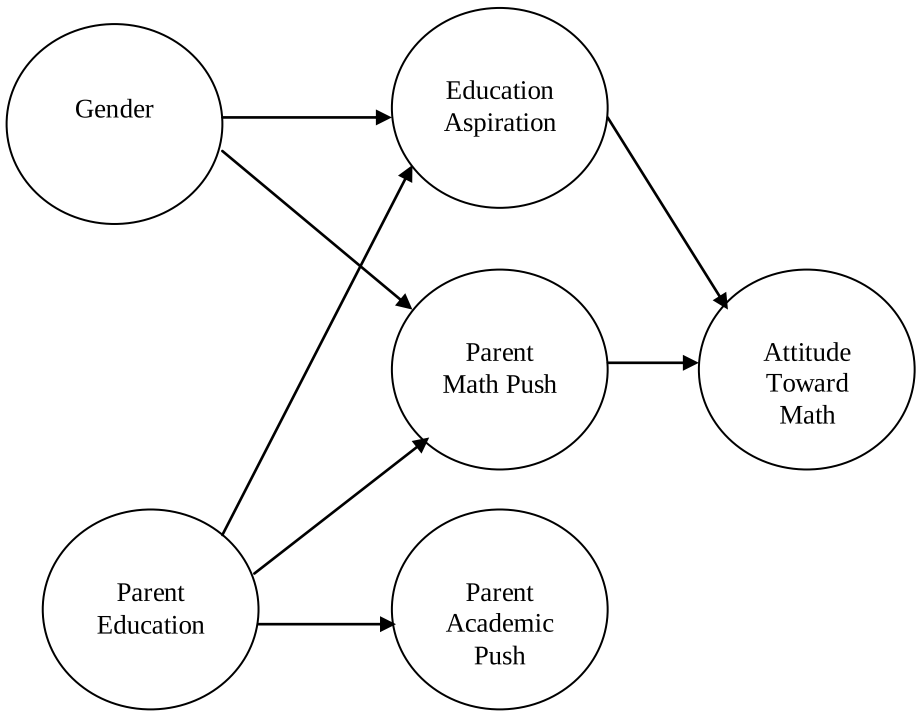

Figure 2.10 A Path Model to Predict Attitude toward Mathematics among 7th-grade Students (Miller, 1988)

In order to estimate the relative strength of each of the paths in the model, a set of log-linear logit models were utilized. The total path model was comprised of three separate or sub models. Models 1, 2, and 3 estimated the paths from gender and parental education to student's educational aspiration. The results indicated that parental education is substantially more influential in the development of student's educational aspirations than is gender. Models 4, 5, and 6 estimated the paths from gender and parental education to parental mathematics push. The results indicated that parental education is positively and strongly associated with the level of parent academic push. There was a significant, but weaker, relationship between gender and the level of parent mathematics push. In the LSAY data, a slightly higher proportion of girls reported a high level of parent mathematics push than boys and this relationship indicated that differential. Models 7,8, and 9 estimated the paths from gender and parental education to parental academic push. The results indicated that parental education is strongly and positively associated with parent academic push, but that there was no significant relationship between gender and parent academic push. This result would suggest that parents threat their sons and daughters equally in regard to general academic encouragement. Lastly, models 10 through 16 described the relationships between each of the independent variables and attitude toward mathematics. The results indicated that student's educational aspiration and parent math push were the strongest predictors of positive attitude toward mathematics courses, with educational aspiration accounting for 24 percent of the total mutual dependence in the model and parent math push explaining about 12 percent of the mutual dependence. This result suggested that while general parental academic encouragement may foster positive attitudes towards schooling, it is specific parental encouragement of mathematics and of higher levels of educational achievement that fosters positive attitudes toward mathematics.

In the study, Miller also constructed a model looking at the influence of peers on attitude toward mathematics and in the end he combined these two models and constructed a final model (Figure 2.11) of attitude toward mathematics that incorporates the strongest attributes of both models. In summary, the final model suggested that 7^{th}-grade student attitudes toward mathematics were significantly influenced by the student's educational aspirations. Students who expected to go to college or graduate school were more likely to hold positive attitudes toward mathematics than students with lower educational expectations. A high level of parent push enhanced the odds of a positive attitude toward mathematics.

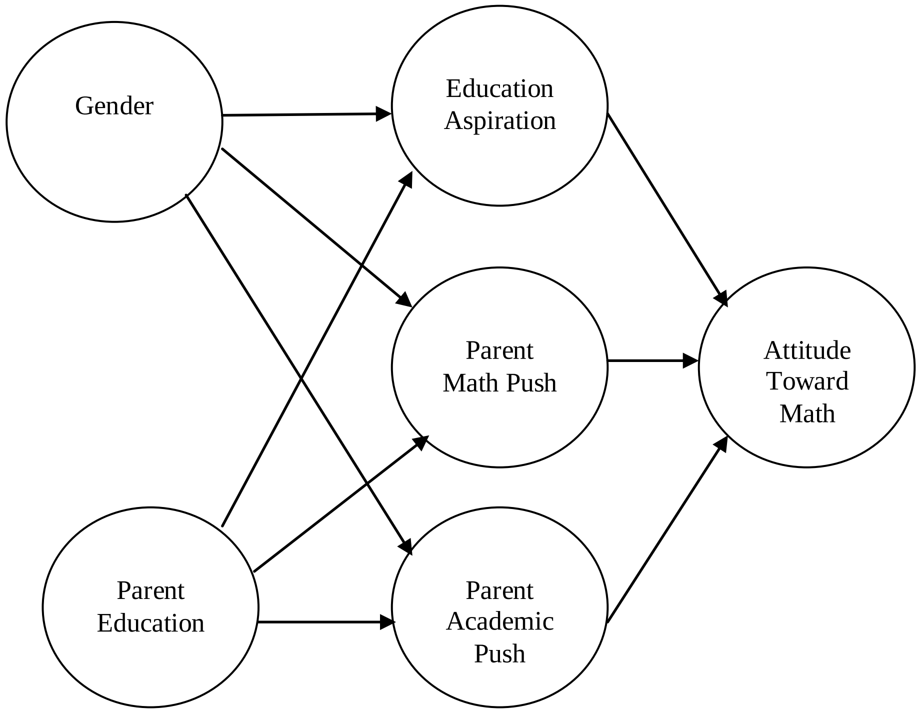

Figure 2.11 A Final Path Model to Predict Attitude toward Mathematics among 7^{th}-grade Students (Miller, 1988)

An extensive study designed by Parsons, Adler and Kaczala (1982) assessed parental influences on children's achievement expectancies and self-concepts of ability with a particular focus on the contributions of parents to the commonly reported sex differences. The potential influence of parents both as role models and as expectancy socializes was also investigated. In the study, extensive questionnaires measuring attitudes and beliefs regarding mathematics achievement were administered to children in grades 5-11 and their parents. The results of the study were the followings. Parental role modeling of mathematical skills did not exert a very strong influence on children's math-related self-perceptions, task perceptions, actual performance, or plans to continue in mathematics courses. Regarding the parental beliefs about their children's math abilities, the difficulty of math itself, and the importance of taking math courses, the results showed that the sex of the child had a significant effect on parents' perceptions of their child's math ability and on parents' perceptions of the relative importance of various high school courses. Parents of daughters believed their child had to work harder to do well in math than parents of sons. Similarly, parents of sons thought advanced math was more important for their child than parents of daughters. Testing whether these parental beliefs were predictive of the children's self- and task- perceptions demonstrated that children's self-perceptions, expectancies, and perceptions of task difficulty related consistently to both their perceptions of their parents' beliefs and expectations and to the parents' actual estimates of their children's abilities. Parents who thought that math is hard for their children and who thought their children were not very good at math had children who also possessed a low self-concept of their math ability, saw math as difficult, and had low expectancies for their future performances in math. In addition, the magnitude of the relations between parental perceptions of their child and their child's beliefs and behaviors did not vary as a function of the child's sex. Moreover, Parsons et al. (1982) used recursive path analysis to assess this hypothesis that parents' beliefs about their children were related to their children's self- and task perceptions. The model (Figure 2.12) specified based on the predictions found in the study and on the model proposed by Parsons et al. previous studies. All paths significant at $p < 0.01$; N=201; standardized beta weights were shown path; R^2=percent of variance for on each criterion measure by all preceding predictor variables; each R^2 was listed under its criterion measure.

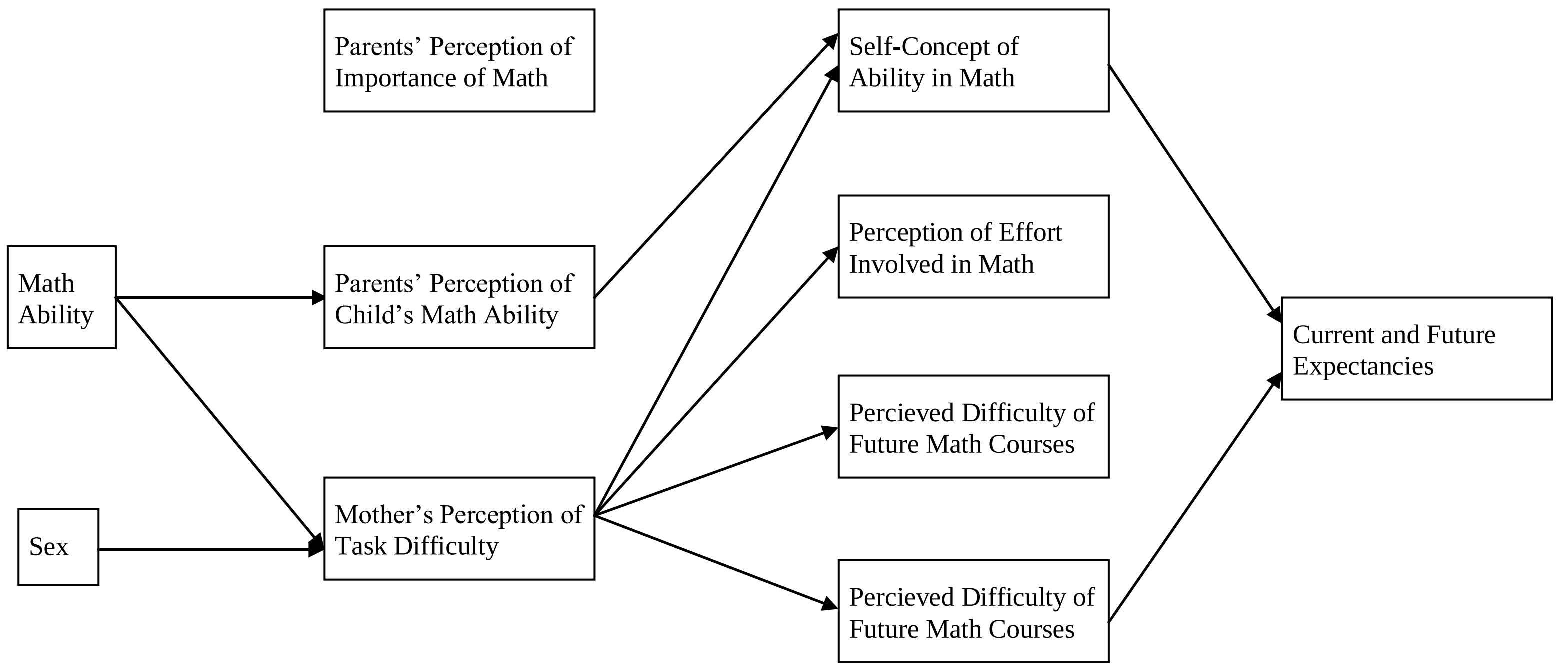

Figure 2.12 Path Analysis Model of Parent and Student Attitudes (Parsons & His Colleagues, 1982)

In support of the researchers predictions, the children's self-concepts and task concepts were more directly related to their parents' beliefs about math aptitude and potential than to their own past performance or their sex. With regard to the differential effectiveness of various socializes, the path analysis and the factor analysis suggested that mothers had the stronger influence on children's achievement beliefs and attitudes; fathers appeared to had little independent effect over and above that which they shared with mothers.

In the present study, the effects of students' perceptions about their parents' attitudes toward and expectations from them as learners of mathematics are investigated.

2.2 Previous Studies

In this section, the literature related to the present study is reviewed. In this study, affective refers to students' positive or negative feelings about mathematics and themselves as learners of mathematics, their perceptions of the difficulty, usefulness, and appropriateness of mathematics as a school subject. Therefore, in this chapter previous studies which were investigated relationships between affective variables and that of ATM are presented.

2.2.1 Relationship between Affective Variables and that of ATM

O'Reilly (1980) examined the attitudes and beliefs of advanced and general level grade 9 and 10 mathematics students in Ontario. In the study, the attitudes were studied in relation to student characteristics, classroom environment, and student achievement. The specific attitudes under investigation were: (a) students' views of the methods employed by teachers of mathematics, (b) students' beliefs about the nature of mathematics and (c) attitudes about the importance of and utility of mathematics. The seven attitude variables were developed by the International Association for the Evaluation of Educational Assessment (IEA) and administered to a total of 1100 students. The first IEA attitude variable defined the teaching methods employed. *Views about mathematics teaching* ranged from a view of the teaching-learning situation which stimulates students by means of an inquiry approach to a view that teachers employ mechanistic, formalistic modes with great emphasis on rote memorization. The second descriptive variable defined the climate of the school and school learning. *Views about school learning* described situations which vary from a teacher-centered, authoritarian-based program to one which promotes inquiry methods, pupil activity and discovery. The underlying continuum for *Attitudes toward mathematics as a process* ranged from a view that mathematics is a fixed, formal system governed by rigid and unchanging rules which a student hard to master, to a view that mathematics is a subject that is still in a process of development. The underlying continuum for *Attitudes about the difficulties of learning mathematics* ranged from a view that only few can learn it to a view that mathematics is not difficult. The underlying continuum for the scale measuring *Attitudes toward the place of mathematics in society* ranged from a view that mathematics is neither essential nor useful to view that mathematical knowledge is important not only in terms of obtaining a good job but also in terms of national development. The scale measuring *Attitudes toward school and school learning* suggested a range from dislike for schooling and a desire to leave it to a genuine liking for school work. The scale measuring *Attitudes toward man and his environment* assessed the student's view of the relationship between man and his environment. Low scores indicated the belief that man is at the mercy of his social and physical environment. An examination of the items suggested that the scale also measures the student's acceptance of the rationalist assumptions that education, medicine, engineering, and scientific research will solve most of the world's problems. The results of the study suggested that student background factors are associated with student's views school learning. Since the other attitude scores are not related to background factors of aptitude and home environment, it was suggested that they are learned at school, even though as influenced by other personal variables. In general, O'Reilly concluded that student attitudes were related to other educational variables and should be considered as important process and outcome variables. Findings of studies based upon the IEA attitude scales appear to be most useful when the students are asked to give their views of the processes teachers use and their beliefs about the nature of mathematics.

Ma and Xu (2004) investigated the causal ordering (predominance) between attitude toward mathematics and achievement in mathematics. They employed structural equation models to analyze a large-scale (*n* = 3116) data from the Longitudinal Study of American Youth across the entire (from grades7 to 12) secondary school. In the study, the model development was achieved in two stages. In the first stage, they tested a series of structural equation models (SEM) for the general causal-relationship between attitude and achievement. Each SEM model included measurement models for attitude and achievement and a structural model that specified the cross-lagged panel design between attitude and achievement. In measurement model of attitude toward mathematics, three indicators were used to represent the latent variable, attitude toward mathematics: (a) mathematics is useful in everyday problems, (b) mathematics helps a person think logically, and (c) I will use mathematics in many ways as an adult. Also, the stability effects of attitude from each year to the next were specified, being depicted as unidirectional paths, across six waves of data (grades 7-12; Figure 2.13).

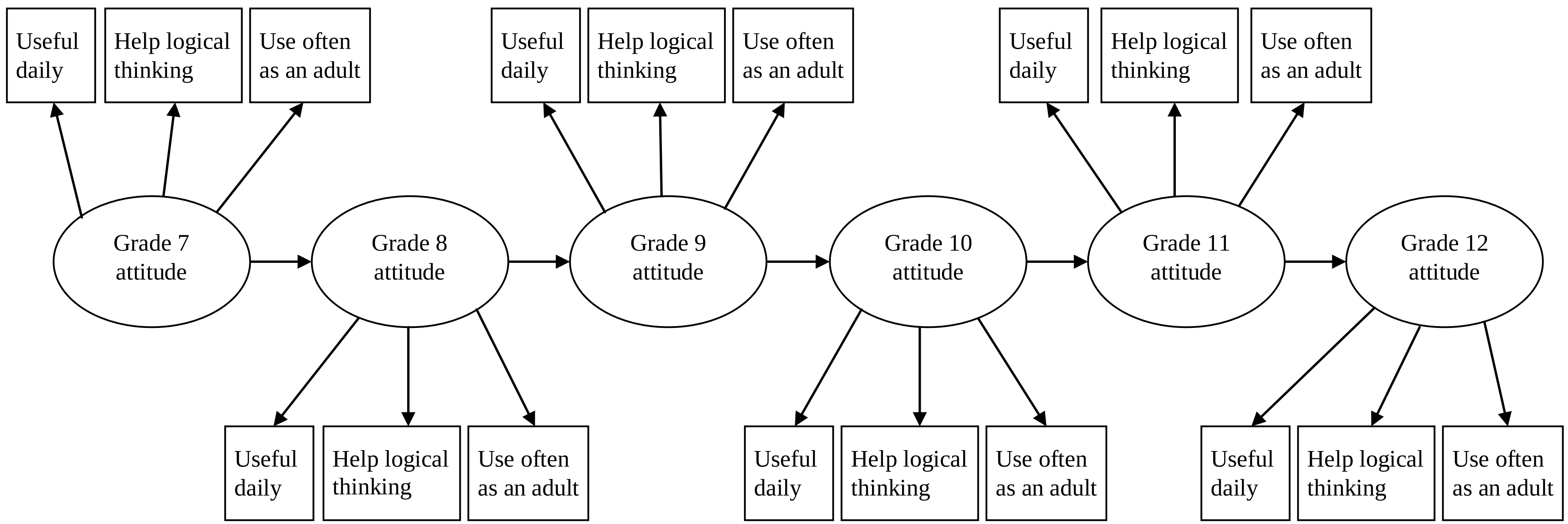

Figure 2.13 Measurement Model of Attitude toward Mathematics across Grades 7-12 (Ma & Xu , 2004)

Values between observed indicators and latent varibles are factor loadings (standardized regression weights)

Ma and Xu (2004) found statistically significant stability effects for attitude toward mathematics across grades 7-12. The stability effects ranged from 0.13 to 0.46 for attitude toward mathematics. Specifically, the effect of prior attitude on later attitude showed an upward pattern across grades 7-12.

2.2.1.1 Confidence in Learning Mathematics

Confidence in learning mathematics is an important affective variable in mathematics education. In a literature review, there were many studies investigating its relationship with mathematics achievement and course election has been studied, particularly in the context of understanding gender-related differences in mathematics (Reyes, 1984). However, examining the relationship between self-confidence and achievement or gender-related differences in self-confidence is not focus of this study. Therefore, while reviewing the literature about confidence in learning mathematics, the studies associated confidence with learning mathematics were looked for.

Aiken (1972b) determined that mathematics attitude was positively related to self-confidence in eighth grade students.

Hannula, Maijala and Pehkonen (2004) presented some preliminary results of the longitudinal aspect of a research project on self-confidence and understanding in mathematics. Their project contained a large survey with a sample from the Finnish pupil population of grades 5 and 7 with 150 school classes and 3057 pupils. The focus of their paper was to reveal the development on pupils' understanding and self –confidence from grade level five to grade eight. They also looked for the most important predictors of the results. The questionnaire was developed for the project and it contained background variables, 19 mathematics tasks, estimations on success expectation and success confidence as well as a belief scale (25 items). In 2001, the questionnaire was administered in ten classes and in 2003, it was administered a second time in these 10 classes. Totally, they had 101 pupils in the younger sample and 90 pupils in the older sample. For the analysis of the longitudinal data they used general linear model multivariate analysis (GLM Multivariate). In their paper, they used three sum variables for success in mathematics tests (fractions, infinity, other tasks), and three sum variables for beliefs (self-confidence, success orientation, defense orientation). The two first mathematics variables (fractions and infinity) represented the indicator for understanding and the third variable (other tasks) consisted of more conceptual tasks. Belief variables (self-confidence, success orientation, defense orientation) were constructed with a factor analysis from the belief scale and self-confidence factor consisted of ten statements which were adapted from the self-confidence subscale of Fennema-Sherman Mathematics Attitude Scales. Lastly, for background variables they were controlled the effects of gender and grade. The results showed that in belief variables, a decline in self-confidence from grade 5 to grade 6 and from grade 7 to grade to grade 8 was observed. However, it was seen that grade 7 measures differed from grade 6 measures to another direction. Concerning the most important predictors of the results, in belief variables, self-confidence was a more important predictor of these two variables. Therefore, it can be concluded that a pupil's self-confidence predicts largely the development of self-confidence in the future, but also the development of success orientation and achievement.

Burton (2004) investigated the ways in which confidence was understood and interpreted with respect to the learning of mathematics by some English 'Advanced' level (+16) students who have chosen to study mathematics, and their teachers. Another way of saying, he focused on the perspectives of the teachers on confidence and contrasting them with those of the students. He conducted interview-based study with semi-structured formats. The students' interviews were in pairs of students and roughly 30 minutes each. Whereas, the teacher interviews were individual and all over one hour in length. The results showed that teachers defined confidence in similar behavioral terms and spoke of "willingness". Unlike the teachers, when the students spoke about confidence, they concentrated on feelings and how the classroom could function to make those feelings better, or worse. Moreover, the students drew attention to the desire for a collaborative working style and they spoke of having a "can do" feeling, reinforced by success, that is getting correct answers and having both knowledge and understanding.

In a three-year longitudinal study, several researchers analyzed the beliefs and attitudes of students in grades one through six in an attempt to determine which beliefs change with age (Kloosterman & Cougan, 1994; Kloosterman et al., 1996). They found that because they expected students to say they were confident because they understood mathematics or because they felt they could solve challenging problems, the number of students who spontaneously mentioned grades and teacher feedback when asked if they did well in math was surprising.

A belief about self-confidence in learning mathematics is an attitude variable that has received considerable attention in past research on student attitudes toward mathematics (Kloosterman, 1988). He attempted to explain self-confidence through motivational variables. One of the motivational variables he considered was attributional style. He suggested that a positive attributional style score was indicative of a mastery goal orientation. The subjects in this study were 489 seventh grade students from three small cities in Indiana. Kloosterman found that attributional style was the strongest predictor of confidence. In addition, all of the motivational variables had a significant correlation with self-confidence and with each other.

In her doctoral dissertation, Tağ (2000) investigated the relationship between attitudes toward mathematics and achievement in mathematics of 951 ninth grade students using structural equation modeling (SEM) techniques. They determined that effectance motivation, usefulness of math, importance of math, confidence in learning mathematics, success attribution in mathematics, mathematics anxiety and mathematics as a male domain as being observed variables of the latent dependent variable attitudes toward mathematics (ATM). The results of the study showed that six of the seven attitudinal variables, confidence in learning mathematics ($\lambda_y = 0.96$, $p<0.01$), math-anxiety ($\lambda_y = 0.94$, $p<0.01$), effectance motivation ($\lambda_y = 0.89$, $p<0.01$), usefulness of mathematics ($\lambda_y = 0.93$, $p<0.01$) and importance of mathematics($\lambda_y = 0.68$, $p<0.01$) and success attribution in mathematics ($\lambda_y = 0.80$, $p<0.01$) were positively and significantly loaded on ATM, where as mathematics as male domain ($\lambda_y = -0.58$, $p<0.01$) was negatively and significantly loaded. Moreover, the results indicated that of these seven variables confidence in learning mathematics accounted for the greatest variance ($R^2 = 0.91$) of latent dependent variable on ATM.

O'Neal, Ernest, McLean and Templeton (1988) examined the factorial validity of four of the Fennema-Sherman Mathematics Attitudes Scales for use with

144 fifth grade students attending public school in a central Alabama college community. These four scales were the confidence in learning mathematics scale, the attitude toward success in mathematics scale, the mathematics anxiety scale and the effectance motivation scale in mathematics. They were administered in the school on a pretest-posttest basis by the researcher to measure changes in attitude following Logo instruction. They conducted principle factor analysis in order to investigate whether the 48 items (12 on each subscale) were measuring the traits suggested by their placement on the four scales or whether, for this population and these items, a different factor pattern emerged. The results of the analysis of the responses of 144 fifth grade students to items on four of the Fennema-Sherman Mathematics Attitude Scales showed that three factors were emerged and the first factor is composed primarily of items from the confidence in learning mathematics scale (7 items) and the mathematics anxiety scale (11 items). Therefore, at least for the fifth grade population from which the sample was drawn, confidence in learning mathematics and mathematics anxiety appeared to be measuring the same construct.

2.2.1.2 Usefulness and Importance of Mathematics

A belief about the usefulness of mathematics is another important attitudinal variable to consider. Usefulness of mathematics refers to students' beliefs about the usefulness of mathematics currently and in relationship to their future. Since mathematics is not easy for most people to learn, it is reasonable to question making the effort if one does not believe in its utility (Fennema & Sherman, 1976).

Kloosterman and Cougan (1994) and Kloosterman et al. (1996) explored elementary students' beliefs the usefulness of mathematics. They concluded that primary students did not have a sincere belief that mathematics was useful. When questioned about why mathematics was important, most of these students responded with comments about needing it to pass to the next grade. Responses from upper elementary students were not much better. While some older students claimed to believe mathematics was a useful subject, very few could provide any substantial examples of real world applications.

Eccles and Midgley (1989) studied the relationship between usefulness, achievement and teacher support as students transitioned from elementary to middle school. They defined teacher support as students' perceptions of the teacher as being caring, friendly, and fair. The findings of this study strongly supported a positive relationship between the perceived level of teacher support and student's beliefs about the usefulness of mathematics. When students transitioned from an elementary school, where they perceived a high level of teacher support, to a middle school, where they perceived a lower level of teacher support, their beliefs about the usefulness of mathematics dropped sharply.

2.2.1.3 Mathematics Anxiety

Many researchers conclude that mathematics anxiety is a multidimensional concept. Bessant (1995) investigated the interrelatedness of various types of mathematics anxiety with attitudes toward mathematics. She administered an 80-item version of the Mathematics Anxiety Rating Scale (MARS) to 173 university students enrolled in one of three introductory statistics courses offered by the departments of mathematics, psychology, or sociology. Factor analysis explored the dimensions of the MARS labeled as General Evaluation Anxiety, Everyday Numerical Anxiety, Passive Observation Anxiety, Performance Anxiety, Mathematics Test Anxiety, and Problem-Solving Anxiety. Mathematics attitude scales were also administered including 35 Likert-format statements dealing with the enjoyment of mathematics, perceptions of its usefulness, and preferences for certain modes of instruction or study environments. Correlational analysis indicated complex interaction patterns between attitudes toward mathematics and the six MARS factor, depending on the overall level of anxiety experienced. Although the results were too detailed to discuss in their entirety, the negative relationship between Mathematics Enjoyment and General Evaluation Anxiety was the largest and the most uniform across the low, medium and high math-anxious students (-0.52, -0.56, -0.52). Enjoyment of Problem Solving was similarly related to Problem-Solving Anxiety (-0.36, 0.18, -0.20). Therefore, it appeared that low levels of anxiety can facilitate the development of attitudes favoring mathematics. Regarding the perceptions of usefulness of mathematics, Scientific Value of Mathematics was correlated both with Passive Observation Anxiety (0.40, -0.10, -0.42) and Problem-Solving Anxiety (0.47, 0.09, -0.27). Further, Mathematics Enjoyment was inversely correlated to Math Test Anxiety among low (-0.26) and moderately math-anxious students (-0.13) but positively correlated within the high-anxiety group (0.49). These results suggested that favorable attitudes toward mathematics may reduce proneness to mathematics anxiety; however, the positive correlation for moderately anxious students indicated that a modicum of anxiety can coexist with positive attitudes toward mathematics.

Some researchers hypothesize that mathematics anxiety is merely a lack of confidence in one's ability to learn mathematics. Fennema and Sherman (1976) found a strong correlation (r = 0.89) between mathematics anxiety and confidence scores, thus lending support to this hypothesis. Rounds and Hendel (1980) used five of the scales to measure attitudes. They found that for a sample of 119 of collage females, the mathematics anxiety scale correlated highly with the confidence in learning mathematics scale (0.72).

To sum up, many researchers have used the mathematics anxiety scale to measure both anxiety and confidence. Therefore, results from several studies suggested that the mathematics anxiety scale and the confidence in learning mathematics scale were measuring the same or similar traits.

2.2.2 Relationship between Teacher and ATM

Haladyna, Shaughnessy and Shaughnessy (1983) proposed a model for explaining causal determinants of attitude toward mathematics. Particularly, they examined teacher and learning environment variables that they believed to be the most powerful causal determinants of attitude toward mathematics. The model hypothesized that attitude development may be influenced by a number of factors operating inside and outside school (Figure 2.14) Although the model recognized that exogenous factors (originating outside school) such as the student's sex, social class, and scholastic aptitude may contribute to attitude formation, these factors were not included in the study for two reasons. First, these exogenous variables reside outside the educators' sphere of immediate influence in school. Secondly, an earlier analysis of data on attitude toward mathematics suggested that these exogenous variables have a limited relationship to attitude (Haladyna, Shaughnessy, & Shaughnessy, 1983). The model, therefore, concentrated on the effects of endogenous variables within the school that were seen as alterable. It posited that the development of attitude toward mathematics was likely to be influenced by the teacher and the learning environment.

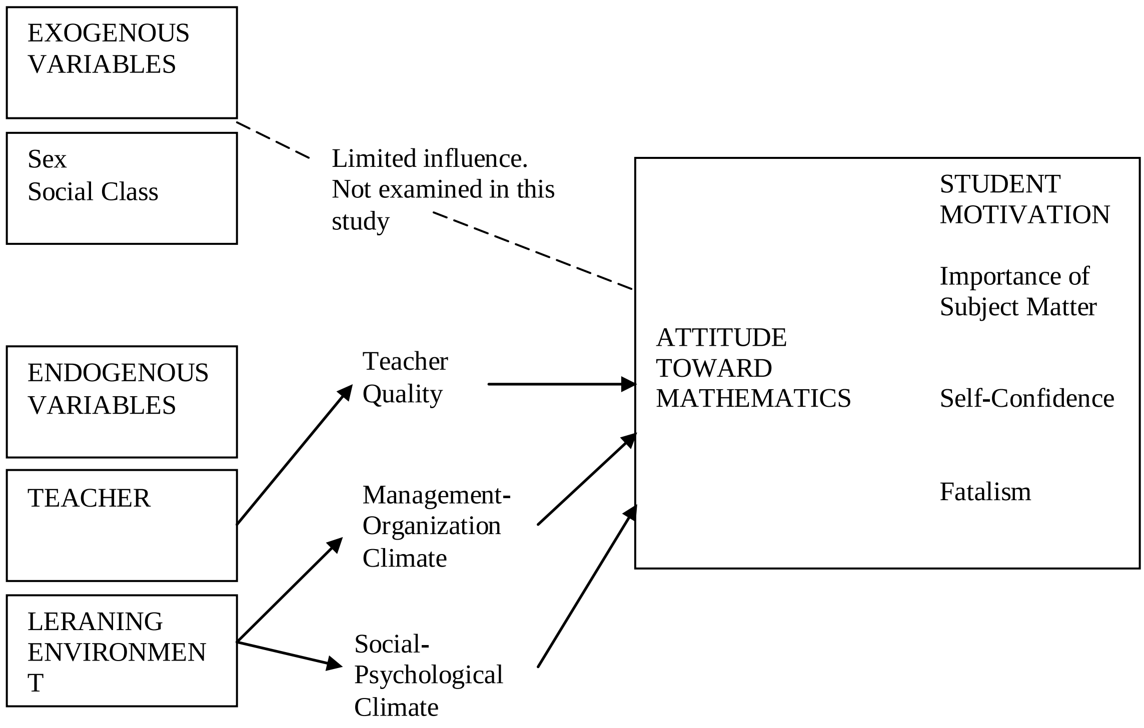

Figure 2.14 Hypothesized Model of Determinants of Attitudes toward Mathematics (Haladyana, Shaughnessy, & Shaughnessy, 1983)

In the study, students' motivation (SM) and class attitude toward mathematics (AM), the dependent variables, were examined in relationship to student motivation (SM), teacher quality (TQ), the social-psychological class climate (SP) and management-organization class climate (MO). In general, the findings suggested strong associations between teacher quality measures and both attitude toward mathematics and student motivation. Moreover, the relationship between the social-psychological dimension and attitude increased with grade. Also, the relationship between the management-organization dimension of the learning environment and attitude showed an increase and then decrease with grade.

McMillan (1976) reviewed 124 dissertations completed between 1969 and 1975 concerned with factors that affected students' attitudes toward various school subjects. His analysis of these studies revealed that non-curricular variables have at least as much impact on attitude as curriculum-related variables. A large percentage of significant findings came from studies relating attitude to teacher behavior, student self-concept, background, parents, and previous attitudes. McMillan pointed out that numerous research reports from journals support his findings (e. g. Phillips, 1973; Walberg, 1969). These studies indicated that teacher attitudes and classroom climate are among the most significant factors related to attitude formation.

Carter and Norwood (1997) examined the relationship between teachers' beliefs about learning and teaching of mathematics, and their respective students' beliefs about mathematics. 7 teachers and 157 students who were thought by them participated in the study. Two instruments were designed to measure teachers' beliefs about mathematics and the teaching and learning of mathematics, and students' beliefs about mathematics. Subscales from "Teachers' Beliefs about Mathematics" instrument included beliefs about mathematics, beliefs about teaching mathematics, and beliefs about learning mathematics. "Student Belief" instrument included task orientation, ego orientation, work avoidance subscales and also subscales on students' beliefs about causes of success such as interest and effort, understanding, competitiveness, and extrinsic factors such as neatness and cooperation. To analyze the data means and standard deviations were calculated. Results indicated that teachers practiced what they believed and that these practices affected what their students believed about mathematics. In other words, there was a straight line relationship among teachers' beliefs, teachers' practice, and students' beliefs about mathematics.

Karp (1991) investigated the relationship of the teaching behaviors and instructional methods of elementary school teachers to the teachers' attitudes toward mathematics. Sample consisted of two classrooms from both the fourth and sixth grades, totally 33 teachers included. He found that the daily experiences of students in mathematics classes of teachers with positive attitudes were substantially different from those of students in classrooms of teachers with negative attitudes. Teachers with negative attitudes toward mathematics used teaching methods that fostered dependency whereas teachers with positive attitudes were found to encourage student initiative and independence.

Mathematics Education in Turkey

The rapid changes in science and technology have forced many countries to change their school curricula and make necessary reforms to improve their citizens' level of education (Ersoy, 2002). Having struggle in joining the European Union (EU) for many years, the Turkish society needs the same reforms (Ersoy, 2006).

The increasing importance and accessibility of information is the most noticeable aspect of this changing age. One of the most important aspects of the transition to the society of information is investment in information (Ministry of National Education, 2005). A second important aspect of the social change and efforts for reforms in all fields of society is our country's effort for accession to EU. Therefore, there have been several reform movements practicing for adapting EU standards in all fields, education as well. The last reform movement in the field of education called as "Program Development Process" by The Turkish Education Board (TEB) has a policy of accession to EU and monitors the latest developments in all over the world in order to move from industry society to information society. Moreover, in our country, educational authorities felt the importance and the necessity of beginning curriculum movements in response to this transition to information society. These curriculum movements are the basis of the curriculum reforms in Turkey conveyed by TEB and Ministry of National Education (MNE).

The curriculum for the mathematics courses for grades 1-5 has been replaced by a new one by the Ministry of National Education. After having been piloted in some selected schools during academic year of 2004-2005, the new program has been implemented in all primary schools in Turkey. One of the curriculum reforms is conducted in the field of mathematics education. According to the contemporary expectations of society from individuals, The Ministry of Turkish Education has changed the school mathematics curricula for grades 6-8 grades as well. The latter change has been piloted in 120 schools located in 9 regions in 2005-2006. It has been prepared on the basis of national and international studies in the field of mathematics education, mathematics curricula of some developed countries, mathematics teaching experiences (MNE, 2005). This new program mainly considers the mathematical concepts, the connections among those concepts, the underlying meanings of computations, and acquiring those computational skills of students (MNE, 2005). The curriculum gives importance to active participation of students during teaching and learning processes. In addition, the goals of the new curriculum also involves creating learning environments in which students having change of making researches, discovering, solving daily life problems, discussing and sharing some solutions and strategies. Besides, the new curriculum gives new roles to students such as, actively involving in both mentally and physically during instructional process, being responsible for learning, questioning, inspecting, discussing, discovering, cooperating, and evaluating (MNE, 2005).

The research studies related with reform efforts have shown that reformed mathematics curricula increase students' performance and provide greater conceptual learning (Ross, Hogaboam-Gray & McDougall, 2002). Moreover, the new mathematics curriculum developed by the MNE and TTKB of the grades 6-8 focuses on students' conceptual learning within and between the branches of mathematics and across disciplines, and real-world situations (MNE, 2005).

The new curriculum gives importance to affective development of students positively. Affective development is taken into consideration in new curriculum while developing mathematical concepts and skills in students (MNE, 2005). To achieve this, the following affective aspects are aimed to be acquired:

- Takes pleasure in mathematics
- Appreciates the power and beauty of mathematics
- Feels self-confidence in mathematics
- Is patient while solving a problem
- Believes that he can learn mathematics

- Does not have concerns that can influence his positive attitudes toward mathematics
- Discusses about subjects relating mathematics
- Helps those who want to learn mathematics
- Realizes the importance of mathematics in a real life
- Performs whatever is required in mathematics lesson
- Not only does the requirements of mathematics lessons, but also make additional studies
- Adapts mathematical culture to his own life
- Participates in the studies about mathematics
- Realizes the contribution of mathematics to science and technological development
- Believes that mathematics improves creativity and sense of aesthetics
- Believes that mathematics contributes to making logical decisions
- Realizes the aesthetic aspect of mathematics
- Realizes the assuming aspect of mathematics
- Thinks that mathematics contributes positively to intellectual development.

Affective development of students is as important as cognitive development of them. In New Elementary School Mathematics Curriculum of MNE, in order to evaluate the affective development attitude scales are used. Someone's score is the sum of his scores that he collects from all the items of a scale. Samples of attitude scales are given in "The Teaching Syllabus and Guidebook for Elementary School Mathematics Course (Grades 6-8)" by MNE (2005). Choices of items in a scale can be: "completely agree", "agree", "undecided", "disagree" and "completely disagree". The attitude scale toward mathematics is presented in Appendix A.

In this study, the affective features that the New Elementary School Mathematics Curriculum of MNE has emphasized will also be considered in terms of the three aspects of attitude toward mathematics which are mainly cognitive, affective and behavioral component of attitude.

2.2.3 Summary of the Findings of Previous Studies

1. Generally, the attitudes are studied in relation to student characteristics, classroom environment, and student achievement (O'Reilly, 1980; Ma & Xu, 2004).

2. The specific attitudes under investigation are: students' views of the methods employed by teachers of mathematics, students' beliefs about the nature of mathematics, and attitudes about the importance of and utility of mathematics (O'Reilly, 1980; Ma & Xu, 2004).

3. Mathematics attitude is positively related to self-confidence in eighth grade students (Aiken, 1972b).

4. The learning of mathematics is influenced by a pupil's mathematics-related beliefs, especially self-confidence (Hannula, Maijala, & Pehkonen, 2004).

5. Primary students do not have a sincere belief that mathematics is useful. They comment that it is useful in order to pass to the next grade (Kloosterman & Cougan, 1994; Kloosterman, Raymond, & Emenaker, 1996).

6. Some older students claim to believe mathematics was a useful subject, very few can provide any substantial examples of real world applications (Kloosterman & Cougan, 1994; Kloosterman, Raymond, & Emenaker, 1996).

7. Low levels of anxiety can facilitate the development of attitudes favoring mathematics (Bessant, 1995).

8. There is a strong correlation between mathematics anxiety and confidence scores, thus lending support to this hypothesis that mathematics anxiety is merely a lack of confidence in one's ability to learn mathematics (Fennema & Sherman, 1976; Rounds & Hendel, 1980).

9. Teacher and learning environment variables are the most powerful causal determinants of attitude toward mathematics (Haladyna, Shaughnessy, & Shaughnessy, 1983; McMillan, 1976).

10. Teachers practiced what they believed and that these practices affected what their students believed about mathematics (Carter & Norwood, 1997; Karp, 1991).

These summary results suggest that there is a need for further studies in order to investigate attitudes toward mathematics in terms of cognitive, affective, and behavioral aspects and factors affecting these aspects. Three models examine the factor structure of attitude toward mathematics; the relationships between perceived father and mother characteristics related to students, perceived teacher characteristics related to students, perceived teacher characteristics related to profession and confidence in learning mathematics, usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, learner behaviors toward mathematics and the time they spent on mathematics at home; and the relationships between perceived father and mother characteristics related to students, perceived teacher characteristics related to students, perceived teacher characteristics related to profession and that of cognitive, affective and behavioral aspects of attitude, respectively.

CHAPTER 3

METHOD

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

3.1 Participants of the Study

The participants of the study consisted of 1960 7th grade students enrolled in 19 different public elementary schools in Istanbul, Turkey. 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. Demographic information namely, school name, gender, mother and father education level, previous year final report card grade for mathematics course, type of help with math from out of school was collected as the major characteristics of the participants. The names of the schools and the distribution of the subjects with respect to gender type were given in Table 3.1.

Table 3.1 Distribution of Subjects of the Present Study

	School	Gender		TOTAL
		Male	Female	
1	Ahmet Emin Yalman Elementary School	42	35	77
2	Cemal Artuz Elementary School	66	68	134
3	Cezayirli Gazi Hasanpaşa Elementary School	54	46	100
4	Cihangir Elementary School	29	30	59
5	Firuzağa Elementary School	18	28	46
6	Galatasaray Elementary School	21	22	43
7	Hasköy Elementary School	98	87	185
8	Hoca İshak Efendi Elementary School	48	51	99
9	İhsan Şerif Elementary School	86	66	152
10	İ.T.O. Kadınlar Çeşmesi Elementary School	59	84	143
11	Kadımehmet Elementary School	52	49	101
12	Kaptanpaşa Elementary School	80	107	187
13	Muallim Cevdet Elementary School	46	66	112
14	Namık Kemal Elementary School	41	22	63
15	Okçumusa Elementary School	39	22	61
16	Orbay Elementary School	31	34	65
17	Pirireis Elementary School	53	82	135
18	Piyalepaşa Elementary School	52	58	110
19	Sururi Elementary School	44	44	88
	TOTAL	959	1001	1960

The participants of the study composed of 1960 students from 19 different schools. Of the students who responded to the demographic questions 51.1% were females (n=1001) and 48.9% were males (n=959). Students' mean previous year final report card grade for mathematics course was 3.15. Detailed information about the participants of the study in terms of mother's and father's education level, previous year final report card grade for mathematics course and type of help with math from out of school was given in Table 3.2. As it can be deducted from the table, nearly half of the students' parents had the primary school degree (54.2% of mothers and 44.3% of fathers). What is more, information collected regarding the type of help with math from out of school indicated that nearly half of the students had no help with math from out of school (45.3 %).

Table 3.2 Demographic Characteristics of the Participants of the Study

	f	%	*f*	%
Education Level	Mother		Father	
Illiterate	192	9.8	41	2.1
Literate	123	6.3	85	4.3
Primary school graduate	1063	54.2	869	44.3
Secondary school graduate	320	16.3	487	24.8
High school graduate or equiv	191	9.7	338	17.2
Higher education graduate	11	0.6	30	1.5
University graduate	50	2.6	88	4.5
Higher degree	10	0.5	22	1.1
Previous year final report card grade for mathematics course				
1	258	13.2		
2	348	17.8		
3	543	27.7		
4	463	23.6		
5	348	17.8		
Help with math out of school				
Extracurricular private schools	518	26.4		
Private tutoring	69	3.5		
Peer	97	4.9		
Parent or close environment	371	18.9		

Table 3.2 (cont'd)

	f	%	*f*	%
Other (computer, books etc.)	17	0.9		
No help	888	45.3		

3.2 Procedure

Before the administrations of the Attitudes toward Mathematics Questionnaire (ATMQ) the necessary permissions were gotten from Turkish Ministry of National Education. In order to construct a model that best describes the relationships between Attitudes toward Mathematics (ATM) and cognitive, affective and behavioral components of it, the data was collected by administering the ATMQ to 1960 7th grade students enrolled in different public elementary schools in Beyoğlu district of Istanbul, Turkey in the fall semester of 2009-2010 academic year.

The ATMQ was administered to students in their classrooms by the researcher during one class hour (40 minutes) and in each class, the purpose of the study and directions were explained. They were informed that there were no right or wrong answers to the items and their answers will not be graded and evaluated so, it was wanted them to be honest and intimate while answering to the items and not to leave unanswered item or answers more than one. After ATMQ was completed, data were first entered into SPSS, then for the confirmatory factor analysis LISREL was used.

3.3 Analysis of Data

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

- Data of the present study were first analyzed by using the SPSS and LISREL package programs.
- Data were coded, collected from the subjects by the following techniques:

- School names were coded according to the alphabetical order from 1 to 19.
- Gender was coded as 0 for male and 1 for female.
- Mother and father education level were coded illiterate as 1, literate as 2, primary school graduate as 3, secondary school graduate as 4, high school graduate or equivalent as 5, higher education graduate as 6, university graduate as 7 and higher degree as 8.
- students' previous year final report card grade for mathematics course were coded 1 as 1, 2 as 2, 3 as 3, 4 as 4 and 5 as 5.
- Type of help with math out of school were coded extracurricular private schools as 1, private tutoring as 2, peer as 3, parent or close environment as 4, no help as 5, and other as 6.
- students' responses to the survey items: strongly agree, agree, undecided, disagree and strongly disagree were coded from 1 to 5 respectively, then transferred them into the computer environment with SPSS. After transferring all data into the computer environment, the positively worded items were revised to negative direction and recoded from 5 to 1 respectively into the computer environment.

* The alpha reliability coefficients for each scale calculated with the SPSS package program.
* Principle component analysis was done to test the construct validity of each scale and to determine whether or not they have sub-dimensions.
* Preliminary data analysis were done by the following reasons:
  - To detect the outliers and to check the data whether data recording error will made (data cleaning).
  - To check normal distribution of the variables.
* Descriptive statistics were used by the following reasons:
  - To get the mean, mode, range, minimum and maximum values, standard deviations of each scale on ATMQ.
  - To get frequencies and percentages of the responses of each item on ATMQ.

- To find the distribution of the number and the frequencies of the subjects.
- To identify the factor structure of ATM confirmatory factor analyze was conducted.

- Data of the present study were analyzed by utilizing Second-Order Factor Analysis and Path Analysis statistical technique. For this purpose Linear Structural Relations (LISREL)-8.54 statistics package program was used.
- The significant level was set to 0.05 (t=1.96).

3.4 Steps in SEM

The five stages characteristic of applications of structural equation modeling (Bollen & Long, 1993) are explained below:

1. Model Specification
2. Identification
3. Estimation
4. Testing Fit
5. Respecification

1. Model Specification

Specification of a model is the foremost requirement for any form of structural equation modeling. The propositions composing the model are most frequently drawn on the basis of a review of the research literature or a theory. The purpose of the hypothesized model is to explain the reasons of the correlated variables in a particular fashion. However, a unique model including all the variables of this study was not found in the literature.

2. Identification

The estimation of unknown parameters, for instance, factor loadings or path coefficients, based on observed covariances or correlations is involved in the application of structural equation modeling techniques. Issues of identification deal with whether unique values can be found for the parameters to be estimated in the theoretical model.

3. Estimation

There are software packages such as LISREL designed to solve sets of structural equations. LISREL solves the equations on the basis of using numerical methods to estimate parameters. LISREL solves the parameters in the model by a process of iterative estimation. There are various estimation techniques depending on the variable scale and/or distributional property of the variable(s) used in the model. The very common fitting criteria are ordinary least squares (OLS), generalized least squares (GLS) and maximum likelihood (ML). In this study, even though items were not continuous in scales, they were treated as continuous for statistical purposes. An assumption that Likert scales have an internal increase in scale was made in this study. Accordingly, maximum likelihood estimation method was used for estimating parameters. This method is very robust against rejected assumptions and works well with data which do not met normality and/or interval scale assumption.

4. Testing Fit

Interpreting model fit or comparing fit indices for alternative or nested models is involved in testing fit of the model. There are numerous fit indices, each having slightly different conception of what it means to say model fits the data. The differences between the observed and model-implied correlation or covariance matrix are considered in these criteria. Multiple measures of fit indices can be used with the varying definitions of model fit. Moreover, the literature provides the basis for a strategy of model testing on several fundamental points. There are some fit indices used in SEM given in APPENDIX D.

In the present study, GFI, AGFI, RMSEA and SRMR fit indices were used in order to determine the degree to which the structural equation model fits the sample data (Table 3.3). The differences between the observed and model-implied correlation or covariance matrix are considered in these criteria.

Table 3.3 Model Fit Criteria and Acceptable Fit Interpretation

(Jöreskog & Sörbom, 1993; Schumacker & Lomax, 2004; Kelloway,1998)

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.
Adjusted GFI (AGFI)	0 (no fit) to 1 (perfect fit)	The values exceeding 0.9 indicates a good fit to the data
Standardized RMR (SRMR)	<0.05	Value less than 0.05 indicates a good model fit.
Root Mean Square 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)

5. Respecification

Improving either the parsimony or the fit of the model is the goal of model respecification (MacCallum, 1986). When the model fit indices suggest a poor fit, structural equation programs such as LISREL commonly provide some guidelines for finding sources of model misspecification. The development of the models is acquired by the modification indices and parameter tests. On the basis of the modification indices and parameter tests, some decisions are made about how to delete, add or modify paths in the model. When the model is modified, the model is reassessed on the same data.

In the present study, all paths in the model were determined based on the literature review and the theoretical assumptions and modification suggestions were considered and applied to each models. Finally, the models were reassessed again.

3.5 Sample Size

The χ^2 criterion is very sensitive to sample size. Because the χ^2 criterion has a tendency to indicate a significant probability level when the sample size increases, generally above 200 (Schumacker & Lomax, 2004). As a result, a non-significant test statistic can be obtained with large samples.

3.6 Missing Data Analysis

The first step of data analysis was 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 3.4.

Table 3.4 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 during the data entering procedure, each participant who left an item without indicating an answer or indicating more than an answer was completely excluded from the study. There were 133 subjects of this type from a total of 2093 students participated to the study. Cohen and Cohen (1983) stated that less than %5 or even %10 missing data on a variable is not large, and in this study all the missing values were less than %10 of the whole sample. After that, all items in data collection instruments were analyzed with SPSS in order to determine missing values, but no item found with missing value. Therefore, listwise deletion of cases was used for handling missing data.

3.7 Normality

Before conducting analysis, multivariate normality assumption was checked. For multivariate normality assumption, skewness and kurtosis values for the individual variables were checked. In addition, Kolmogorov-Smirnov test (K-S) results were also taken into consideration because a significant K-S statistics can be due to the violation of the multivariate normality assumption. So, K-S test results can give an idea about multivariate normality assumption.

Generally, skewness and kurtosis values can be considered as acceptable between -2 and +2 range (George & Mallery, 2003). Table 3.5 shows skewness and kurtosis values for the individual variables were in -2 and +2 range, so they can be considered as an indication of a univariate normality for the individual variables. On the other hand, significant K-S test results for the individual variables revealed that multivariate normality was not met. Pallant (2001) stated that violation of the assumption of normality is "quite common in large samples" (p.58).

Table 3.5 Univariate Normality Statistics of the Variables

	Skewness		**Kurtosis**	
	Statistic	**Std. Error**	**Statistic**	**Std. Error**
CONF	-.110	.055	-.490	.111
USEIMP	-.727	.055	.182	.111
LIKE	-.775	.055	.362	.111
ANX	.042	.055	-.339	.111
MATHBEHA	-.717	.055	-.056	.111
TIME	-.062	.055	-.288	.111
PFACHST	-.408	.055	-.443	.111
PMOCHST	-.398	.055	-.696	.111
PTECHST	.295	.055	.163	.111
PTECHTP	-.999	.055	1.182	.111

3.8 Instruments

In order to get an insight about the 7th grade students' attitudes toward mathematics and to model the relationships between attitude toward mathematics (ATM) and its cognitive, affective and behavioral components including students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's, father's and mother's attitudes toward and expectations from them as learners of mathematics, Attitudes Toward Mathematics Questionnaire (ATMQ) was implemented in the fall semester of 2009-2010 academic year. The ATMQ consists of two parts. In the first part, there were six questions investigating students' demographic characteristics involving school name, class, gender, mother and father education level, previous year final report card grade for mathematics course and kind of help that student is taking for mathematics out of school.

In the second part of the ATMQ, there were ten scales that are mainly designed by adaptation of mathematics attitude measuring scales that were developed by Tağ (2000). Of those ten scales, eight were adapted from the scales developed by Tağ (2000) and two were translated and adapted from the scales developed by Beth and Neustadt (2005) and Mohamad-Ali (1995). While putting the statements of the scales developed by Tağ, each statement was checked separately whether there can be some statements that may cause any misunderstanding or misinterpretation by the students. After determining the problematic statements, they were reconstructed with an instructor from faculty of mathematics education. Moreover, each statement of the scales developed by Beth and Neustadt's (2005) and Mohamad-Ali (1995) were translated and adapted into Turkish by the researcher of the current study. Translated version of the statements of the scales was examined by an instructor from faculty of mathematics education and two foreign language teachers. And then the statements were translated back into English by the researcher, and original statements were compared with the adapted one.

The scales in the ATMQ were determined and constructed by concerning the purpose of the study. They were critical for representing cognitive, affective and behavioral components of attitude. Therefore, in order to measure 7th grade students' attitudes toward mathematics, the following scales were used:

1. Confidence in Learning Mathematics Scale (CONF)
2. Usefulness and Importance of Mathematics Scale (USEIMP)
3. Liking for Mathematics Scale (LIKE)
4. Anxiety Scale (ANX)
5. Learner Behaviors toward Mathematics Scale (MATBEHA)
6. Time Spent on Mathematics at Home Scale (TIME)
7. Mother Scale (PMOCHST)
8. Father Scale (PFACHST)
9. Teacher Scale I (PTECHST)
10. Teacher Scale II (PTECHTP)

In the study, the scales CONF and USEIMP were used to measure observed variables of the latent variable, cognitive component of attitude toward mathematics. LIKE and ANX scales were used to measure observed variables of the latent variable, affective component of attitude toward mathematics. Lastly, MATBEHAV and TIME scales were used to measure observed variables of the latent variable, behavioral component of attitude toward mathematics. Moreover, these three factors most likely indicate a second-order factor, namely attitude. We therefore hypothesized the second-order factor model for this study.

Totally, there were 104 items in the ATMQ, 6 in the first part and 98 items in the second part of the scale. The items in the second part were scaled on a five-point Likert Type Scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. The positively worded items were scored from Strongly Agree as 5, to Strongly Disagree as 1, and negatively worded items were revised to positive direction for scoring purposes.

To test the construct validity of each scale and to determine whether or not they have sub-dimensions factor analysis were done. The alpha reliability coefficients for each scale were calculated with the SPSS package program. For each scale following results were obtained.

3.8.1 Confidence in Learning Mathematics Scale (CONF)

Confidence in learning mathematics scale was adapted from Fennema-Sherman Attitude Scale (1976) to measure confidence in one's ability to learn and perform well on mathematical tasks by Tag (2000). There were twelve statements in the scale, six positive and six negative. For example, one of the statement is "I am sure that I can learn mathematics". 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.

Tağ (2000) administered the confidence in learning mathematics scale to 353 9^{th} grade students in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.93. and principle component analysis supported the scale had no sub-dimensions.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of CONF with 12 items was found to be 0.879. Moreover, the value of the corrected-item total correlation was appropriate for each item of the CONF (see APPENDIX C).

To test the construct validity of CONF and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 12 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same, negatively stated items came together under the first factor and positively stated items came together under the second factor which indicates that CONF has no sub-dimensions.

3.8.2 Usefulness and Importance of Mathematics Scale (USEIMP)

Usefulness and importance of mathematics scale was adapted from Fennema-Sherman Attitude Scale (1976) and TIMSS(1999) to measure a student's beliefs about the usefulness of mathematics currently and in relationship to his or her future education and vocation, and beliefs about the importance of mathematics in relationship to his or her life by Tag (2000). There were seventeen items, eleven positive and six negative. For example, one of the statement indicating the usefulness of mathematics is “I will need mathematics for my future work” and one of the statement indicating the importance of mathematics is “Mathematics is important to everyone's life”. The scale with 17 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.

Tağ (2000) administered the usefulness of mathematics scale to 353 9^{th} grade students in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.92 and principle component analysis supported the scale had no sub-dimensions. Moreover, she administered the importance of mathematics scale to same 353 9^{th} grade students with alpha reliability coefficient of the scale was 0.69 and principle component analysis supported the scale had no sub-dimensions.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of USEIMP with 17 items was found to be 0.876. Moreover, the value of the corrected-item total correlation was appropriate for each item of the USEIMP (see APPENDIX C).

To test the construct validity of USEIMP and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 17 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion however, the item 9 was excluded from the scale because this item had very low value of factor loading. After omitting the item 9, the final form had 16 items, eleven positive and five negative, with 0.878 alpha reliability coefficient.

After varimax rotation their eigen-values remained the same, positively stated items came together under the first factor and negatively stated items came together under the second factor which indicates that USEIMP has no sub-dimensions.

3.8.3 Liking for Mathematics Scale (LIKE)

Liking for mathematics scale was adapted from Fennema- Sherman Attitude Scale (1976) to measure a student's liking or disliking for mathematics and his positive and negative feelings about mathematics or about himself as a learner of mathematics by Tag (2000). There were five items, four positive and one negative. For example, one of the statement is "I like mathematics". The scale with 5 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.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of LIKE with 5 items was found to be 0.769. Moreover, the value of the corrected-item total correlation was appropriate for each item of the LIKE (see APPENDIX C).

To test the construct validity of LIKE and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 5 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same, all items came together under the first factor which indicates that LIKE has no sub-dimensions.

3.8.4 Mathematics Anxiety Scale (ANX)

Mathematics anxiety scale was adapted from Fennema- Sherman Attitude Scale (1976) to measure feelings of anxiety, dread, nervousness and associated bodily symptoms related to doing mathematics by Tag (2000). There were twelve items, six positive and six negative. For example, one of the item is "Mathematics usually makes me feel uncomfortable and nervous. 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.

Tağ (2000) administered the mathematics anxiety scale to 353 9^{th} grade students in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.91 and principle component analysis supported the scale had no sub-dimensions.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of ANX with 12 items was found to be 0.827. Moreover, the value of the corrected-item total correlation was appropriate for each item of the ANX (see APPENDIX C).

To test the construct validity of ANX and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 12 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same positively stated items came together under the first factor and negatively stated items came together under the second factor which indicates that ANX has no sub-dimensions.

3.8.5 Learner Behaviors toward Mathematics Scale (MATHBEHA)

The items of Learner Behaviors toward Mathematics Scale were written by adapting of the questions in "Student Interview Guide" developed by Beth and Neustadt (2005). The purpose of their thesis was to explore the factors that contribute to high school girls' positive attitudes toward mathematics from their perspectives and they chose the learner behaviors as one of the factors that contribute to these girls' positive attitudes toward mathematics. In the current scale, the statements were designed to measure ways students learn mathematics (learning style), participation in math classes, hand raising and doing mathematics homework. There are five items, three positive and two negative. For example, one of the item is "In mathematics lessons, I raise my hand more likely for a question than an answer". The scale with 5 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.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. Initially, the alpha reliability coefficient of MATHBEHA with 5 items was 0.450 which requires extreme caution when results are interpreted. Therefore, analyzing the statements that made up this scale separately showed that removal of the item 5 would improve the reliability coefficient to 0.599. The value of the corrected-item total correlation of item 5 "I am more likely to raise my hand for a question than for an answer" was −0.33. This value was very low and because of the reliability purposes, this item was not used in the present study. The final alpha reliability coefficient of MATHBEHA with 4 items was found as 0.599, almost 0.60 in the main study. The reliabilities around 0.60 were interpreted as satisfactory for such a small number of items (Özdemir, 2003; Yayan & Berberoglu, 2004). Other items of MATHBEHA had appropriate values of the corrected-item total correlation (see APPENDIX C).

To test the construct validity of MATHBEHA and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 4 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same, all items came together under the first factor which indicates that MATHBEHA has no sub-dimensions.

3.8.6 Time Spent on Mathematics at Home Scale (TIME)

The items of Time Spent on Mathematics at Home Scale were written by adapting the statements of the instrument developed by Mohamad-Ali (1995). In this scale, students were asked to estimate the time they spent on mathematics at home. For the scale, there are four statements, two positive (suggesting that they spent a lot of time on mathematics at home) and two negative (suggesting that they spent the least time on mathematics at home). For example, one of the statement is “I spend very little time on mathematics at home”. The scale with 4 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.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of TIME with 4 items was found as 0.659. Moreover, the value of the corrected-item total correlation was appropriate for each item of the time (see APPENDIX C).

To test the construct validity of TIME and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 4 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same, negatively stated items came together under the first factor and positively stated items came together under the second factor which indicates that TIME has no sub-dimensions.

3.8.7 Father Scale (PFACHST)

Father scale was adapted from Fennema- Sherman Attitude Scale (1976) to measure students' perception of their father's attitudes toward them as learners of mathematics by Tag (2000). It also includes students' perception of father's interest, encouragement, and confidence in the student's ability (Tağ, 2000). There were twelve items, six positive and six negative. For example, one of the item is "My father has always been interested in my progress in mathematics". Moreover, there is only one item which measures students' perception of their father's attitudes toward mathematics. 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.

Tağ (2000) administered the father scale to 353 9th grade students in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.85 and principle component analysis supported the scale had no sub-dimensions.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of PFACHST with 12 items was found to be 0.817. Moreover, the value of the corrected-item total correlation was appropriate for each item of the PFACHST (see APPENDIX C).

To test the construct validity of PFACHST and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 12 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion however, the item 7 was excluded from the scale because this item had very low value of factor loading. After omitting the item 7 "My father would not encourage me to plan a career which includes mathematics", the final form had 11 items, six positive and five negative, with 0.843 alpha reliability coefficient.

After varimax rotation their eigen-values remained the same, negatively stated items came together under the first factor and positively stated items came together under the second factor which indicates that PFACHST has no sub-dimensions.

3.8.8 Mother Scale (PMOCHST)

Mother scale was adapted from Fennema- Sherman Attitude Scale (1976) to measure students' perception of their mother's attitudes toward them as learners of mathematics by Tag (2000). It also includes students' perception of mother's interest, encouragement, and confidence in the student's ability (Tağ, 2000). There were twelve items, six positive and six negative. For example, one of the item is "My mother would not encourage me to plan a career which includes mathematics". Moreover, there is only one item which measures students' perception of their mother's attitudes toward mathematics. 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.

Tağ (2000) administered the mother scale to 353 9^{th} grade in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.82 and principle component analysis supported the scale had no sub-dimensions.

Data of the present study were first analyzed by using the SPSS for the reliability and validity of the scale. The alpha reliability coefficient of PMOCHST with 12 items was found to be 0.833. Moreover, the value of the corrected-item total correlation was appropriate for each item of the PMOCHST (see APPENDIX C).

To test the construct validity of PMOCHST and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 12 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion however, the item 9 was excluded from the scale because this item had very low value of factor loading. After omitting the item 9 “My mother wouldn’t encourage me to plan a career which includes mathematics”, the final form had 11 items, six positive and five negative, with 0.840 alpha reliability coefficient.

After varimax rotation their eigen-values remained the same, negatively stated items came together under the first factor and positively stated items came together under the second factor which indicates that PMOCHST has no sub-dimensions.

3.8.9 Teacher Scale I (PTECHST)

Teacher scale I was adapted from Fennema- Sherman Attitude Scale (1976) to measure students’ perception of their teacher’s attitudes toward and expectations from them as learners of mathematics by Tag (2000). It also includes students’ perception of teacher’s interest, encouragement, and confidence in the student’s ability (Tağ, 2000). There were twelve items, six positive and six negative. For example, one of the item is “Mathematics teachers think I’m the kind of person who could do well in mathematics”. 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.

Tağ (2000) administered the teacher scale I to 353 9th grade students in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.79 and principle component analysis supported the scale had no sub-dimensions.

The alpha reliability coefficient of PTECHST with 12 items was found to be 0.690 in the main study. The values of the corrected-item total correlation of item 1 “Mathematics teachers encourage me to study mathematics more” and item 6 “I talk to my mathematics teachers about a career which includes mathematics” were 0.127 and 0.184, respectively. Although these values were low, the items are frequently used in many studies. Thus, these items were used in the present study. Other items of PTECHST had appropriate values of the corrected-item total correlation (see APPENDIX C).

To test the construct validity of PTECHST and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 12 items and total variance of the scale were given in Appendix G. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same, negatively stated items came together under the first factor and positively stated items came together under the second factor which indicates that PTECHST has no sub-dimensions.

3.8.10 Teacher Scale II (PTECHTP)

Teacher scale II was adapted from TIMSS (1999) to measure students’ perception of teacher’s teaching profession by Tag (2000). There were seven items, five positive and two negative. For example, one of the item is “My mathematics teacher likes mathematics”. Tağ The scale with 7 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.

Tağ (2000) administered the teacher scale II to 353 9^{th} grade in the pilot study. In her administration, alpha reliability coefficient of the scale was 0.79 and principle component analysis supported the scale had no sub-dimensions.

The alpha reliability coefficient of PTECHTP with 7 items was found to be 0.724 in the main study. Moreover, the value of the corrected-item total correlation was appropriate for each item of the PTECHTP (see APPENDIX C).

To test the construct validity of PTECHTP and to determine whether or not it has sub-dimensions Principle Component Analysis was done. According to the initial principal factor solution with iterations, the scale was one-dimensional. The eigen-values and factor loadings of 12 items and total variance of the scale were given in Appendix M. Using factor loadings of 0.4 or greater as a criterion, no item was omitted from the scale.

After varimax rotation their eigen-values remained the same, all items came together under the first factor which indicates that PTECHTP has no sub-dimensions.

3.9 Confirmatory Factor Analysis of the Attitude Towards Mathematics Questionnaire

With the selected observed variables, a confirmatory factor analysis with ten factors was carried out to assess the fit. The ten-factor model proposed for the confirmatory factor analysis for ATMQ items yielded a Chi-Square, $\chi 2$ = 148832.18 which was significant with degrees of freedom of, *df* = 4232, and the significance level, *p* = .00. $\chi 2$ criterion tends to result with a significant probability level with large sample sizes, generally with sample size above 200 (Schumacker & Lomax, 2004). In the present study, chi-square index indicated a significant value, which was expected because of the large sample size (N = 1960). Therefore, it was not taken into account for a fit index. The final SIMPLIS syntax used in the analysis was presented in APPENDIX E.

The goodness-of- fit indices, namely; Goodness of Fit Index (GFI), Adjusted GFI (AGFI), Standardized RMR (SRMR), Root Mean Square Error of Approximation (RMSEA) and 90 Percent Confidence Interval for Root Mean Square Error of Approximation (RMSEA (90% CI)) used to evaluate the model were given in Table 3.6. The values for the whole goodness-of-fit statistics were provided in APPENDIX F.

Table 3.6 Goodness-of-Fit Indices of the Confirmatory Factor Model of ATMQ

Index	Value	Criterion
GFI	0.38	≥ .95
AGFI	0.35	≥ .95
SRMR	0.12	<.05
RMSEA (90% CI)	0.13 (0.0;0.0)	<.05

From Table 3.6, the Goodness of Fit index (GFI) and the Adjusted Goodness of Fit Index (AGFI) of the model were 0.38 and 0.35, respectively. Moreover, the Standardized Root Mean Square Residual (SRMR) of the model was 0.12 and the Root Mean Square Error of Approximation (RMSEA) of the model was 0.13. Pintrich, Garcia, & McKeachie (1991) developed a self-report questionnaire which was called Motivated Strategies for Learning Questionnaire (MSLQ). There were essentially two sections to the MSLQ, a motivation section and a learning strategies section. The motivation section of the MSLQ consisted of 31 items that assess students' goals and value beliefs for a course, their beliefs about their skill to succeed in a course, and their anxiety about tests in a course. On the other hand, the learning strategy section of the MSLQ includes 50 items regarding students' use of different cognitive and metacognitive strategies, namely, rehearsal**,** elaboration, organization, critical thinking, metacognitive self-regulation and concerning student management of different resources, namely, time and study environment, effort, regulation, peer learning, help seeking. Pintrich, Garcia, & McKeachie (1991) were tested the dimensions of both motivation and learning strategies sections of the MLSQ by Confirmatory Factor Analysis using LISREL. The fit statistics of the motivation section of the questionnaire: the chi-square to degrees of freedom ratio ($\chi 2/df$ = 3.49); the Goodness of Fit Index (GFI = 0.77); and the Root Mean Square Residual (RMR = 0.07). Moreover, the fit statistics of the learning strategy section of the questionnaire: the chi-square to degrees of freedom ratio ($\chi 2/df$ = 2.26); the Goodness of Fit Index (GFI = 0.78); and the Root Mean Square Residual (RMR =

0.08). They reported that although the goodness-of-fit indices were not within acceptable limits, they were quite reasonable values, because students' motivation, strategy use may differ depending upon course characteristics, teacher demands, and individual student characteristics. So, they proposed that overall the models show sound structures and one can reasonably claim factor validity of the scales. In the present study, considering the fact that reliability of dimensions and fit indices of ATMQ were comparable with MSLQ, it was decided that ATMQ was used in the current study. However, it should be noted that the values for ATMQ do not indicate a good fit (Sungur, 2004).

Table 3.7 indicates the Lambda-x estimates and standard errors as obtained for the latent factors of the ATMQ .

Table 3.7 LISREL Estimates, Standard Errors of the ATMQ

	Indicator	Lambda-x	*SE*
Confidence in Learning Mathematics (CONF)	q1	1.07	0.04
	q2	0.95	0.03
	q3	1.57	0.05
	q4	0.95	0.03
	q5	1.28	0.04
	q6	0.95	0.03
	q7	1.17	0.03
	q8	0.92	0.03
	q9	1.40	0.04
	q10	0.65	0.03
	q11	1.38	0.03
	q12	1.39	0.04
Usefulness and Importance of Mathematics (USEIMP)	q1	2.62	0.08
	q2	1.32	0.04
	q3	1.83	0.05
	q4	1.95	0.05
	q5	1.60	0.04
	q6	1.09	0.04
	q7	1.33	0.05
	q8	1.41	0.05

Table 3.7 (cont'd)

	Indicator	Lambda-x	*SE*
Usefulness and Importance of Mathematics (USEIMP)	q10	1.50	0.05
	q11	1.47	0.05
	q12	1.38	0.04
	q13	1.39	0.06
	q14	1.29	0.04
	q15	1.71	0.05
	q16	1.46	0.05
	q17	1.87	0.05
Liking for Mathematics (LIKE)	q1	2.46	0.05
	q2	2.40	0.05
	q3	1.34	0.04
	q4	1.00	0.04
	q5	1.29	0.06
Mathematics Anxiety (ANX)	q1	1.08	0.04
	q2	1.38	0.06
	q3	0.89	0.03
	q4	094	0.04
	q5	0.91	0.04
	q6	1.08	0.04
	q7	1.61	0.05
	q8	0.90	0.04
	q9	0.92	0.04
	q10	1.03	0.04
	q11	1.27	0.04
	q12	1.62	0.04
Learner Behaviors toward Mathematics (MATHBEHA)	q1	0.59	0.06
	q2	2.69	0.04
	q3	2.69	0.04
	q4	0.49	0.04
Time Spent on Mathematics at Home (TIME)	q1	1.07	0.04
	q2	0.70	0.03
	q3	1.22	0.04
	q4	0.68	0.04
Students' Perceptions of their Father's Attitudes toward and Expectations from them as Learners of Mathematics (PFACHST)	q1	0.91	0.05
	q2	1.08	0.05
	q3	0.77	0.04
	q4	0.99	0.05
	q5	1.37	0.06
	q6	1.41	0.06
	q8	1.58	0.04
	q9	2.15	0.05
	q10	2.01	0.05
	q11	1.86	0.04
	q12	1.95	0.05

Table 3.7 (cont'd)

	Indicator	Lambda-x	*SE*
Students' Perceptions of their Mother's Attitudes toward and Expectations from them as Learners of Mathematics (PMOCHST)	q1	1.66	0.08
	q2	1.28	0.05
	q3	1.08	0.04
	q4	1.07	0.05
	q5	0.95	0.04
	q6	0.95	0.05
	q7	1.85	0.05
	q8	1.87	0.04
	q10	1.99	0.05
	q11	1.94	0.05
	q12	1.82	0.05
Students' Perceptions of their Mathematics Teacher's Attitudes toward and Expectations from them as Learners of Mathematics (PTECHST)	q1	-0.15	0.04
	q2	0.46	0.04
	q3	0.47	0.04
	q4	0.12	0.04
	q5	0.30	0.04
	q6	-0.05	0.04
	q7	0.97	0.05
	q8	0.72	0.04
	q9	2.03	0.06
	q10	1.58	0.04
	q11	1.83	0.05
	q12	1.33	0.04
Students' Perceptions of their Mathematics Teacher's Teaching Profession (PTECHTP)	q1	2.92	0.09
	q2	1.98	0.06
	q3	1.74	0.05
	q4	1.23	0.05
	q5	1.48	0.06
	q6	1.26	0.05
	q7	1.41	0.06

Table 3.8 displays Phi values which are estimates for the covariances between the latent constructs. In this table CO, UI, LIKE, ANX, MBEH, TIME, FAST, MOST, TEST, TETP represents Confidence in Learning Mathematics, Usefulness and Importance of Mathematics, Liking for Mathematics, Mathematics Anxiety, Learner Behaviors toward Mathematics, Time Spent on Mathematics at Home, Students' Perceptions of their Father's Attitudes toward and Expectations from them as Learners of Mathematics, Students' Perceptions of their Mother's Attitudes toward and Expectations from them as Learners of Mathematics, Students'

Perceptions of their Mathematics Teacher's Attitudes toward and Expectations from them as Learners of Mathematics, Students' Perceptions of their Mathematics Teacher's Teaching Profession, respectively.

Table 3.8 Phi Estimates

	CO	UI	LIKE	ANX	MBEH	TIME	FAST	MOST	TEST
UI	.61								
LIKE	.74	.69							
ANX	.81	.58	.73						
MBEH	.34	.39	.23	.34					
TIME	.60	.56	.58	.57	.38				
FAST	.47	.56	.38	.49	.55	.55			
MOST	.50	.61	.40	.46	.53	.61	.86		
TEST	.53	.46	.34	.58	.41	.53	.62	.62	
TETP	.45	.59	.53	.41	.31	.38	.36	.40	.39

Note. CO = Confidence in learning mathematics, UI = Usefulness and importance of mathematics, LIKE = Liking for mathematics, ANX = Mathematics anxiety, MBEH = Learner behaviors toward mathematics, TIME = Time spent on mathematics at home, TETP = Students' perceptions of their mathematics teacher's teaching profession, TEST = Students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, FAST = Students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics, MOST = Students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics.

3.10 Internal Validity of the Present Study

Internal validity of a study means that any relationship observed between two or more variables should be unambiguous and being due to "something else". The "something else" may be the age or ability of the subjects, the conditions under which the study is conducted, or the type of materials used (Fraenkel & Wallen, 1996).

The selection of people for the study may result in the individuals (or groups) differing from one another in unintended ways that is related to the variables to be studied. This is called subject characteristics thereat (Fraenkel & Wallen, 1996). In the present study subjects characteristics could not be a problem for the internal validity. Subjects were all seventh grade students so almost all the subjects' ages were very close to each other. Genders of the subjects were included as a variable.

Hence, age and gender bias did not affect research results unintentionally. Subjects' socioeconomic backgrounds, which may affect the results of the study, were almost the same in the present study since all the subjects enrolled to public elementary schools in the same district of Istanbul. Moreover, subjects' parents' education level included as a variable effect of socioeconomic background tried to be controlled in this study.

The particular locations which data are collected a location threat (Fraenkel & Wallen, 1996). In the present study, location could not be a problem for the internal validity. Similar classroom settings in which data were collected and administering the ATMQ and interviewing almost at the same times controlled location threat.

Lose of subjects as the study progress is known as mortality threat (Fraenkel & Wallen, 1996). In the present study, mortality could not be a problem for the internal validity. Subjects were not known when they were get attitude scales.

The way in which instruments are used may also constitute a threat to internal validity of the study (Fraenkel & Wallen, 1996). Instrument decay, data collector characteristics, and data collector bias could not be problem to internal validity. Data collector- the researcher followed the same procedure and read the same instructions to all participating students. Moreover, data collector characteristics were not related to the variables being investigated and data were collected in the same way from all schools. The computer read data.

Since the present study is not an intervention or experimental study testing, maturation, Hawthore effect, regression, implementation could not be problem for the internal validity. Furthermore, since there weren't any unplanned occasions during the implementation of the attitude scales, history could not be a problem for the internal validity. Confidentiality was satisfied by being remembered to students that their answers wouldn't be seen by anybody else expect the researcher and also wouldn't be used any other purposes expect the present study. Moreover, without taking accounts the names of the subjects satisfied confidentiality.

3.11 External Validity of the Present Study

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

3.11.1 Population Validity

In the present study convenience sampling was utilized. However, all public elementary schools in Beyoğlu district of Istanbul tried to be included. Therefore, generalizations of the findings of the study can be done on students enrolled to schools in that district of Istanbul. Nevertheless, since sample size was not big enough generalizations of the findings of the study were limited. On the other hand, generalization can be done on subjects having the same characteristics mentioned in the “Subjects of the Study” section.

3.11.2 Ecological Validity

The ecological validity is the degree to which results of a study can be extended to other setting or occasions (Fraenkel & Wallen, 1996). The measuring instruments were used in regular classroom settings. Since the study is on seventh grade elementary school students, the results of the present study can be generalized to similar settings to this study.

CHAPTER 4

RESULTS

This chapter devoted to the presentation of the results of the study. They are presented into three main parts; descriptive statistics, results of the research problems and summary of the results.

4.1 Descriptive Statistics

In order to analyze the profile of the participants of the study in terms of their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics, the time they spent on mathematics at home, perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's, father's and mother's attitudes toward and expectations from them as learners of mathematics, mean per item scores of the scales, standard deviations, minimum and maximum values per item were used.

For Confidence in Learning Mathematics Scale, minimum per item score was 1.08, maximum per item score was 5.00, and the mean per item was found as 3.61 (SD = 0.75). When the scale is thought as a continuum, the mean score of the scale is close to the highest and of the scale. Therefore, it can be said that students more believed that they have definite confidence rather than distinct lack of confidence in learning mathematics.

For Usefulness and Importance of Mathematics Scale with the exclusion of one item, the minimum per item score was 1.63, maximum per item score was 5.00, and the mean per item was found as 4.09 (SD = 0.65). Since the higher scores indicate belief in the usefulness and importance of mathematics, the results showed that students were more likely to view mathematics as an useful field of study currently, and in relationship to their future education, vocation, or other activities and important in relationship to their lives.

For Liking for Mathematics Scale, minimum per item score was 1.00, maximum per item score was 5.00, and the mean per item was found as 3.82 (SD = 0.84). When the scale is thought as a continuum, the mean score of the scale is close to the highest end of the scale. Therefore, it can be said that students had enjoyment of mathematics.

For Mathematics Anxiety Scale, the minimum per item score was 1.00, maximum per item score was 5.00, and the mean per item was found as 3.44 (SD = 0.77). Descriptive statistics indicate that mean score of the scale is above the half point and close to the highest end of the continuum. Therefore, it can be said that students had feelings at ease, comfortable and calm rather than feelings of anxiety, dread and nervousness related to doing mathematics.

For Learner Behaviors toward Mathematics Scale with the exclusion of one item, minimum per item score was 1.50, maximum per item score was 5.00, and the mean per item was found as 4.12 (SD = 0.72). When the scale is thought as a continuum, the mean score of the scale is close to the highest end of the scale. Therefore, it can be said that students were generally actively involved in math classes such as, participating in mathematics activities, raising hands, or doing mathematics homework.

For Time Spent on Mathematics at Home Scale, the minimum per item score was 1.00, maximum per item score was 5.00, and the mean was found as 3.29 (SD = 0.91). Descriptive statistics indicate that mean per item score of the scale is above the half point and close to the highest end of the continuum. Therefore, it can be said that students likely to spent their time on mathematics at home.

For Father Scale with the exclusion of one item, the minimum per item score was 1.00, maximum per item score was 5.00, and the mean per item was found as 3.97 (SD = 0.73). Descriptive statistics indicate that mean score of the scale is above the half point and close to the highest end of the continuum. Therefore, it can be said that students likely to think their father had positive attitudes toward them as learner of mathematics. Moreover, students' father is interested, encouraged and confident in the students' ability.

For Mother Scale with the exclusion of one item, the minimum per item score was 1.36, maximum per item score was 5.00, and the mean was found as 4.01 (SD = 0.72). Descriptive statistics indicate that mean per item score of the scale was above the half point and close to the highest end of the continuum. Therefore, it can be said that students likely to think their mother had positive attitudes toward them as learner of mathematics. Moreover, students' mother is interested, encouraged and confident in the students' ability.

For Teacher Scale I, the minimum per item score was 1.25, maximum score per item was 5.00, and the mean per item was found as 3.36 (SD = 0.60). Descriptive statistics indicate that mean score of the scale is above the half point and close to the highest end of the continuum. Therefore, it can be said that students likely to think their mathematics teacher had positive attitudes toward them as learner of mathematics. Moreover, students' mathematics teacher is interested, encouraged and confident in the students' ability.

For Teacher Scale II, minimum per item score was 1.14, maximum per item score was 5.00, and the mean per item was found as 4.20 (SD = 0.65). When the scale is thought as a continuum, the mean score of the scale is close to the highest end of the scale. Therefore, it can be said that students were more likely to view their mathematics teacher as being good at his teaching profession.

4.2 Results of the Research Problems

In this part, first the results of the second-order factor model was introduced which identified the three components of attitude toward mathematics in seventh grade students. Then, the results of the two path analytic models explaining relationships among the selected variables were presented. To test the proposed models, LISREL was used. Significance levels for all the analyses were stated as 0.05 (t=1.96). Moreover, in the models, standardized coefficients and t values were given.

Research Problem 1: What is the factor model explaining three components of attitude toward mathematics in 7th grade students?

The confirmatory factor analysis presented in the Method chapter attempted to determine which sets of observed variables define theoretical constructs or factors. However, a second-order factor model is present when first-order factors are explained by some higher order factor structure (Schumacker & Lomax, 2004). Based on the given theoretical perspective and assumptions, the collected data on observed variables identify three common factors (Cognitive, Affective and Behavioral) and these three factors most likely indicate a second-order factor, Attitude. Therefore, the second-order factor model was hypothesized for this study.

For the purpose of revising the model data fit of the initial model displayed in Chapter 1, the model fit indexes such a as GFI, AGFI, SRMR, and RMSEA with 90% CI, the significance of the paths was considered with respect to the *t*-test results. For the purpose of revising the model data fit, modification indexes were also considered. While checking the modification indexes, one value was considered deviant from the rest. This value is 112.6, between the observed variables of CONF and ANX, therefore, one covariance term was added into the model between these two observed variables. As a result, the final second-order factor model with estimates was given in Figure 4.1 and with significant *t*-values was presented in Figure 4.2. The final SIMPLIS syntax used in the analysis was presented in APPENDIX E.

All the fit indices, namely; Goodness of Fit Index (GFI), Adjusted GFI (AGFI), Standardized RMR (SRMR), Root Mean Square Error of Approximation (RMSEA) and 90 Percent Confidence Interval for Root Mean Square Error of Approximation (RMSEA (90% CI)) indicated a good model fit. The goodness-of-fit indices used to evaluate the model were given in Table 4.1. The Chi-Square, $\chi 2$ = 32.90 was significant with degrees of freedom of, $df = 5$, and the significance level, $p = .00$. $\chi 2$ criterion tends to result with a significant probability level with large sample sizes, generally with sample size above 200 (Schumacker & Lomax, 2004). In the present study, chi-square index indicated a significant value, which was expected because of the large sample size (N = 1960). Therefore, it was not taken into account for a fit index. The values for the whole goodness-of-fit statistics were provided in APPENDIX F.

Table 4.1 Goodness-of-Fit Indices for the Second-Order Factor Model

Index	**Value**	**Criterion**
GFI	0.99	≥ .95
AGFI	0.98	≥ .95
SRMR	0.014	<.05
RMSEA(90% CI)	0.053 (0.037;0.071)	<.05

From Table 4.1, the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI) of the model were 0.99 and 0.98, respectively. Since these values were approaching to unity, the model had a good fit to the data.

The Standardized Root Mean Square Residual (SRMR) of the model was 0.014. The value of SRMR indicated a good fit to the data since the value was smaller than 0.05.

For RMSEA, values below .05 indicate a very good fit to the data (Kelloway, 1998; Schumacker & Lomax, 2004). Browne and Cudeck (1993) suggest the values less than .05 indicate good model data fit, values ranging from .05 to .08 indicate mediocre fit, and values greater than .10 indicate poor fit. Here the value of RMSEA was .053 and it was very close to .05. Moreover, the upper confidence limit was below the value .08 suggested by Browne and Cudeck (1993). Therefore, it was concluded that the model fitted well and represented a reasonably close approximation in the population.

As a result, all the goodness-of-fit indices of the model were investigated through their criteria and it was found that the model indicated a good fit to the data. Thus, all the indicators except for Chi-Square suggested an overall fit between the model and the observed data.

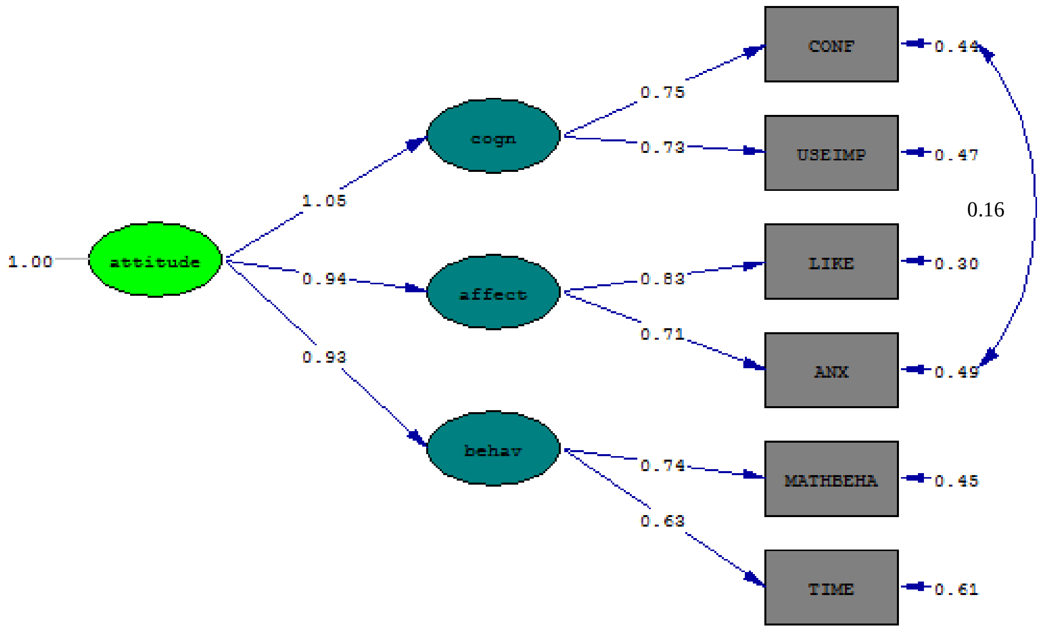

Figure 4.1 Second-Order Factor Model with Standardized Estimates

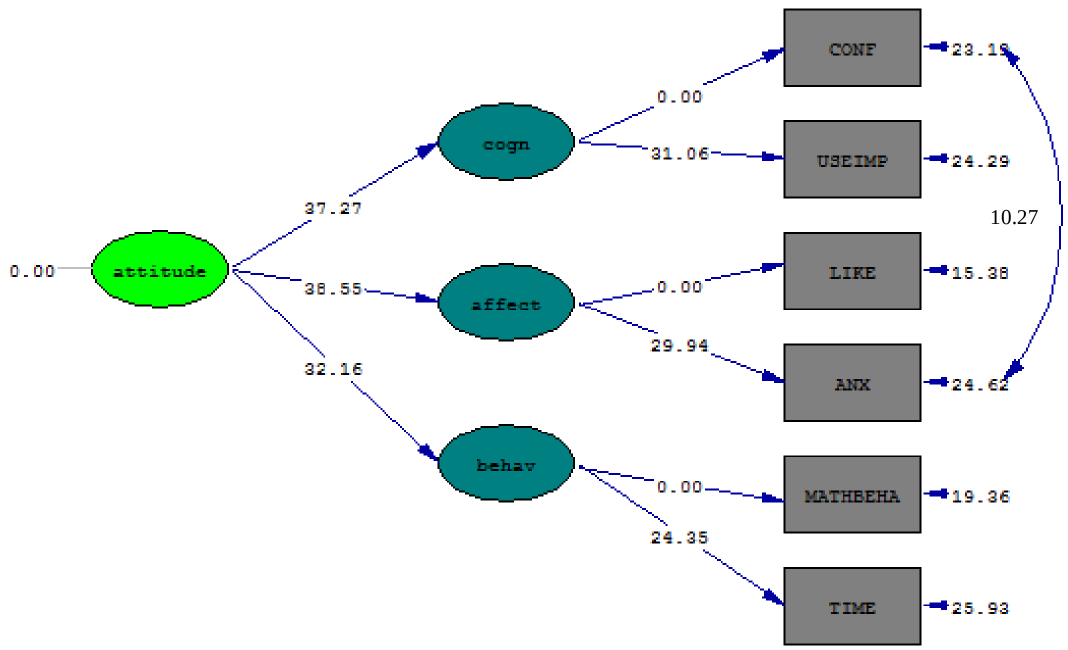

Figure 4.2 Second-Order Factor Model with *t*-Values

In table 4.2, 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 4.2 λ_y Coefficients of Endogenous Latent Variables for the Second-Order Factor Model

Latent Variable	**Observed Variables**	**λ_y parameter**	**R^2**
cogn	CONF	0.59	0.56
	USEIMP	0.49	0.53
affect	LIKE	0.65	0.70
	ANX	0.51	0.51
behav	MATHBEHA	1.69	0.55
	TIME	0.57	0.39

Two observed variables are significantly and positively loaded on cogn, CONF (λ_y = 0.59) and USEIMP (λ_y = 0.49). Two observed variables are significantly and positively loaded on affect, LIKE (λ_y = 0.65) and ANX (λ_y = 0.51). Lastly, two observed variables are significantly and positively loaded on behav, MATHBEHA (λ_y = 1.69) and TIME (λ_y = 0.57).

The squared multiple correlation (R^2) is a standardized factor loading squared that means the extent that a factor can explain the variance in a manifest variable (Albright & Park, 2009). For instance, values of R^2 equals to 0.50 mean that the 50% of the variance of a variable is explained by another variable (Kline, 1998). In Table 4.2, a good deal of variance in each observable variable was accounted for. The latent variable cogn explains about 56 percent (=$.75^2$) of variance in CONF and about 53 percent (=$.73^2$) of variance in USEIMP. The latent variable affect explains about 70 percent (=$.83^2$) of variance in LIKE and about 51 percent (=$.71^2$) of variance in ANX. Lastly, behave explains about 55 percent (=$.74^2$) of variance in MATHBEHA and about 39 percent (=$.63^2$) of variance in TIME. Overall, large R^2

values for each variable supported the idea that the second-order factor model is very appropriate to explain students' attitudes toward mathematics.

The strength and direction of the relationships among exogenous and endogenous variables are indicated by the structure coefficients (β and γ). The strength and direction of the relationships among exogenous and endogenous variables were identified by γ (lowercase gamma) values. The γ values in the model were given in Table 4.3.

Table 4.3 γ Values for the Second-Order Factor Model

Exogenous Latent Variable	**γ Parameter (t value)**	**Endogenous Latent Variable**
	1.05 (37.27)	cogn
attitude	0.94 (38.55)	affect
	0.93 (32.16)	behav

Lastly, the correlation matrix of endogenous latent variables revealed that cogn was significantly and positively correlated with affect (r = .99, $p < .05$) and with behav (r = .97, $p < .05$), and affect was significantly and positively correlated with behave (r = .88, $p < .05$).

The null hypothesis introduced in Chapter 1 was evaluated according to the final model obtained. A significant factor model between cognitive, affective, behavioral components of attitude and attitude itself was obtained. According to the model:

1. As expected, confidence in learning mathematics is significantly and positively loaded on cognitive component of attitude toward mathematics (λ_y = 0.59, $p < .05$).

2. As expected, usefulness and importance of mathematics is significantly and positively loaded on cognitive component of attitude toward mathematics ($\lambda_y = 0.49$, $p < .05$).
3. As expected, liking for mathematics is significantly and positively loaded on affective component of attitude toward mathematics ($\lambda_y = 0.65$, $p < .05$).
4. As expected, mathematics anxiety is significantly and positively loaded on affective component of attitude toward mathematics ($\lambda_y = 0.51$, $p < .05$).
5. As expected, learner behaviors toward mathematics is significantly and positively loaded on behavioral component of attitude toward mathematics ($\lambda_y = 1.69$, $p < .05$).
6. As expected, time spent on mathematics at home is significantly and positively loaded on behavioral component of attitude toward mathematics ($\lambda_y = 0.57$, $p < .05$).
7. As expected, cognitive component of attitude is significantly and positively related to the attitude toward mathematics ($\gamma = 1.05$, $t = 37.27$, $p < .05$).
8. As expected, affective component of attitude is significantly and positively related to the attitude toward mathematics ($\gamma = 0.94$, $t = 38.55$, $p < .05$).
9. As expected, behavioral component of attitude is significantly and positively related to the attitude toward mathematics ($\gamma = 0.93$, $t = 32.16$, $p < .05$).

Research Problem 2: What is the model explaining relationships among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home?

In order to determine the relationships among students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home, a path analytic model was proposed. The variables which were entered in structural equation modeling were measured by dividing the sum of the items of each scale to the number items of it.

For the purpose of revising the model data fit of the initial model displayed in Chapter 1, the model fit indexes such a as GFI, AGFI, SRMR, and RMSEA with 90% CI, the significance of the paths from was considered with respect to the *t*-test results. For the purpose of revising the model data fit, modification indexes were also considered. The path between PMOCHST and ANX given in the initial model, was found to have non-significant *t*-value. In the following analysis, this path was removed from the model. Moreover, as a result of inspecting the modification indexes, eight values were considered deviant from the rest. These values are: 609.0, between the observed variables of CONF and ANX; 411.0, between the observed variables of LIKE and CONF; 358.1, between the observed variables of LIKE and USEIMP; 379.1, between the observed variables of ANX and LIKE; 239.8, between the observed variables of MATHBEHA and CONF; 181.4, between the observed variables of MATHBEHA and LIKE; 149.1, between the observed variables of MATHBEHA and ANX; and 120.8, between the observed variables of MATHBEHA and TIME. Thus, eight covariance terms were added into the model between those observed variables. As a result, the final path analytic model with estimates was given in Figure 4.3 and with significant *t*-values was presented in Figure 4.4. The final SIMPLIS syntax used in the analysis was presented in APPENDIX E.

All the fit indices, namely; Goodness of Fit Index (GFI), Adjusted GFI (AGFI), Standardized RMR (SRMR), Root Mean Square Error of Approximation (RMSEA) and 90 Percent Confidence Interval for Root Mean Square Error of Approximation (RMSEA (90% CI)) indicated a model fit. The goodness-of-fit indices used to evaluate the model were given in Table 4.4. The Chi-Square, χ_2 = 443.55 was significant with degrees of freedom of, df = 14, and the significance level, p = .00. χ_2 criterion tends to result with a significant probability level with large sample sizes, generally with sample size above 200 (Schumacker & Lomax, 2004). In the present study, chi-square index indicated a significant value, which was expected because of the large sample size (N = 1960). Therefore, it was not taken into account for a fit index. The values for the whole goodness-of-fit statistics were provided in APPENDIX F.

Table 4.4 Goodness-of-Fit Indices for the Path Analytic Model

Index	**Value**	**Criterion**
GFI	0.96	≥ .95
AGFI	0.83	≥ .95
SRMR	0.063	<.05
RMSEA(90% CI)	0.13(0.12 ; 0.14)	<.05

From Table 4.4, the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI) of the model were 0.96 and 0.83, respectively. Since these values were approaching to unity, the model had a good fit to the data.

The Standardized Root Mean Square Residual (SRMR) of the model was 0.063. The value of SRMR indicated a good fit to the data since the value was very close to 0.05.

For RMSEA, values below .05 indicate a very good fit to the data (Kelloway, 1998; Schumacker & Lomax, 2004). Browne and Cudeck (1993) suggest the values less than .05 indicate good model data fit, values ranging from .05 to .08 indicate mediocre fit, and values greater than .10 indicate poor fit. Following the guidelines of Browne and Cudeck (1993), it is seen that the value of RMSEA was 0.13 and the 90 percent confidence interval was from 0.12 to 0.14. Since the lower bound was above the recommended value of 0.05 suggested by Browne and Cudeck (1993), it was concluded that the degree of approximation in the population was too large and the modified model indicated a poor fit to the data.

As a result, all the goodness-of-fit indices of the model were investigated through their criteria and because of RMSEA, it was concluded that the model indicated a poor fit to the data.

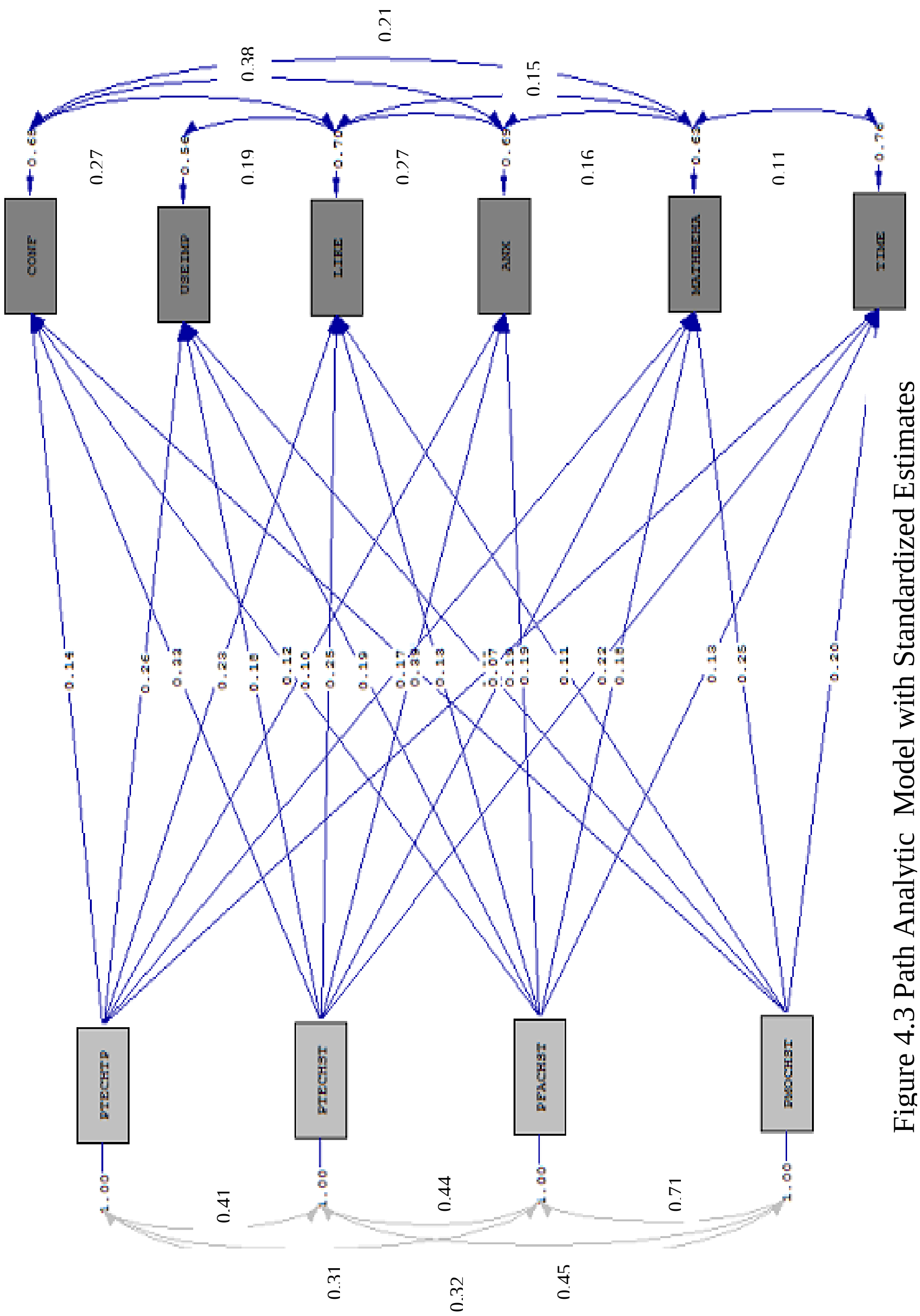

Figure 4.3 Path Analytic Model with Standardized Estimates

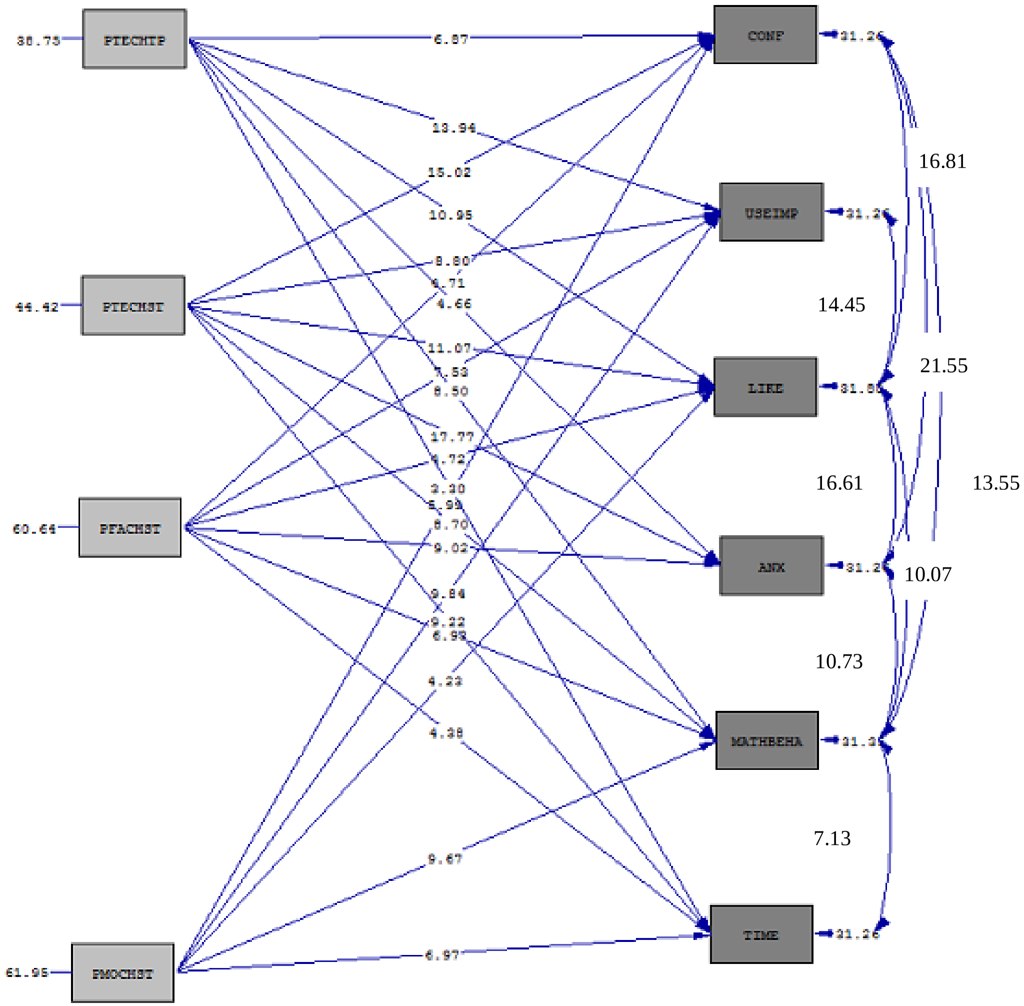

Figure 4.4 Path Analytic Model with t-Values

The strength and direction of the relationships among exogenous and endogenous variables were identified by γ (lowercase gamma) values (Table 4.5).

Table 4.5 γ Values for the Path Analytic Model

Exogenous Variable	**γ Parameter (*t*-value)**	**Endogenous Variable**
PTECHTP	0.14 (6.99)	CONF
	0.26 (13.94)	USEIMP
	0.23 (10.83)	LIKE
	0.10 (4.60)	ANX
	0.17 (8.42)	MATHBEHA
	0.07 (3.30)	TIME
PTECHST	0.33 (15.24)	CONF
	0.18 (8.80)	USEIMP
	0.25 (10.90)	LIKE
	0.39 (17.44)	ANX
	0.19 (8.59)	MATHBEHA
	0.22 (9.22)	TIME
PFACHST	0.12 (4.24)	CONF
	0.19 (7.53)	USEIMP
	0.13 (4.36)	LIKE
	0.19 (6.53)	ANX
	0.18 (6.68)	MATHBEHA
	0.13 (4.38)	TIME
PMOCHST	0.14 (5.55)	CONF
	0.25 (9.84)	USEIMP
	0.11 (4.17)	LIKE
	0.25 (9.49)	MATHBEHA
	0.20 (6.97)	TIME

As was seen from Table 4.5 and Figure 4.3, the standardized path coefficients changed between 0.07 and 0.39 in the fitted model. According to Cohen (1988) standardized path coefficients with absolute values less than 0.10 may indicate a "small" effect; whereas values around 0.30 indicate a "medium" and values above 0.50 indicate a "large" effect, respectively (Kline, 1998). With respect to these criteria, except the path coefficient from PTECHTP to the TIME, all the other path coefficients indicated medium effects with various magnitudes. The path coefficient from PTECHTP to the TIME indicates a small effect size.

In the study, R^2 values were calculated to indicate the proportion of explained variance of the endogenous variables. In Table 4.6, R^2 values for endogenous variables were given.

Table 4.6 R^2 Values for Endogenous Variables for the Path Analytic Model

Endogenous Variable	$\mathbf{R^2}$
CONF	0.32
USEIMP	0.44
LIKE	0.30
ANX	0.31
MATHBEHA	0.37
TIME	0.24

The variables PTECHTP, PTECHST, PFACHST and PMOCHST explained 32% of the variance of CONF. The variables PTECHTP, PTECHST, PFACHST and PMOCHST explained 44% of the variance of USEIMP. The variables PTECHTP, PTECHST, PFACHST and PMOCHST explained 30% of the variance of LIKE. The latent variables PTECHTP, PTECHST and PFACHST explained 31% of the variance of ANX. PTECHTP, PTECHST, PFACHST and PMOCHST explained 37% of the variance of MATHBEHA. The variables PTECHTP, PTECHST, PFACHST and PMOCHST explained 24% of the variance of TIME.

Lastly, Pearson correlation coefficient was utilized for determining the relationships among the variables of the model proposed. Table 4.7 shows the inter-correlations of the variables used.

Table 4.7 Inter-Correlations of the Variables

	CO	UI	LIKE	ANX	MBEH	TIME	TETP	TEST	FAST
UI	.54								
LIKE	.62	.62							
ANX	.69	.48	.59						
MBEH	.53	.51	.50	.45					
TIME	.45	.45	.46	.41	.44				
TETP	.36	.48	.40	.32	.37	.27			
TEST	.50	.48	.44	.52	.40	.39	.41		
FAST	.40	.52	.37	.39	.48	.39	.31	.44	
MOST	.42	.54	.38	.36	.51	.42	.32	.45	.71

Note. CO = Confidence in learning mathematics, UI = Usefulness and importance of mathematics, LIKE = Liking for mathematics, ANX = Mathematics anxiety, MBEH = Learner behaviors toward mathematics, TIME = Time spent on mathematics at home, TETP = Students' perceptions of their mathematics teacher's teaching profession, TEST = Students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, FAST = Students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics, MOST = Students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics.
$p < .01$

From Table 4.7, all correlations are positive and significant at the .01 level of significance.

The null hypothesis introduced in Chapter 1 was evaluated according to the final model obtained. However, a significant model between students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's, father's and mother's attitudes toward and expectations from them as learners of mathematics, confidence in learning mathematics, usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and the time they spent on mathematics at home was not obtained.

Research Problem 3: What is the model explaining relationships between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics and cognitive, affective and behavioral components of attitude toward mathematics?

In order to determine the relationships between students' perceptions of their mathematics teacher's teaching profession, their mathematics teacher's and parents' attitudes toward and expectations from them as learners of mathematics, and three components of attitude toward mathematics, a path analytic model with latent variables was proposed.

For the purpose of revising the model data fit of the initial model displayed in Chapter 1, the model fit indexes such a as GFI, AGFI, SRMR, and RMSEA with 90% CI, the significance of the paths from observed to latent variables was considered with respect to the *t*-test results. For the purpose of revising the model data fit, modification indexes were also considered. The paths between PFACHST and affect, PFACHST and behave, and PMOCHST and cogn indicated non-significant *t*-values. In the following analysis, these paths were removed from the model. While checking the modification indexes, six values were considered deviant from the rest. These values are: 1230.7, between the observed variables of PTECHST and PTECHTP; 128.3, between the observed variables of ANX and USEIMP; 38.6, between the observed variables of ANX and CONF; 37.9, between the observed variables of PTECHST and LIKE; 27.6, between the observed variables of PTECHTP and CONF, and 17.8, between the observed variables of PFACHST and USEIMP. Thus, six covariance terms were added into the model between those observed variables. As a result, the final path analytic model with estimates was given in Figure 4.5 and with significant *t*-values was presented in Figure 4.6. The final SIMPLIS syntax used in the analysis was presented in APPENDIX E.

All the fit indices, namely; Goodness of Fit index (GFI), Adjusted GFI (AGFI), Standardized RMR (SRMR), Root Mean Square Error of Approximation (RMSEA) and 90 Percent Confidence Interval for Root Mean Square Error of Approximation (RMSEA (90% CI)) indicated a good model fit. The goodness-of-fit indices used to evaluate the model were given in Table 4.8. The Chi-Square, $\chi2$ = 110.67 was significant with degrees of freedom of, *df* = 15, and the significance level, *p* = .00. $\chi2$ criterion tends to result with a significant probability level with large sample sizes, generally with sample size above 200 (Schumacker & Lomax, 2004). In the present study, chi-square index indicated a significant value, which was expected because of the large sample size (N = 1960). The values for the whole goodness-of-fit statistics were provided in APPENDIX F.

Table 4.8 Goodness-of-fit indices of the Path Analytic Model with Latent Variables

Index	**Value**	**Criterion**
GFI	0.99	≥ .95
AGFI	0.96	≥ .95
SRMR	0.017	<.05
RMSEA(90% CI)	0.057 (0.047;0.067)	<.05

From Table 4.8, the Goodness of Fit Index (GFI) and the Adjusted Goodness of Fit Index (AGFI) of the model were 0.99 and 0.96, respectively. Since these values were approaching to unity, the model had a good fit to the data.

The Standardized Root Mean Square Residual (SRMR) of the model was 0.017. The value of SRMR indicated a good fit to the data since the value was smaller than 0.05.

The Root Mean Square Error of Approximation (RMSEA) of the model was 0.057 and the upper confidence limit was below the value .08 suggested by Browne and Cudeck (1993). Therefore, it was concluded that the model fitted well and represented a reasonably close approximation in the population.

As a result, all the goodness-of-fit indices of the model were investigated through their criteria and it was found that the model indicated a good fit to the data. Thus, all the indicators except for Chi-Square suggested an overall fit between the model and the observed data.

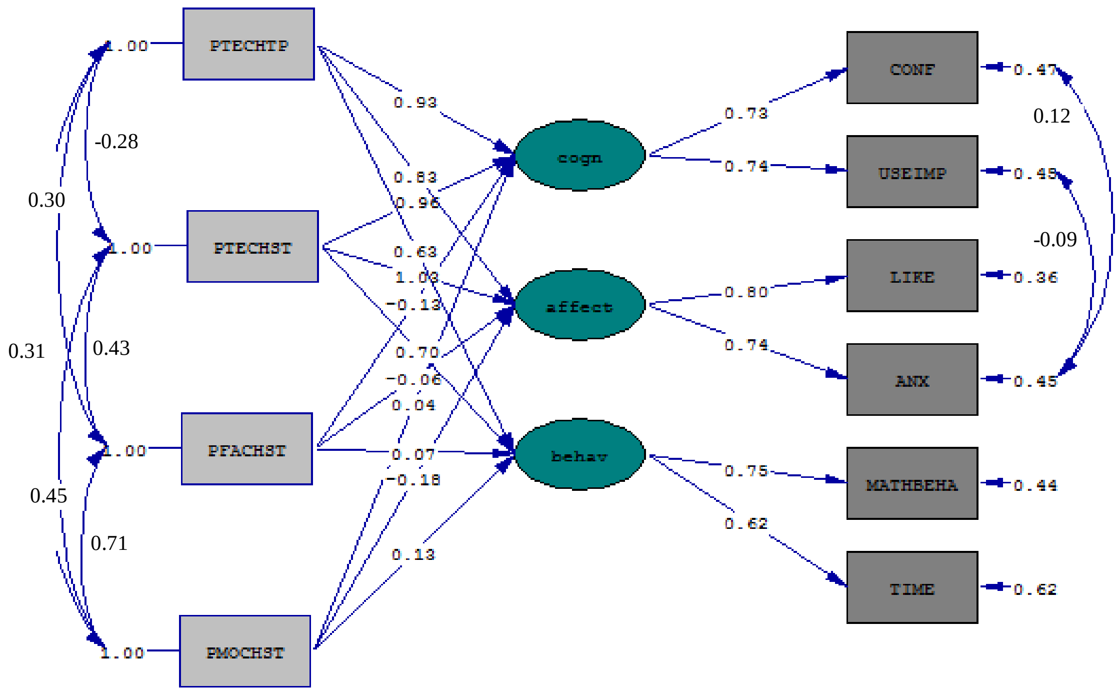

Figure 4.5 Path Analytic Model with Latent Variables with Standardized Estimates

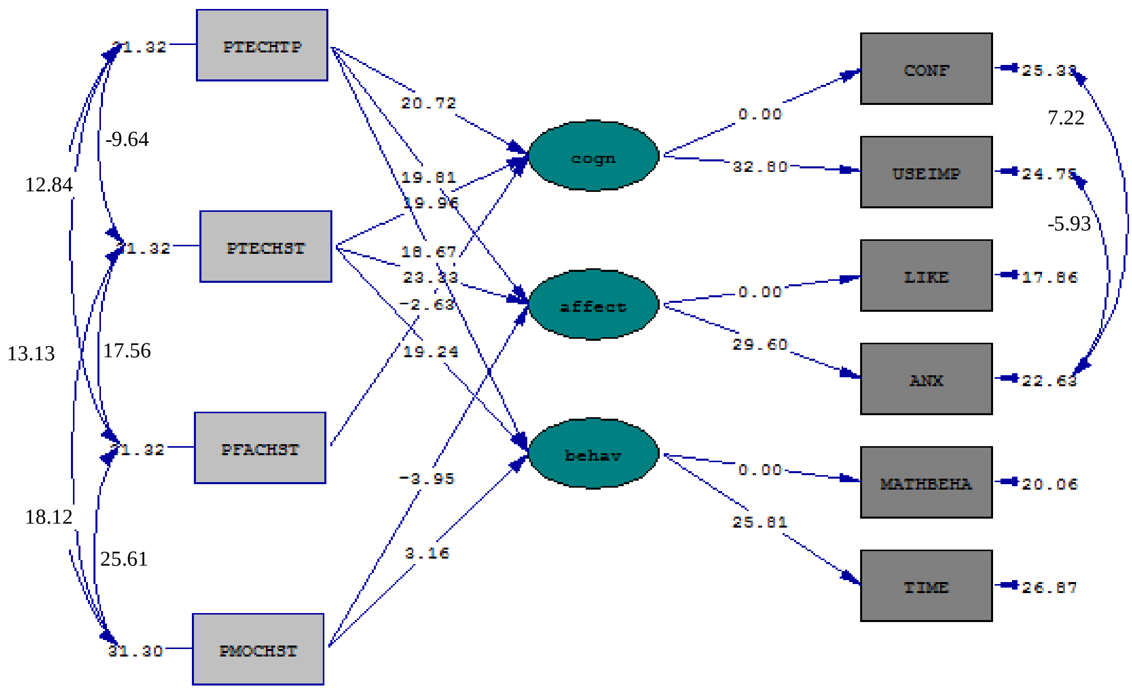

Figure 4.6 Path Analytic Model with Latent Variables with *t*-Values

The strength and direction of the relationships among exogenous and endogenous variables were identified by γ (lowercase gamma) values. The γ values in the model were given in Table 4.9.

Table 4.9 γ Values for the Path Analytic Model with Latent Variables

Exogenous Variable	**γ Parameter (t value)**	**Endogenous Variable**
PTECHTP	0.93 (20.72)	cogn
	0.83 (19.81)	affect
	0.63 (18.67)	behav
PTECHST	0.96 (19.96)	cogn
	1.03 (23.33)	affect

Table 4.9 (cont'd)

Exogenous Variable	**γ Parameter (t value)**	**Endogenous Variable**
PTECHST	0.70 (19.24)	behav
PFACHST	-0.13 (-2.63)	cogn
PMOCHST	-0.18 (-3.95)	affect
	0.13 (3.16)	behav

As was seen from Table 4.9 and Figure 4.5 which displays the path analytic model with latent variables with standardized estimates, the standardized path coefficients changed between 0.13 and 1.03 in the fitted model. According to Cohen (1988) standardized path coefficients with absolute values less than 0.10 may indicate a "small" effect; whereas values around 0.30 indicate a "medium" and values above 0.50 indicate a "large" effect, respectively (Kline, 1998). With respect to these criteria, the path coefficient from PFACHST to cogn, from PMOCHST to affect and behav indicated small effect sizes in the model fitted. All the other path coefficients indicated large effects with various magnitudes.

When the directions of relationships were considered, it was observed that PTECHTP and PTECHST with cogn, affect and behave, and PMOCHST with behav gave positive relationships, whereas PFACHST with cogn and PMOCHST with affect indicated rather negative relationships.

Finally, the structural equations of the model fitted for 1960 seventh grade Turkish students were given below;

- cogn = 1.43*PTECHTP + 1.60*PTECHST – 0.18*PFACHST + 0.054*PMOCHST, Errorvar.= –0.18, $R^2 = 1.18$
- affect = 1.28*PTECHTP + 1.71*PTECHST – 0.084*PFACHST - 0.25*PMOCHST, Errorvar.= –0.016, $R^2 = 0.98$
- behave = 0.96*PTECHTP + 1.16*PTECHST + 0.095*PFACHST + 0.17*PMOCHST, Errorvar.= 0.13, $R^2 = 0.87$

The null hypothesis introduced in Chapter 1 was evaluated according to the final model obtained. A significant model between students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's, father's and mother's attitudes toward and expectations from them as learners of mathematics, cognitive, affective, behavioral and attitude was obtained. According to the model:

1. As expected, students' perceptions of their mathematics teacher's teaching profession is significantly and positively related to the cognitive component of attitude ($\gamma = 0.93$, $t = 20.72$, $p < .05$).
2. As expected, students' perceptions of their mathematics teacher's teaching profession is significantly and positively related to the affective component of attitude ($\gamma = 0.83$, $t = 19.81$, $p < .05$).
3. As expected, students' perceptions of their mathematics teacher's teaching profession is significantly and positively related to the behavioral component of attitude ($\gamma = 0.63$, $t = 18.67$, $p < .05$).
4. As expected, students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics is significantly and positively related to the cognitive component of attitude ($\gamma = 0.96$, $t = 19.96$, $p < .05$).
5. As expected, students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics is significantly and positively related to the affective component of attitude ($\gamma = 1.03$, $t = 23.33$, $p < .05$).
6. As expected, students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics is significantly and positively related to the behavioral component of attitude ($\gamma = 0.70$, $t = 19.24$, $p < .05$).
7. Surprisingly, students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics is significantly and negatively related to the cognitive component of attitude ($\gamma = -0.13$, $t = -2.63$, $p < .05$).

8. Surprisingly, students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics is not significantly related to the affective component of attitude.
9. Surprisingly, students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics is not significantly related to the behavioral component of attitude.
10. Surprisingly, students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics is not significantly related to the cognitive component of attitude.
11. As expected, students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics is significantly and negatively related to the affective component of attitude ($\gamma = -0.18$, $t = -3.95$, $p < .05$).
12. Surprisingly, students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics is significantly and positively related to the behavioral component of attitude ($\gamma = 0.13$, $t = 3.16$, $p < .05$).

4.3 Summary of the Results

After missing data analysis and normality checks, descriptive analysis were done. In this study, a ten-factor structure underlying Turkish seventh grade students' attitudes toward mathematics was obtained. According to the ten-factor model obtained in this study, Turkish seventh grade students' attitudes toward mathematics composed of their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, feelings about mathematics (either liking or disliking), anxiety about mathematics, behaviors toward mathematics, the time they spent on mathematics at home, perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, perceptions of their father's attitudes toward and expectations from them as learners of mathematics, and perceptions of their mother’s attitudes toward and expectations from them as learners of mathematics.

According to the descriptive statistics results, seventh grade Turkish students generally had positive attitudes toward mathematics. In terms of sub dimensions constituting the students attitudes toward mathematics, the highest mean score of students belonged to the learner behaviors toward mathematics sub scale. Therefore, it can be concluded that students were more actively involved in math classes such as, participating in mathematics activities, raising hands, or doing mathematics homework. On the contrary, the lowest mean score of students was from time spent on mathematics sub-scale. As a result, it can be said that although students were shown to be active during mathematics classes, they spent less time on mathematics at their home.

In the inferential statistics part, three proposed models were tested using LISREL. The first model tested was a second-order factor model identifying three components of attitude toward mathematics namely; cognitive, affective and behavioral. After having done some of the suggestions given by the LISREL, a good data model fit was obtained. According to the model, confidence in learning mathematics and the usefulness and importance of mathematics positively and significantly loaded on cognitive component of attitude. Liking for mathematics and mathematics anxiety loaded on affective component of attitude significantly and positively. Lastly, learner behaviors toward mathematics and time spent mathematics at home positively and significantly loaded on behavioral component of attitude. The model also showed that each component of attitude was highly related with attitude toward mathematics. Moreover, all structure coefficients between each component of attitude and attitude toward mathematics were nearly same.

The second model tested was investigating the relationships among students’ perceptions of their mathematics teacher’s teaching profession, perceptions of their mathematics teacher’s, father’s and mother’s attitudes toward and expectations from them as learners of mathematics, confidence in learning mathematics, usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, behaviors toward mathematics and time spent on mathematics at home. Although the non-significant path; namely the path between PMOCHST and ANX was excluded from the model and some of the suggestions given by the LISREL were done, a good data model fit was not obtained. However, the relationships among the variables of the model proposed were examined using correlation analysis. The results of correlation analysis showed that all correlations were significant and positive in direction at the .01 level of significance.

Lastly, the third model tested was investigating the relationships between students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's, father's and mother's attitudes toward and expectations from them as learners of mathematics, and three components of attitude toward mathematics. When the non-significant paths; namely the paths between PFACHST and affect, PFACHST and behave, and PMOCHST and cogn were excluded from the model and some of the suggestions given by the LISREL were done, a good data model fit was obtained. According to the model, students' perceptions of their mathematics teacher's teaching profession were significantly and positively related to the three components of attitude. Similarly, students' perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics was significantly and positively related to the three components of attitude. Students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics was only related with the cognitive component of attitude significantly and negatively. Finally, students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics was related with the affective component of attitude significantly and negatively and the behavioral component of it significantly and positively.

CHAPTER 5

DISCUSSIONS, CONCLUSIONS, IMPLICATIONS AND RECOMMENDATIONS

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

5.1 Discussions

In the present study, three structural models of attitude toward mathematics were presented. The first model demonstrated the second-order factor structure of attitude toward mathematics namely, cognitive, affective and behavioral. Moreover, the model showed how six attitudinal variables identified those three components of attitude toward mathematics. In the second model, the effects of students' perceptions of their teachers' teaching profession, students' perceptions of their teachers' attitudes toward them as learners of mathematics, and students' perceptions of their parents' attitudes toward them as learners of mathematics on six attitudinal variables were investigated. Lastly, the third model presented the effects of students' perceptions of their teachers' attitudes toward them as learners of mathematics, and students' perceptions of their parents' attitudes toward them as learners of mathematics on cognitive, affective and behavioral components of attitude toward mathematics.

Before discussing the results of the models obtained, it is useful to discuss the results of the descriptive analysis obtained. The results of the descriptive analysis showed that the students surveyed in this study likely to have positive attitudes toward mathematics as measured by the sub-scales of the ATMQ. Of these attitude scales, the scale measuring students' perception of their teacher's teaching profession had the highest mean per item score. This could be interpreted as the students surveyed in this study had positive perception of their teacher's teaching profession. Another interpretation could be that students would not say anything that reflected badly on their teachers since this might affect their math grades or their teacher's attitudes toward them negatively.

This finding supports the findings of previous studies that investigated Turkish students' attitudes and interests toward mathematics course in different school grades. Şen and Koca (2006) reported that secondary school students had generally positive attitudes toward mathematics classes. They further reported that two main reasons for students' developing positive attitudes toward mathematics were admiring the teacher and understanding the subject. Ünlü (2007) found that more than half of the students in third, fourth and fifth grades selected mathematics as the most liked subject among the other school subjects. He reported that students selected the choice "subject itself" as the most important factor for their liking for mathematics, followed by the "teacher".

A national, longitudinal data on middle-school students (Reynolds & Walberg, 1992) showed that students are more likely to acquire favorable attitudes toward mathematics if they perceive the classroom context (e.g., teachers) in a positive light. Of course, it is possible that this finding simply reflects the tendency of interested students to like their teachers, rather than to truly measure the influence of instructional quality. Together with the results of a national survey of high school seniors (Armstrong & Price, 1982), there is a tendency for attitude scores to decline as students move from elementary school to secondary school.

In the present study, another important result of the descriptive analysis indicated that the scale, time spent on mathematics at home had the lowest mean per item score but responses to this scale were still somewhat positive. On its own, this finding may explain why the students surveyed in the present study had a mean previous year final report card grade for mathematics course of 3.15. In order to do well in mathematics, students have to spend more time at home on doing mathematics problems. In the secondary school level, Alkan, Güzel and Elçi (2004) found that all of the students interviewed for the study agreed that they spent considerable time on mathematical tasks out of school. Perhaps, the seventh grade participants of the present study fit this pattern as they would be in the equivalent of secondary school grade.

No matter how the definition of the term attitude has been varied over a long period of time by many psychologist and sociologist, the common point among those definitions is the three classes of responses elicited by attitude object: cognitive, affective and behavioral (Rosenberg & Hovland, 1960; Triandis (1971). Similarly, Malmivuori (2001) stated that attitude would constitute a single second-order factor while beliefs, affective responses and related behavior alone would operate as first-order affective factors. We therefore hypothesized the second-order factor model for this study.

In the first model of the study, which was a second–order factor model for attitude toward mathematics, it was hypothesized that attitude toward mathematics is explained by cognitive, affective, and behavioral components. In the model proposed, it was hypothesized that the cognitive component of attitude toward mathematics is explained by students' confidence in learning mathematics and their beliefs about the usefulness and importance of mathematics. Moreover, it was hypothesized that the affective component of attitude toward mathematics is explained by their liking for mathematics and mathematics anxiety. Finally, in the model proposed, it was hypothesized that the behavioral component of attitude toward mathematics is explained by learner behaviors toward mathematics and the time they spent on mathematics at home. The results supported in all of the hypothesized relationships. Moreover, the final model obtained revealed that there was a strong relationship between three components of attitude and attitude toward mathematics.

Once we have specified a priori model on the basis of theoretical knowledge, second-order factor analysis estimated the parameters of the specified model. As a result of performing a specification search to find a better fitting model, we included additional parameters to arrive at a modified model. For this purpose, we added an error covariance between the observed variables of confidence in learning mathematics and mathematics anxiety since the largest decrease in chi-square resulted from them, thus maintaining our hypothesized second-order factor model. This was an expected modification supported by the prior research on attitude toward mathematics. A number of investigators have used Fennema-Sherman Mathematics Attitudes Scales in their research and they found the Mathematics Anxiety Scale correlated more high with the Confidence in Learning Mathematics Scale (Fennema & Sherman, 1976; Rounds & Hendel, 1980).

In the second structural model of the study, it was hypothesized that there is a relationship between the variables, students' perceptions of their teachers' teaching profession, students' perceptions of their teachers' attitudes toward them as learners of mathematics, students' perceptions of their parents' attitudes toward them as learners of mathematics, and their confidence in learning mathematics, beliefs about the usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, learner behaviors toward mathematics and the time they spent on mathematics at home. Across the particular set of model fit indices, the best values indicated that the model fit is poor.

The results of correlation analysis between the observed variables used in the second model showed that all correlations were significant and positive in direction at the .01 level of significance. The highest correlation was between the students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics and the perceptions of their mother's attitudes toward and expectations from them as learners of mathematics ($r = .71$, $p < .01$). It appeared that the students gave similar responses to corresponding statements in the questionnaire for both father and mother. Both scales were also correlated in similar manners with all other scales. In future studies, it is probably appropriate to consider parents' attitudes and expectations as a single variable. In the Fennema-Sherman (1976) study, the Father and Mother Scales correlated .62 and the highest intercorrelation between the scales was .63 between the Confidence and Teacher Scales.

There was a very strong correlation between confidence in learning mathematics and mathematics anxiety ($r = .69$, $p < .01$). Students who had high confidence in their ability to learn and perform well on mathematical tasks were likely to feel less anxiety related to doing mathematics. This was consistent with most researchers hypothesize that mathematics anxiety is merely a lack of confidence in one's ability to learn mathematics (Fennema & Sherman, 1976; Rounds & Hendel, 1980).

The lowest correlation was between students' perceptions of their mathematics teachers' teaching profession and time spent on mathematics at home for all students (r = .27, $p < .01$). This meant that students' perceptions their mathematics teachers' teaching profession is not really related with their spending more or less time on mathematics at home.

The third model obtained in the study revealed that cognitive component of attitude toward mathematics explained positively by students' perceptions of their mathematics teacher's teaching profession and perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, and negatively by perceptions of their father's attitudes toward and expectations from them as learners of mathematics. The affective component of attitude toward mathematics explained positively by students' perceptions of their mathematics teacher's teaching profession and perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, and negatively by perceptions of their mother's attitudes toward and expectations from them as learners of mathematics. The behavioral component of attitude toward mathematics explained positively by students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, and perceptions of their mother's attitudes toward and expectations from them as learners of mathematics.

When the model obtained was compared with to the hypothesized model in the beginning of the study, it was seen that some of the hypothesis related to the relationships among the variables included in the study were validated and some of them surprisingly did not. Therefore, while some of the findings obtained from the model testing were parallel to the findings of the previous studies in the literature, and some of them were contradicted. Specifically, in the final model obtained, no relationships were found between the cognitive component of attitude toward mathematics and students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics, between the affective component of attitude toward mathematics and students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics, and between the behavioral component of attitude toward mathematics and students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics.

Although no specific finding was obtained in the previous studies investigating the relationships between the students' perceptions of their teacher's and parents' attitudes toward them and three separate components of attitude, there are evidences in the literature that students' perceptions of their teacher's (Aiken, 1970; Kulm, 1980; Leder, 1992; Haladyna et al., 1983) and parents' (Eccles et al., 1983; Fennema & Sherman, 1976) attitudes toward and expectations from them as learners of mathematics had effect on their attitudes toward mathematics.

Poffenberger and Norton (1959) found that students' attitudes toward mathematics were positively related to how they rated their fathers' attitudes toward mathematics. However, they suggested that attitudes reported for the mothers were not significantly related to students' own attitudes because only a small number of students indicated that their mothers liked mathematics. In this study, no effect of students' perceptions of their mother's attitudes toward and expectations from them as learners of mathematics on cognitive component of attitude toward mathematics and students' perceptions of their father's attitudes toward and expectations from them as learners of mathematics on affective component of attitude toward mathematics was found. This could be interpreted as mothers develop more emotional relationships with their children that may resulted in more effect on affective aspects of students' attitudes toward mathematics whereas, fathers become more rational and this affect cognitive aspects of students' attitudes toward mathematics although results showed that they have no effect on students' behaviors toward mathematics.

5.2 Conclusions

This section presented the conclusions of the findings of the present study. In the study, mainly students' attitudes toward mathematics was investigated in terms of cognitive, affective and behavioral components of attitude based on 1960 7th grade students' data. In addition, the influences of teacher's and parents' attitudes toward and expectations from students as learners of mathematics on three components of attitude toward mathematics as well as the attitudinal variables that comprise these three components were investigated. The structural equation modeling techniques were used for determining the factor structure of attitude toward mathematics and the effects of these variables.

According to the results of the study, students' attitudes toward mathematics could be identified with three-factor structure. These factors were the cognitive, the affective, and the behavioral. The cognitive component of students' attitudes toward mathematics could be explained by their confidence in learning mathematics and beliefs about the usefulness and importance of mathematics, the affective component of students' attitudes toward mathematics could be explained by their liking for mathematics and anxiety about mathematics, and the behavioral component of students' attitudes toward mathematics could be explained by their behaviors toward mathematics and the time they spent on mathematics at home. In addition, there were strong relationships among cognitive, affective and behavioral components of students' attitudes toward mathematics.

Another conclusion from the study could be that students' confidence in learning mathematics, beliefs usefulness and importance of mathematics, liking for mathematics, mathematics anxiety, learner behaviors toward mathematics and the time they spent on mathematics at home were predicted by their perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, perceptions of their father's attitudes toward and expectations from them as learners of mathematics, perceptions of their mother's attitudes toward and expectations from them as learners of mathematics. Moreover, all variables in the study were significantly and positively correlated.

It could be concluded from the study that students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, and perceptions of their father's attitudes toward and expectations from them as learners of mathematics predicted the cognitive component of their attitudes toward mathematics.

Students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, and perceptions of their mother's attitudes toward and expectations from them as learners of mathematics predicted the affective component of their attitudes toward mathematics.

Lastly, students' perceptions of their mathematics teacher's teaching profession, perceptions of their mathematics teacher's attitudes toward and expectations from them as learners of mathematics, and perceptions of their mother's attitudes toward and expectations from them as learners of mathematics predicted the behavioral component of their attitudes toward mathematics.

5.3 Implications and Recommendations

The findings of the present study indicated that further research should be conducted to examine the structure of attitude toward mathematics in terms of cognitive, affective and behavioral components and the interaction among these components. The influence of teacher's and parents' attitudes and expectations on three components of attitude should also be investigated. The models presented for attitude toward mathematics in this study had implications for further research studies.

Based on both the findings of this study and the related studies in the literature some implications for research methodology can be drawn. The first improvement needed in future research is the need to go beyond simplistic positive-negative distinction of affect. In this study, differentiating attitude toward mathematics as cognitive, affective and behavioral is very remarkable. Many of the mathematics attitude scales that have been constructed and used in research studies are generally intended to assess factors such as liking/disliking, usefulness, confidence. The choice of using items only about beliefs or emotions does not take into account the behavioral component. What seems to be implicit in this choice is the assumption that an individual's behavior toward an object has not got any meaning about his or her attitude toward that object. It is a common fact that a person's consistencies in thinking, feeling and acting suggest the existence of an attitude. Therefore, in order to assess an attitude, we have to take into account all three components of it namely, cognitive, affective, and behavioral components.

In the research on attitudes, typical research questions are: the relationship between attitude and achievement, the causes of the dramatic change of attitude toward mathematics from elementary to high school, for different gender groups, socioeconomic status etc. Additionally, the instruments traditionally used in order to assess and measure attitudes do not vary according to the various definitions, and according to the fact that an explicit definition of attitude is given or not. These instruments generally focus on measuring, instead of assessing of attitude. Therefore, an obvious implication for research methodology is that to get a refined picture of attitude one needs to define explicitly which aspects of attitude are under examination and in order to study different aspects more accurately, appropriate methods should be applied.

Regarding affective traits, there is a need for new longitudinal studies with measurement instruments that would take into account the synergistic relationships between cognition, emotion, and behavior. Since simple answers cannot satisfy the complexity of classrooms, more attention should be paid to three main elements in order to study affect in mathematics education: cognition, emotion, and behavior. It is highly recommended that the researches on affect in mathematics classrooms should involve three approaches (observations, interviews, and questionnaire) which focus on emotional reactions of students in mathematics classes and achieve methodological triangulation.

The other improvement is the need to pay attention to emotional reactions that may reveal things that are inaccessible to consciousness or purposefully hidden from the observer. However, it should be considered that not all emotions have distinctive facial expression (e.g. interest). It is widely accepted by many researchers that in order to study affect there is a further need to focus on emotional reactions of students in mathematics classes.

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

Mathematics teachers should:

- be careful so as not to lose the positive attitudes that the students have toward mathematics,
- be aware of the problems of anxious students. She/he should be focus on causes, effects and remedies of mathematics anxiety,
- carefully design collaborative activities which provide opportunities for all kinds of social needs to be met,
- create such a classroom environment that students have to be sure about their ability to learn mathematics and perform well in mathematics class,
- manage to find tasks that are engaging and create a learning context where engagement can be sustained,
- give assignments that require students to discuss solution paths in groups before giving their own answers,
- stress sufficiently the use of mathematics for studying and controlling our physical and social environment,
- provide success experiences for the students who consistently fail in mathematics, lose self-confidence and develop feelings of dislike and hostility toward the subject,
- be aware of the students' perception of usefulness and importance of mathematics. She/he should provide a classroom environment that students realize the usefulness and importance of mathematics in the daily life and in the future vocation,
- behave equally and encourage equally both boys and girls to study mathematics,
- encourage a climate where risk-taking is valued,
- aim to make students' experiences constructive so that they contribute to an enduring positive disposition towards engagement in mathematics,
- vary their teaching styles to engage students' individual aptitudes, learning styles and strengths,
- engage with the student at a personal level,
- be sympathetic to individual learning needs.

Parents should:

- be cooperate with teachers, encourage their child and increase their child's confidence in learning mathematics,
- spend more time supervising their children's work at home and make sure they spend more time on mathematics.

Education faculties can improve teacher education programs 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 activities to increase students' interest and engagement.

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

1. In order to be able to talk about Turkey overall, subjects from different schools of different geographical regions can be selected for further research studies.
2. For a deep investigation about the cognitive, affective and behavioral components of students' attitudes toward mathematics, qualitative research methods can be utilized such as human observer, audio- and video record or interviews.

3. To provide further information on the effects of teacher attitudes, direct observation of teacher-student interaction in mathematics classes is needed.
4. Different gender groups and grade levels can be searched for.
5. The cognitive, affective and behavioral components of attitude can be investigated deeply at different content areas of mathematics such as number and operation, algebra, geometry, measurement, data analysis and probability, as well as at different subject areas such as physics, chemistry or biology.
6. Structural equation modeling similar to other correlational methods of analysis does not give information about causation. In order to make inferences about causal relationships, further studies, more specifically experimental research is needed.

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APPENDIX A

PERMISSION TO DO RESEARCH FROM MINISTRY OF TURKISH EDUCATION

T.C.
İSTANBUL VALİLİĞİ
İl Milli Eğitim Müdürlüğü

Sayı : B.08.4.MEM.4.34.00.18.580/6377/105638 — 19 Ekim 2009
Konu: **Anket.**
(Özge GÜN)

VALİLİK MAKAMINA

İlgi : a-)Orta Doğu Teknik Üniversitesi'nin 28/09/2009 tarih ve 400-7087 sayılı yazısı.
b-)Milli Eğitim Bakanlığına Bağlı Okul ve Kurumlarda Yapılacak Araştırma ve Araştırma Desteğine Yönelik İzin ve Uygulama Yönergesi.
c-)Milli Eğitim Bakanlığı Eğitim Araştırma Geliştirme Dairesi Başkanlığı'nın 11/04/2007 tarih ve 1950 sayılı emri.
d-)Milli Eğitim Müdürlüğü Anket Komisyonu'nun 15/10/2009 tarihli tutanağı.

Orta Doğu Teknik Üniversitesi Ortaöğretim Fen ve Matematik Alanları Eğitimi EABD Doktora Programı öğrencisi **Özge GÜN'ün**, İlimizde ekte isimleri belirtilen okullarda uygulanmak üzere **"İlköğretim 7. Sınıf Öğrencilerinin Matematik Dersine Yönelik Tutumlarının Bilişsel Duyuşsal ve Davranışsal Boyutlara Göre İncelenmesi"** konulu anket çalışmalarını yapma istekleri hakkındaki İlgi (a) yazı ve ekleri Müdürlüğümüzce incelenmiştir.

Orta Doğu Teknik Üniversitesi Ortaöğretim Fen ve Matematik Alanları Eğitimi EABD Doktora Programı öğrencisi **Özge GÜN'ün**, İlimizde ekte isimleri belirtilen okullarda uygulanmak üzere **"İlköğretim 7. Sınıf Öğrencilerinin Matematik Dersine Yönelik Tutumlarının Bilişsel Duyuşsal ve Davranışsal Boyutlara Göre İncelenmesi"** konulu anket çalışmalarını yapması, bilimsel amaç dışında kullanılmaması koşuluyla, okul idarelerinin denetim, gözetim ve sorumluluğunda, İlgi (c) Bakanlık Emri esasları dahilinde uygulanması, sonuçtan Müdürlüğümüze rapor halinde (CD formatında)bilgi verilmesi kaydıyla Müdürlüğümüzce uygun görülmektedir.

Makamınızca da uygun görüldüğü takdirde Olurlarınıza arz ederim.

Dr. Muammer YILDIZ
Milli Eğitim Müdürü

EKLER :
Ek-1. İLGİ (a)yazı ve ekleri

OLUR
19/10/2009
Hasan KAYA
Vali a.
Vali Yardımcısı

NOT :Verilecek cevapta tarih, kayıt numarası, dosya numarası yazılması rica olunur.
Adres :İstanbul Milli Eğitim Müdürlüğü A.Blok Ankara cad. No:2 Cağaloğlu 526 13 82

APPENDIX B

SCALES

AÇIKLAMA

Sevgili öğrenciler, elinizdeki anket bir araştırmada kullanılmak için hazırlanmıştır. Soruları okurken dikkatlice okuyup size en uygun olan seçeneğin önündeki parantez içine (X) işareti koyun. Araştırmanın amacına ulaşması vereceğiniz yanıtların doğru ve samimi olmasına bağlıdır. Sonuçlar bilimsel amaçlar dışında kesinlikle kullanılmayacaktır. Çalışmaya yaptığınız katkıdan dolayı teşekkür ederim.

ÖZGE GÜN
Orta Öğretim Fen ve Matematik Alanları Eğitimi Bölümü
Doktora Öğrencisi, Orta Doğu Teknik Üniversitesi, Ankara

KİŞİSEL BİLGİ FORMU

1. Okulunuzun İsmi: ……………………………………………………………

2. Sınıfınız: …………

3. Cinsiyetiniz: ( ) Kız ( ) Erkek

4. Anne ve babanızın öğrenim durumu:

	Anne	Baba
a. Okuma yazma bilmiyor	( )	( )
b. Okur-yazar	( )	( )
c. İlkokul mezunu	( )	( )
d. Ortaokul mezunu	( )	( )
e. Lise ve dengi okul mezunu	( )	( )
f. Yüksekokul mezunu	( )	( )
g. Üniversite mezunu	( )	( )
h. Daha yüksek	( )	( )

5. İlköğretim ikinci kademe eğitiminiz boyunca matematik dersi yıl sonu başarı notunuzu her sınıf için işaretleyin.

6. sınıf:	1 ( ) , 2 ( ) , 3 ( ) , 4 ( ) , 5 ( )
7. sınıf:	1 ( ) , 2 ( ) , 3 ( ) , 4 ( ) , 5 ( )
8. sınıf:	1 ( ) , 2 ( ) , 3 ( ) , 4 ( ) , 5 ( )

6. Şu anda okul dışında matematik dersinden yardım alıyorsanız size uygun olan durumu işaretleyin.

a. Dershane	:	( )
b. Özel ders	:	( )
c. Arkadaş	:	( )
d. Aile ya da yakın çevre	:	( )
e. Herhangi bir yardım almıyorum	:	( )
f. Diğer (belirtiniz)	:	

MATEMATİK TUTUM ÖLÇEĞİ

Bu ölçekte bir dizi cümleler yer almaktadır. Bu cümlelerin doğru cevapları bulunmamaktadır. Bu cümleler, ifade edilen düşüncelere sizin ne derece katılıp katılmadığınızı belirtmenize olanak verecek şekilde düzenlenmiştir. Diyelim ki cümle şöyle:

Örnek: Matematiği severim.

Böyle bir cümleyi okuduğunuzda bu düşünceye katılıp katılmadığınızı biliyor olacaksınız. Eğer bu düşünceye kesinlikle katılıyorsanız cevap olarak “kesinlikle katılıyorum” seçeneğini işaretleyiniz. Eğer sadece katılıyorsanız “katılıyorum” seçeneğini işaretleyeceksiniz. Eğer cümlede belirtilen düşünceye katılmıyorsanız, ne derece katılmadığınızı göstermek için; düşünceye sadece katılmamanız durumunda “katılmıyorum” seçeneğini, kesinlikle karşı olmanız durumunda “kesinlikle katılmıyorum” seçeneğini işaretleyiniz. Fakat ifade edilen düşünce hakkında olumlu ya da olumsuz bir görüş belirtmiyorsanız, yani, kararsızsanız “kararsızım” seçeneğini işaretleyiniz.

Hiçbir cümlede fazla zaman kaybetmeden hızlı fakat dikkatli okuyarak **her cümleyi** cevaplayınız.

Doğru ya da yanlış cevap bulunmamaktadır. Yalnızca sizin doğru bulduğunuz cevaplar doğru kabul edilmektedir. Mümkün olduğunca, yaşadıklarınızı düşünerek karar veriniz.

Öğretmen Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematik öğretmenim, matematiği sever.					
2. Matematik öğretmenim, matematik hakkında çok şey bilmektedir.					
3. Matematik öğretmenim, çalışmalarımıza değer verir.					
4. Bir problemim olduğu zaman matematik öğretmenim her şeyi daha kötü yapar.					
5. Matematik öğretmenim, bana karşı çok adildir.					
6. İyi bir çalışma yaptığımda matematik öğretmenim bunu bana söyler.					
7. Matematik öğretmenim, sınıfta kız ve erkeklere farklı davranmaktadır.					

Matematik Öğrenmede Kendine Güven Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematik çalışmalarında genellikle kendime güvenirim.					
2. İleri düzeyde matematik çalışabileceğime eminim.					
3. Matematik öğrenebileceğime eminim.					
4. Daha zor matematiğin üstesinden gelebileceğimi düşünüyorum.					
5. Matematikten iyi notlar alabilirim.					
6. Matematik söz konusu olduğunda, kendime çok güvenirim.					
7. Matematikte başarılı değilim.					
8. İleri düzeyde matematiği yapabileceğimi zannetmiyorum.					
9. Matematikte başarılı olabilecek biri değilim.					
10. Çalıştığım halde, bazı nedenlerden dolayı matematik bana zor geliyor.					
11. Çoğu dersin üstesinden gelebilirim, fakat matematiği yapabilecek yeteneğim yoktur.					
12. Matematik her zaman en başarısız olduğum bir alandır.					

Matematiğin Kullanışlılığı ve Önemi Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Gelecekteki çalışmalarım için matematiğe ihtiyacım olacaktır.					
2. Yararlı olduğunu bildiğim için matematik çalışıyorum.					
3. Matematik bilmek hayatımı kazanmama yardım edecektir.					
4. Matematik değerli ve gerekli bir alandır.					
5. Gelecekteki çalışmalarım için çok iyi bir matematik bilgisine ihtiyacım olacaktır.					
6. Bir yetişkin olarak matematiği çeşitli şekillerde kullanacağım.					
7. Matematiğin yaşantımla ilgisi yoktur.					
8. Yaşantımdaki çalışmalarımda matematik benim için önemli olmayacaktır.					
9. Ben matematiği bir yetişkin olarak günlük hayatımda nadiren kullanacağım bir alan olarak görüyorum.					
10. Matematik öğrenmek zaman kaybıdır.					
11. Yetişkin hayatımı düşündüğümde, lisede iken matematikte başarılı olmanın hiç bir önemi yok.					
12. Okulu bitirdiğimde, matematiği çok az kullanacağımı düşünüyorum.					
13. Matematiği kullanmayı içeren bir işe sahip olmayı isterim.					
14. İstediğim işe sahip olmak için matematikte başarılı olmam gereklidir.					
15. İstediğim üniversite/liseye girebilmem için matematikte başarılı olmam gerekir.					
16. Matematik herkesin hayatı için önemlidir.					
17. Matematikte başarılı olmamın önemli olduğunu düşünüyorum.					

Matematiği Sevme Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematiği severim.					
2. Matematik öğrenmekten hoşlanırım.					
3. Matematik sıkıcıdır.					
4. Matematik kolay bir alandır.					
5. Kendimi memnun etmek için matematikte başarılı olmam gereklidir.					

Matematik Kaygısı Ölçeği

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

Öğretmen Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Öğretmenlerim daha çok matematik çalışmam için teşvik ederlerdi.					
2. Öğretmenlerim matematikte başarılı olabilecek nitelikte bir kişi olduğumu düşünürler.					
3. Matematik öğretmenleri, matematik alanında ilerlemem için gerekli yeteneğe sahip olduğumu hissettirirlerdi.					
4. Matematik öğretmenlerim alabileceğim bütün matematik derslerini almam için teşvik ettiler.					
5. Matematik öğretmenlerim benim matematikteki gelişmemle ilgilendiler.					
6. Matematik öğretmenlerimle, matematik gerektiren bir meslek (kariyer) hakkında konuşurum.					
7. Matematik öğretmenleriyle konuşurken, konuşma ciddi konulara geldiğinde dikkate alınmamış hissettim.					
8. Matematik öğretmenlerinin saygısını kazanmanın zor olduğunu anladım.					
9. Öğretmenlerim, ileri matematiğin benim için zaman kaybı olduğunu düşünüyorlar.					
10. Bir matematik öğretmeninin beni ciddiye almasını sağlamak genellikle sorun olmuştur.					
11. Eğer öğretmenlerime fen ve matematik alanlarında bir meslek ile ilgilendiğimi söylemiş olsaydım ciddi olmadığımı düşünürlerdi.					
12. Öğretmenlerin benimle matematik hakkında ciddi olarak konuşmalarını sağlarken zorlandım.					

Baba Ölçeği

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

Matematiğe Yönelik Davranışlar Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematik ödevlerimi her zaman yaparım.					
2. Matematik derslerine zamanında gelirim.					
3. Matematik derslerinde devamsızlık yaparım.					
4. Matematik derslerinde sık sık parmak kaldırırım.					
5. Matematik derslerinde cevap vermekten çok soru sormak için parmak kaldırırım.					

Matematiğe Evde Ayrılan Zaman Ölçeği

	Kesinlikle Katılıyorum	Katılıyorum	Kararsızım	Katılmıyorum	Kesinlikle Katılmıyorum
1. Matematiğe evde çok az zaman ayırırım.					
2. Diğer derslerle karşılaştırdığımda çalışma zamanımın çoğunu matematiğe ayırırım.					
3. Çalışma zamanımın çok azını matematiğe ayırırım.					
4. Evde geçirdiğim zamanın çoğunu matematiğe ayırırım.					

Anne Ölçeği

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

APPENDIX C

ITEM TOTAL STATISTICS FOR THE SCALES

Table C.1 Item-Total Statistics for CONF

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
conf1	39.52	71.089	.538	.409	.872
conf 2	39.79	71.373	.527	.427	.873
conf3	39.26	71.592	.558	.423	.871
conf4	39.97	71.036	.516	.386	.873
conf5	39.51	70.339	.592	.420	869
conf6	39.99	69.437	.602	.484	.869
conf7	39.89	66.224	.644	.479	.865
conf8	40.04	68.424	.551	.364	.871
conf9	39.70	66.593	.650	.526	.865
conf10	40.58	68.690	.472	.284	877
conf11	39.81	65.260	.696	.576	.862
conf12	39.77	66.352	.593	.459	.869

Table C.2 Item-Total Statistics for USEIMP

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
useimp1	64.34	109.716	.456	341	.872
useimp2	64.64	108.385	.478	.337	.871
useimp3	64.52	106.706	.571	.439	.868
useimp4	64.41	107.291	.599	.447	.867
useimp5	64.61	106.332	.586	.466	.867
useimp6	65.01	108.276	448	.306	.872
useimp7	64.88	104.193	.525	.409	.869
useimp8	64.95	103.566	.480	.359	.871
useimp9	65.55	106.497	.351	.249	.878
useimp10	64.65	104.021	.542	.509	.868
useimp11	64.69	104.527	.534	.493	.868
useimp12	65.06	101.264	.621	.479	.864
useimp13	65.32	106.307	.416	.307	.874
useimp14	64.88	104.591	.540	.441	.868
useimp15	64.58	106.533	.522	.389	.869
useimp16	64.71	106.226	.522	.392	.869
useimp17	64.56	105.657	.582	.432	.867

Table C.3 Item-Total Statistics for LIKE

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
like1	15.00	11.012	.717	.614	.666
like2	15.00	11.370	.712	.607	.673
like3	15.31	11.785	.475	262	.752
like4	16.21	11.910	450	.231	.761
like5	15.03	13.002	.400	.182	.772

Table C.4 Item-Total Statistics for ANX

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
anx1	37.80	73.475	.494	.373	.814
anx2	37.54	76.066	.392	.223	.821
anx3	37.97	74.252	.510	.376	.813
anx4	38.11	72.040	.484	.459	814
anx5	38.16	72.286	.506	.504	.812
anx6	37.76	73.290	.493	.324	.814
anx7	37.56	72.684	.517	.403	.812
anx8	37.99	76.011	.341	.229	.826
anx9	38.12	75.176	367	.244	.824
anx10	38.06	73.072	.477	.366	.815
anx11	38.16	69.150	.601	.450	.804
anx12	37.81	69.561	.611	.501	.803

Table C.5 Item-Total Statistics for MATHBEHA

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
mathbeha1	15.50	6.733	.323	.280	.335
mathbeha2	15.15	6.932	.438	.273	.290
mathbeha3	15.42	6.397	.313	.142	.335
mathbeha4	16.10	6.595	.266	.198	.372
mathbeha5	16.52	8.204	−.033	.056	.599

Table C.6 Item-Total Statistics for TIME

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
time1	9.88	8.247	.409	.286	614
time2	9.90	8.442	.467	.386	.574
time3	9.69	8.232	.446	.301	.587
time4	10.10	8.499	.438	.374	.593

Table C.7 Item-Total Statistics for PFACHST

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
pfachst1	42.54	61.849	.395	.338	.809
pfachst2	42.66	60.268	.488	.425	.802
pfachst3	42.88	59.985	.459	.413	.804
pfachst4	42.93	60.110	.417	.307	.808
pfachst5	42.76	59.773	.518	.537	.800
pfachst6	42.76	59.728	.511	.510	.800
pfachst7	43.76	65.249	.087	.069	.843
pfachst8	42.59	58.444	.550	.425	.797
pfachst9	42.87	55.082	.647	.547	.786
pfachst10	42.67	57.575	.566	.543	.795
pfachst11	42.73	57.764	.540	.518	.797
pfachst12	42.87	57.004	.560	.439	.795

Table C.8 Item-Total Statistics for PMOCHST

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
pmochst1	43.40	63.674	.462	.581	.823
pmochst2	43.41	62.820	.541	.617	.818
pmochst3	43.56	62.174	.506	.419	.820
pmochst4	43.40	62.983	.485	.397	.822
pmochst5	43.46	63.489	.437	.325	.825
pmochst6	43.74	63.461	.378	.250	.830
pmochst7	43.49	60.443	.530	.446	.818
pmochst8	43.48	58.700	.632	.531	.809
pmochst9	44.21	62.527	.314	.188	.840
pmochst10	43.57	58.961	.618	.497	.811
pmochst11	43.52	59.492	.573	.477	.814
pmochst12	43.42	61.358	.508	.359	.820

Table C.9 Item-Total Statistics for PTECHST

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ptechst1	37.02	48.417	.127	.190	701
ptechst2	36.92	44.730	.431	.384	.656
ptechst3	36.88	44.340	.443	.403	.654
ptechst4	37.18	45.702	.322	.356	.671
ptechst5	37.00	44.697	.383	.349	.662
ptechst6	37.42	47.503	.184	.223	.692
ptechst7	37.27	46.702	.216	.189	.688
ptechst8	37.49	46.375	.224	.166	.687
ptechst9	36.57	44.625	.369	.350	.664
ptechst10	36.93	43.394	.435	.370	.653
ptechst11	37.01	43.480	.394	.353	.659
ptechst12	37.06	43.761	.426	.339	.655

Table C.10 Item-Total Statistics for PTECHTP

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
ptechtp1	24.85	16,.943	.487	.322	.687
ptechtp2	24.94	16.653	.484	.324	.685
ptechtp3	25.14	15.744	.538	.307	.670
ptechtp4	25.22	15.637	.445	.225	.689
ptechtp5	25.62	15.314	.413	.186	.699
ptechtp6	25.25	16.217	.418	.206	.696
ptechtp7	25.55	14.574	.376	.181	.719

APPENDIX D

MODEL FIT CRITERIA AND ACCEPTABLE FIT INTERPRETATION

Table D.1 Some Fit Indices used in SEM

(Jöreskog & Sörbom, 1993; Schumacker & Lomax, 2004; 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 Square Residual (RMR)	Researcher defines level.	Value less than 0.05 indicates a good model fit
Standardized RMR (SRMR)	<0.05	Value less than 0.05 indicates a good model fit.
Root Mean Square 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

Table D.1 (cont'd)

Model fit criterion	*Acceptable level*	*Interpretation*
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 MODELS

E.1 Simplis Syntaxes for the Confirmatory Factor Model

ATMQ – A Confirmatory Factor Analysis
Observed Variables:
CONF1 CONF2 CONF3 CONF4 CONF5 CONF6 CONF7 CONF8 CONF9
CONF10 CONF11 CONF12 USEIMP1 USEIMP2 USEIMP3 USEIMP4 USEIMP5
USEIMP6 USEIMP7 USEIMP8 USEIMP10 USEIMP11 USEIMP12 USEIMP13
USEIMP14 USEIMP15 USEIMP16 USEIMP17 LIKE1 LIKE2 LIKE3 LIKE4
LIKE5 ANX1 ANX2 ANX3 ANX4 ANX5 ANX6 ANX7 ANX8 ANX9 ANX10
ANX11 ANX12 MATHBEH1 MATHBEH2 MATHBEH3 MATHBEH4 TIME1
TIME2 TIME3 TIME4 PFACHST1 PFACHST2 PFACHST3 PFACHST4
PFACHST5 PFACHST6 PFACHST8 PFACHST9 PFACHS10 PFACHS11
PFACHS12 PMOCHST1 PMOCHST2 PMOCHST3 PMOCHST4 PMOCHST5
PMOCHST6 PMOCHST7 PMOCHST8 PMOCHS10 PMOCHS11 PMOCHS12
PTECHST1 PTECHST2 PTECHST3 PTECHST4 PTECHST5 PTECHST6
PTECHST7 PTECHST8 PTECHST9 PTECHS10 PTECHS11 PTECHS12
PTECHTP1 PTECHTP2 PTECHTP3 PTECHTP4 PTECHTP5 PTECHTP6
PTECHTP7
Covariance Matrix From File Tezdata.cov
Sample Size 1960
Latent Variables: CONF USEIMP LIKE ANX MATHBEHA TIME PFACHST
PMOCHST PTECHST PTECHTP
Relationships:
CONF1 CONF2 CONF3 CONF4 CONF5 CONF6 CONF7 CONF8 CONF9
CONF10 CONF11 CONF12 = CONF
USEIMP1 USEIMP2 USEIMP3 USEIMP4 USEIMP5 USEIMP6 USEIMP7
USEIMP8 USEIMP10 USEIMP11 USEIMP12 USEIMP13 USEIMP14 USEIMP15
USEIMP16 USEIMP17 = USEIMP
LIKE1 LIKE2 LIKE3 LIKE4 LIKE5 = LIKE
ANX1 ANX2 ANX3 ANX4 ANX5 ANX6 ANX7 ANX8 ANX9 ANX10 ANX11
ANX12 = ANX
MATHBEH1 MATHBEH2 MATHBEH3 MATHBEH4 = MATHBEHA
TIME1 TIME2 TIME3 TIME4 = TIME
PFACHST1 PFACHST2 PFACHST3 PFACHST4 PFACHST5 PFACHST6
PFACHST8 PFACHST9 PFACHS10 PFACHS11 PFACHS12 = PFACHST
PMOCHST1 PMOCHST2 PMOCHST3 PMOCHST4 PMOCHST5 PMOCHST6
PMOCHST7 PMOCHST8 PMOCHS10 PMOCHS11 PMOCHS12 = PMOCHST

PTECHST1 PTECHST2 PTECHST3 PTECHST4 PTECHST5 PTECHST6 PTECHST7 PTECHST8 PTECHST9 PTECHS10 PTECHS11 PTECHS12 = PTECHST
PTECHTP1 PTECHTP2 PTECHTP3 PTECHTP4 PTECHTP5 PTECHTP6 PTECHTP7 = PTECHTP
Path Diagram
End of problem

E.2 Simplis Syntaxes for the Second-Order Factor Model

Second-Order Factor Model of Attitude toward Mathematics
Observed Variables:
CONF USEIMP LIKE ANX MATHBEHA TIME
Covariance Matrix From File model1.cov
Sample Size 1960
Latent Variables: cogn affect behav attitude
Relationships:
CONF USEIMP = cogn
LIKE ANX = affect
MATHBEHA TIME = behav
cogn = attitude
affect = attitude
behav = attitude
Set variance of attitude = 1.0
Let error covariance between CONF and ANX correlate
Path Diagram
End of problem

E.3 Simplis Syntaxes for the Path Analytic Model

Path Analysis
Observed Variables:
CONF USEIMP LIKE ANX MATHBEHA TIME PTECHTP PTECHST PFACHST PMOCHST
Covariance Matrix From File model2.cov
Sample Size 1960
Relationships:
CONF = PTECHTP PTECHST PFACHST PMOCHST
USEIMP = PTECHTP PTECHST PFACHST PMOCHST
LIKE = PTECHTP PTECHST PFACHST PMOCHST
ANX = PTECHTP PTECHST PFACHST
MATHBEHA = PTECHTP PTECHST PFACHST PMOCHST
TIME = PTECHTP PTECHST PFACHST PMOCHST
Let error covariance between LIKE and CONF correlate

Let error covariance between LIKE and USEIMP correlate
Let error covariance between ANX and CONF correlate
Let error covariance between ANX and LIKE correlate
Let error covariance between MATHBEHA and CONF correlate
Let error covariance between MATHBEHA and LIKE correlate
Let error covariance between MATHBEHA and ANX correlate
Let error covariance between TIME and MATHBEHA correlate
Path Diagram
End of problem

E.4 Simplis Syntaxes for the Path Analytic Model with Latent Variables

Path Analysis with Latent Variables
Observed variables
CONF USEIMP LIKE ANX MATHBEHA TIME PTECHTP PTECHST PFACHST PMOCHST
Covariance Matrix From File model3.cov
Sample Size 1960
Latent Variables cogn affect behav
Relationships
CONF USEIMP = cogn
LIKE ANX = affect
MATHBEHA TIME = behav
cogn = PTECHTP PTECHST PFACHST PMOCHST
affect = PTECHTP PTECHST PFACHST PMOCHST
behav = PTECHTP PTECHST PFACHST PMOCHST
Let error covariance between PTECHST and PTECHTP correlate
Let error covariance between ANX and USEIMP correlate
Let error covariance between ANX and CONF correlate
Let error covariance between PTECHST and LIKE correlate
Let error covariance between PTECHTP and CONF correlate
Let error covariance between PFACHST and USEIMP correlate
Path Diagram
Admissibility Check = OFF
Iterations = 25000
End of problem

APPENDIX F

GOODNESS-OF-FIT STATISTICS FOR THE MODELS

F.1 Goodness-of-Fit Statistics for the Confirmatory Factor Model

Degrees of Freedom = 4232
Minimum Fit Function Chi-Square = 50168.78 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 148832.18 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 144600.18
90 Percent Confidence Interval for NCP = (0.0 ; 0.0)

Minimum Fit Function Value = 25.61
Population Discrepancy Function Value (F0) = 73.81
90 Percent Confidence Interval for F0 = (0.0 ; 0.0)
Root Mean Square Error of Approximation (RMSEA) = 0.13
90 Percent Confidence Interval for RMSEA = (0.0 ; 0.0)
P-Value for Test of Close Fit (RMSEA < 0.05) = 1.00

Expected Cross-Validation Index (ECVI) = 76.21
90 Percent Confidence Interval for ECVI = (2.40 ; 2.40)
ECVI for Saturated Model = 4.56
ECVI for Independence Model = 344.66

Chi-Square for Independence Model with 4371 Degrees of Freedom = 675003.40
Independence AIC = 675191.40
Model AIC = 149298.18
Saturated AIC = 8930.00
Independence CAIC = 675809.98
Model CAIC = 150831.48
Saturated CAIC = 38312.82

Normed Fit Index (NFI) = 0.93
Non-Normed Fit Index (NNFI) = 0.93
Parsimony Normed Fit Index (PNFI) = 0.90
Comparative Fit Index (CFI) = 0.93
Incremental Fit Index (IFI) = 0.93
Relative Fit Index (RFI) = 0.92
Critical N (CN) = 174.72

Root Mean Square Residual (RMR) = 0.59
Standardized RMR = 0.12
Goodness of Fit Index (GFI) = 0.38
Adjusted Goodness of Fit Index (AGFI) = 0.35
Parsimony Goodness of Fit Index (PGFI) = 0.36

F.2 Goodness-of-Fit Statistics for the Second-Order Factor Model

Degrees of Freedom = 5
Minimum Fit Function Chi-Square = 33.05 (P = 0.00)
Normal Theory Weighted Least Squares Chi-Square = 32.91 (P = 0.00)
Chi-Square Difference with 1 Degree of Freedom = 110.56 (P = 0.0)
Estimated Non-centrality Parameter (NCP) = 27.91
90 Percent Confidence Interval for NCP = (13.37 ; 49.94)

Minimum Fit Function Value = 0.017
Population Discrepancy Function Value (F0) = 0.014
90 Percent Confidence Interval for F0 = (0.0068 ; 0.025)
Root Mean Square Error of Approximation (RMSEA) = 0.053
90 Percent Confidence Interval for RMSEA = (0.037 ; 0.071)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.34

Expected Cross-Validation Index (ECVI) = 0.033
90 Percent Confidence Interval for ECVI = (0.026 ; 0.044)
ECVI for Saturated Model = 0.021
ECVI for Independence Model = 4.20

Chi-Square for Independence Model with 15 Degrees of Freedom = 8219.03
Independence AIC = 8231.03
Model AIC = 64.91
Saturated AIC = 42.00
Independence CAIC = 8270.51
Model CAIC = 170.20
Saturated CAIC = 180.19

Normed Fit Index (NFI) = 1.00
Non-Normed Fit Index (NNFI) = 0.99
Parsimony Normed Fit Index (PNFI) = 0.33
Comparative Fit Index (CFI) = 1.00
Incremental Fit Index (IFI) = 1.00
Relative Fit Index (RFI) = 0.99

Critical N (CN) = 895.33
Root Mean Square Residual (RMR) = 0.018
Standardized RMR = 0.014
Goodness of Fit Index (GFI) = 0.99

Adjusted Goodness of Fit Index (AGFI) = 0.98
Parsimony Goodness of Fit Index (PGFI) = 0.24

F.3 Goodness-of-Fit Statistics for the Path Analytic Model

Degrees of Freedom = 14
Minimum Fit Function Chi-Square = 417.97 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 443.55 (P = 0.0)
Chi-Square Difference with 1 Degree of Freedom = 0.55 (P = 0.46)
Estimated Non-centrality Parameter (NCP) = 429.55
90 Percent Confidence Interval for NCP = (364.47 ; 502.03)

Minimum Fit Function Value = 0.21
Population Discrepancy Function Value (F0) = 0.22
90 Percent Confidence Interval for F0 = (0.19 ; 0.26)
Root Mean Square Error of Approximation (RMSEA) = 0.13
90 Percent Confidence Interval for RMSEA = (0.12 ; 0.14)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.00

Expected Cross-Validation Index (ECVI) = 0.27
90 Percent Confidence Interval for ECVI = (0.24 ; 0.31)
ECVI for Saturated Model = 0.056
ECVI for Independence Model = 9.91

Chi-Square for Independence Model with 45 Degrees of Freedom = 19353.15
Independence AIC = 19373.15
Model AIC = 525.55
Saturated AIC = 110.00
Independence CAIC = 19438.96
Model CAIC = 795.35
Saturated CAIC = 471.94

Normed Fit Index (NFI) = 0.98
Non-Normed Fit Index (NNFI) = 0.93
Parsimony Normed Fit Index (PNFI) = 0.30
Comparative Fit Index (CFI) = 0.98
Incremental Fit Index (IFI) = 0.98
Relative Fit Index (RFI) = 0.93

Critical N (CN) = 137.60

Root Mean Square Residual (RMR) = 0.055
Standardized RMR = 0.063
Goodness of Fit Index (GFI) = 0.96
Adjusted Goodness of Fit Index (AGFI) = 0.83
Parsimony Goodness of Fit Index (PGFI) = 0.24

F.4 Goodness-of-Fit Statistics for the Path Analytic Model with Latent Variables

Degrees of Freedom = 15
Minimum Fit Function Chi-Square = 113.55 (P = 0.0)
Normal Theory Weighted Least Squares Chi-Square = 110.67 (P = 0.00)
Estimated Non-centrality Parameter (NCP) = 95.67
90 Percent Confidence Interval for NCP = (65.93 ; 132.91)

Minimum Fit Function Value = 0.058
Population Discrepancy Function Value (F0) = 0.049
90 Percent Confidence Interval for F0 = (0.034 ; 0.068)
Root Mean Square Error of Approximation (RMSEA) = 0.057
90 Percent Confidence Interval for RMSEA = (0.047 ; 0.067)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.11

Expected Cross-Validation Index (ECVI) = 0.097
90 Percent Confidence Interval for ECVI = (0.082 ; 0.12)
ECVI for Saturated Model = 0.056
ECVI for Independence Model = 9.88

Chi-Square for Independence Model with 45 Degrees of Freedom = 19343.03
Independence AIC = 19363.03
Model AIC = 190.67
Saturated AIC = 110.00
Independence CAIC = 19428.84
Model CAIC = 453.90
Saturated CAIC = 471.94

Normed Fit Index (NFI) = 0.99
Non-Normed Fit Index (NNFI) = 0.98
Parsimony Normed Fit Index (PNFI) = 0.33
Comparative Fit Index (CFI) = 0.99
Incremental Fit Index (IFI) = 0.99
Relative Fit Index (RFI) = 0.98

Critical N (CN) = 528.58

Root Mean Square Residual (RMR) = 0.013
Standardized RMR = 0.017
Goodness of Fit Index (GFI) = 0.99
Adjusted Goodness of Fit Index (AGFI) = 0.96
Parsimony Goodness of Fit Index (PGFI) = 0.27

APPENDIX G

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

Table G.1 Total Variance Explained for CONF

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.256	43.800	43.800	5.256	43.800	43.800
2	1.658	13.813	57.613			
3	.742	6.181	63.794			
4	.653	5.443	69.237			
5	.597	4.974	74.211			
6	.569	4.741	78.953			
7	.502	4.185	83.138			
8	.486	4.053	87.190			
9	.429	3.572	90.762			
10	.407	3.390	94.152			
11	.374	3.120	97.272			
12	.327	2.728	100.00			

Extraction Method: Principal Component Analysis.

Table G.2 Factor Loadings of the Items of CONF

	Component
	1
conf11	.749
conf9	.714
conf7	.706
conf6	.697
conf5	.687
conf12	.659
conf3	.657
conf1	.638
conf2	.629
conf8	.621
conf4	.619
conf10	.541

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.3 Total Variance Explained for USEIMP

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,871	36,695	36,695	5,871	36,695	36,695
2	2,103	13,143	49,838	2,103	13,143	49,838
3	1,066	6,662	56,500	1,066	6,662	56,500
4	,829	5,178	61,678			
5	,711	4,444	66,122			
6	,670	4,188	70,309			
7	,574	3,588	73,898			
8	,563	3,520	77,418			
10	,539	3,370	80,788			
11	,487	3,043	87,180			
12	,448	2,800	89,979			
13	,433	2,706	92,685			
14	,412	2,577	95,262			
15	,397	2,482	97,745			
16	,361	2,255	100,000			
17	,487	3,043	87,180			

Extraction Method: Principal Component Analysis

Table G.4 Factor Loadings of the Items of USEIMP

	Component
	1
useimp4	.701
useimp5	.695
useimp3	.681
useimp17	.678
useimp14	.640
useimp12	.633
useimp16	.627
useimp15	.618
useimp11	.613
useimp10	.609
useimp2	.583
useimp1	.564
useimp6	.556
useimp7	.541
useimp8	.535
useimp13	.519

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.5 Total Variance Explained for LIKE

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,702	54,044	54,044	2,702	54,044	54,044
2	,778	15,567	69,611			
3	,733	14,661	84,272			
4	,546	10,925	95,197			
5	,240	4,803	100,000			

Extraction Method: Principal Component Analysis.

Table G.6 Factor Loadings of the Items of LIKE

	Component
	1
like1	.871
like2	.866
like3	.670
like4	.638
like5	.582

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.7 Total Variance Explained for ANX

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,203	35,028	35,028	4,203	35,028	35,028
2	1,928	16,067	51,095	1,928	16,067	51,095
3	,975	8,122	59,218			
4	,780	6,503	65,721			
5	,691	5,759	71,480			
6	,668	5,564	77,043			
7	,583	4,859	81,902			
8	,524	4,371	86,273			
9	,492	4,098	90,370			
10	,437	3,639	94,009			
11	,369	3,076	97,085			
12	,350	2,915	100,000			

Extraction Method: Principal Component Analysis.

Table G.8 Factor Loadings of the Items of ANX

	Component
	1
anx12	.754
anx7	.706
anx10	.645
anx1	.576
anx3	.574
anx2	.541
anx6	.540
anx9	.532
anx8	.529

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.9 Total Variance Explained for MATHBEHA

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,890	47,257	47,257	1,890	47,257	47,257
2	,932	23,312	70,569			
3	,694	17,358	87,928			
4	,483	12,072	100,000			

Extraction Method: Principal Component Analysis.

Table G.10 Factor Loadings of the Items of MATHBEHA

	Component
	1
mathbeha2	.772
mathbeha1	.753
mathbeha4	.684
mathbeha3	.509

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.11 Total Variance Explained for TIME

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1,985	49,631	49,631	1,985	49,631	49,631
2	1,147	28,686	78,318	1,147	28,686	78,318
3	,487	12,170	90,488			
4	,380	9,512	100,000			

Extraction Method: Principal Component Analysis.

Table G.12 Factor Loadings of the Items of TIME

	Component
	1
time2	.748
time4	.727
time3	.685
time1	.654

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.13 Total Variance Explained for PFACHST

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,305	39,140	39,140	4,305	39,140	39,140
2	2,214	20,127	59,268	2,214	20,127	59,268
3	,852	7,742	67,009			
4	,631	5,740	72,750			
5	,571	5,187	77,937			
6	,504	4,580	82,517			
7	,466	4,233	86,751			
8	,448	4,074	90,825			
9	,371	3,370	94,195			
10	,342	3,106	97,301			
11	,297	2,699	100,000			

Extraction Method: Principal Component Analysis.

Table G.14 Factor Loadings of the Items of PFACHST

	Component
	1
pfachst9	.729
pfachst5	.652
pfachst6	.647
pfachst12	.645
pfachst10	.644
pfachst8	.639
pfachst11	.622
pfachst2	.617
pfachst3	.600
pfachst4	.544
pfachst1	.518

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.15 Total Variance Explained for PMOCHST

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,279	38,900	38,900	4,279	38,900	38,900
2	2,061	18,736	57,636	2,061	18,736	57,636
3	,918	8,344	65,980			
4	,655	5,958	71,938			
5	,562	5,109	77,047			
6	,548	4,980	82,028			
7	,514	4,673	86,701			
8	,449	4,083	90,784			
9	,427	3,880	94,663			
10	,344	3,126	97,790			
11	,243	2,210	100,000			

Extraction Method: Principal Component Analysis.

Table G.16 Factor Loadings of the Items of PMOCHST

	Component
	1
pmochst8	.699
pmochst2	.680
pmochst10	.679
pmochst3	.645
pmochst11	.632
pmochst4	.621
pmochst1	.610
pmochst7	.598
pmochst12	.595
pmochst5	.570
pmochst6	.506

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.17 Total Variance Explained for PTECHST

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,914	24,284	24,284	2,914	24,284	24,284
2	2,836	23,635	47,919	2,836	23,635	47,919
3	,853	7,107	55,026			
4	,799	6,661	61,687			
5	,744	6,199	67,886			
6	,730	6,086	73,972			
7	,617	5,142	79,114			
8	,556	4,636	83,750			
9	,536	4,464	88,214			
10	,518	4,318	92,532			
11	,473	3,943	96,475			
12	,423	3,525	100,000			

Extraction Method: Principal Component Analysis.

Table G.18 Factor Loadings of the Items of PTECHST

	Component
	1
ptechst10	.710
ptechst4	.698
ptechst12	.685
ptechst11	.678
ptechst9	.667
ptechst5	.641
ptechst3	.614
ptechst2	.607
ptechst6	.602
ptechst1	.561
ptechst7	.474
ptechst8	.462

Extraction Method: Principal Component Analysis.
1 components extracted.

Table G.19 Total Variance Explained for PTECHTP

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2,792	39,885	39,885	2,792	39,885	39,885
2	,990	14,142	54,027			
3	,845	12,068	66,095			
4	,681	9,728	75,823			
5	,620	8,852	84,675			
6	,588	8,396	93,071			
7	,485	6,929	100,000			

Extraction Method: Principal Component Analysis.

Table G.20 Factor Loadings of the Items of PTECHTP

	Component
	1
ptechtp3	.718
ptechtp2	.691
ptechtp1	.689
ptechtp6	.602
ptechtp4	.594
ptechtp5	.580
ptechtp7	.521

Extraction Method: Principal Component Analysis.
1 components extracted.

CURRICULUM VITAE

PERSONAL INFORMATION

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EDUCATION

Degree	Institution	Year of Graduation
BS	METU Elementary Mathematics Education	2004
High School	Arifiye Anatolian Teachers High School, Sakarya	1999

WORK EXPERIENCE

Year	Place	Enrollment
2011- Present	Dobruca Elementary School	Mathematics Teacher
2009- 2011	Okçumusa Elementary School	Mathematics Teacher
2007- 2009	Sakarya Elementary School	Mathematics Teacher
2004- 2007	Kazımpaşa Elementary School	Mathematics Teacher

FOREIGN LANGUAGES

Advanced English

HOBBIES

Swimming, Tennis, Movies