FIFTH GRADE STUDENTS' MATHEMATICS-RELATED BELIEFS

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ABSTRACT

FIFTH GRADE STUDENTS' MATHEMATICS-RELATED BELIEFS

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The purpose of this study was to investigate 5th grade students' mathematics related beliefs and to examine possible gender differences on students' mathematics-related beliefs in Turkey. For this purpose, Mathematics-Related Belief Scale which specifically addressed 5th grade students' beliefs was developed in the first phase. After ensuring the validity and reliablity of the scale, it was implemented in 14 randomly selected schools located in Sivas city center. A total of 750 students participated in the study.

The results of the study indicated that Mathematics-Related Belief Scale was a valid and reliable scale consisting three subscales which were beliefs about mathematics and learning mathematics, self-efficacy and views about teacher role. The results of the study indicated that 5th grade students had availing beliefs about self and beliefs about mathematics and mathematics learning. On the other hand, students had the view that their teachers had rather authoritarian roles. In the course of gender, the study revealed that the gender difference in views of teacher role and self-efficacy beliefs were not significant, while girls significantly get higher scores on mathematics and learning mathematics beliefs subscale. In general, the results implied that 5^{th} grade students had availing beliefs for learning mathematics and they have not developed gender related biases yet.

Keywords: Mathematics-Related Beliefs, 5^{th} graders, Scale Development, Gender

ÖZ

5. SINIF ÖĞRENCİLERİNİN MATEMATİK HAKKINDAKİ İNANIŞLARI

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Bu çalışmanın amacı Türkiye'deki 5. sınıf öğrencilerinin matematik hakkındaki inanışlarını ve bu inanışlarının cinsiyetler arasında farklılık gösterip göstermediğini incelemektir. Bu kapsamda ilk olarak 5. sınıf öğrencilerinin inanışlarını ölçmeye yönelik Matematik Hakkındaki İnanışlar Ölçeği geliştirilmiştir. Ölçeğin güvenirlik ve geçerlik çalışması yapıldıktan sonra, ölçek Sivas merkezde bulunan rastgele seçilmiş 14 okulda uygulanmıştır. Çalışmaya toplamda 750 5. sınıf öğrencisi katılmıştır.

Analiz sonuçları ölçeğin üç alt boyuttan oluştuğunu göstermiştir. Bunlar matematik ve matematik öğrenimi hakkındaki inanışlar, öz yeterlik inanışları ve öğretmen rolüne yönelik görüşleridir. Araştırma sonuçları 5. sınıf öğrencilerinin matematik ve matematik öğrenimi ve öz yeterlik inançlarına yönelik yararlı inanışlara sahip olduğunu göstermektedir. Ancak öğretmen rolüne yönelik görüşleri incelendiğinde, öğrencilerin öğretmenlerinin otoriter role sahip olduklarını belirttikleri görülmektedir. Cinsiyet faktörüne bakıldığında, öğrencilerin öz yeterlik inanışları ve öğretmen rolü ile ilgili görüşlerinde cinsiyetler arasında anlamlı bir farklılık görülmezken, kız öğrenciler matematik ve matematik öğrenimi alt faktöründe erkek öğrencilerden anlamlı olarak yüksek bir puan almışlardır. Genel olarak bakıldığında, araştırmanın sonuçları 5. sınıf öğrencilerinin matematiğe yönelik yararlı inanışlara sahip olduğunu göstermiştir.

Anahtar Kelimeler: Matematik hakkındaki inanışlar, Ölçek geliştirme, 5. sınıf, Cinsiyet.

To my parents:

Meryem & Şefik KIBRISLIOĞLU

I am so lucky to have you

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LIST OF ABBREVIATIONS

MRBS: Mathematics-Related Belief Scale

CFA: Confirmatory Factor Analysis

EFA: Exploratory Factor Analysis

PCA: Pirincaple Component Analysis

MANOVA: Multivariate Analysis of Variance

CHAPTER 1

INTRODUCTION

Mathematics learning is generally considered as a mental process (Goldin, 2002). However, as Maker (1982, as cited in Ma & Kishor, 1997) indicates almost in every context, differentiating affective and cognitive domains is very difficult and there are both cognitive and affective components in every construct. Therefore, both affective and cognitive components are influential in mathematics learning and teaching (Forgasz & Leder, 2002).

Phillipp, (2007) defines affect as "a disposition or tendency or emotion or feeling attached to an idea or object" (p.259). Students' perceptions and feelings about mathematics indicate their future preferences, persistence on a given task, way of studying, and participation in the classroom activities (Reyes, 1984). Indeed, affective factors can estimate students' future learning and future success (Hannula, Opt'Eynde, Schlöglmann, & Wedege, 2007). Therefore, affect is an important research area in mathematics education.

In the literature, affective factors are categorized and defined in different ways by different researchers. Ma and Kishor (1997) and Phillipp (2007) categorized mathematics-related affect as beliefs, attitudes and emotions. Emotions are "rapidly changing states of feelings" (Goldin, 2002, p.61). Attitudes are defined as "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object" (Fishbern & Ajzen, 1975, p.6). On the other hand, beliefs are "internal representations to which the holder attributes truth, validity or applicability usually stable and highly cognitive, may be highly structured" (Goldin, 2002, p.61). These constructs are related to each other and are often defined in different ways.

Beliefs play a central role in the development process of attitudes and emotions (McLeod, 1992). It is emphasized that a person's beliefs about the object affects his/her disposition towards that object (Phillipp, 2007). Indeed, it can be inferred that beliefs, emotions and attitudes are representations of the same affective relation in differentiating level of cognition, intensity and stability (McLeod, 1992). Goldin (2002, p.61) adds values, ethics and morals as the 4^{th} category of affect and defines values as "deeply-held preferences, possible characterized as personal truths, stable, highly affective as well as cognitive."

In other perspective, according to Hannula's (2011) framework, mathematics-related affect is composed of cognitive domain, emotions and motivation. Cognitive domain is composed of belief, knowledge and memories, emotions are composed of emotional reactions, moods and feelings such as joy, pride, anxiety and motivation is considered as a construct which explains people's preferences (Hannula, 2011). Hannula (2011) explains relationship between these constructs as follows: Cognitive domain is responsible for receiving and organizing the information about self and environment. According to this information, motivation settles the orientation of the behavior. This orientation is determined with the help of the way a person gives priority one behavior to another. The result of the behavior which is oriented by motivation determines the emotions. Respectively, emotions affect the precision of cognition which also impacts the motivation.

It is generally emphasized that beliefs are hidden factors affecting other affective constructs. Actually, beliefs control people's actions and later learning (Lester Jr., 2002). As Schommer (1990) indicated, students' beliefs affect the ways that students get, monitor and aggregate the knowledge. Indeed, beliefs are an important component of mathematics teaching and learning process (De Corte, Op'y Ende & Verschaffeffel, 2002; Philipp, 2007). They have an important influence on the motivation towards mathematics (Kloosterman, 1996). Students' beliefs about mathematics affect how much effort they will spend for the tasks, their interest about mathematics and enjoyment with the task (Kloosterman, 2002). There is actually a circular relation between beliefs and learning. The experiences students have when they are learning affect their beliefs; on the other hand, their beliefs about learning also influence their approach to new learning experiences (Spangler, 1992). Students' beliefs about mathematics determine how students connect real life activities and school mathematics (Lester Jr., 2002). While summarizing research findings, Wittrock (1986) indicated that students' beliefs about achievement have a considerable influence on their success in school. The similar idea has also been mentioned in many studies that there is a reciprocal relationship between mathematics learning and mathematics-related beliefs (Beghetto & Baxter, 2012; Duel, Hutter, & Schommer-Aikines, 2005; Eleftherios & Theodosis, 2007; House, 2010; Jansen, 2008; Kloosterman & Cougan, 1994; Köller, 2001). For this reason, belief is an important research area also in mathematics education.

1.1. Students' Mathematics-Related Beliefs

The scope of this study is students' mathematics related beliefs. In general, identification of students' beliefs is the core idea in belief studies. Research in students' mathematics-related beliefs is conducted through qualitative, quantitative and mixed methodologies. In general terms, studies can be grouped as studies of identification of beliefs and relationships with other variables, and scale construction studies. A brief summary of related studies are given below.

Belief identification studies aim to reveal the structure of students' belief systems, beliefs students have about mathematics, or the relationship between students' beliefs and achievement and other demographic variables such as gender, grade level, and socioeconomic status; and affective variables such as attitude and self-efficacy. Identification is important because beliefs don't emerge suddenly. Rather, beliefs develop in the scope of people's experiences about the belief object (Lester Jr., 2002). Therefore, the environment that teaching and learning take place and the characteristics of the teachers are very influential in the development of students' mathematics-related beliefs (Greer, Verschaffel & De Corte, 2002; Yackell & Ramussen, 2002). However, there may be mismatch between students' mathematics-related beliefs and teachers' expectation about what students should believe (Tsamir & Tirosh, 2002). Therefore, in order to understand students' way of thinking in mathematics and to direct them towards desired beliefs, which are the beliefs enhance students' mathematics learning, it is very important to identify students' mathematics related beliefs (Kloosterman, 1996). Hence, the core aim of the current study is identifying beliefs of 5th grade students in order to contribute to their learning of mathematics in the middle schools.

Relationship identification is also an important research area because it helps both understanding the construct and if/how other variables affect it. Gender and grade level are important variables and they have been investigated in many belief studies in the literature. Gender is a controversial issue in mathematics education research. Some research results indicate that gender is an important variable which affects people's beliefs (Duell & Hutter 2005; Eleftherios & Theodosis, 2007; Leedy, Lalonde & Runk, 2003; Reçber, 2011; Schommer-Aikens & Kislenko 2009) while others argue that gender difference is not a significant issue (Ağaç, 2013; Aksu, Demir, & Sümer, 2002; Nortlander & Nortlander, 2009). Therefore, there is still a disagreement on this issue and literature should be enhanced with new research with different samples. Hence, in this study gender differences is also investigated in order to contribute literature with findings from a relatively different sample, the 5th grade students in Turkey.

Grade level is another important variable in belief research with students. Beliefs are mostly studied cross-sectionally longitudinal with the students across middle school or high school grades. Some of the studies indicated that the differences in students' mathematic-related beliefs across grade levels were significant (Aksu, Demir, & Sümer, 2002; Kislenko 2009; Kloosterman & Cugan, 1994). However, there is very little number of studies on younger students' mathematics-related beliefs in the accessible literature. There is a general knowledge about how students' beliefs change from the 6th grade to the 11th grade as studies mentioned above reported, but there is not sufficient information about what kind of beliefs younger students have. Therefore, there is a need to investigate younger students' beliefs in order to improve our knowledge of what beliefs they might be holding about learning mathematics.

In the present study, 5th grade students' beliefs were investigated because 5th grade is the beginning of middle school where several important mathematics topics are introduced to the students after they complete elementary school. Moreover, while elementary school mathematics curriculum focuses more on the basic skills like operations and recognizing the fundamental concepts, middle school mathematics emphasize problem solving and building relationships (MONE, 2013). Therefore, it is important to know what kinds of beliefs 5th grade students have when they start middle school in order to (i) understand the effectiveness of the elementary school mathematics instruction on students' mathematics-related beliefs and (ii) determine the possible mathematical experiences in middle school which will help students learn meaningful mathematics.

There are several studies which aimed to construct a valid belief scale for students both in Turkey and in other countries. However, the psychometric properties of many scales in the literature, including some popular scales, are poor (Walker, 2007). Although there are several successful scale adaptation studies in Turkey (such as Uğurluoğlu, 2008; Yılmaz, 2007), these scales were targeting rather older students' mathematics related beliefs. Therefore, development of new scales is a need in the literature. Hence, a scale addressing specifically 5th grade students was developed within the scope of current study.

Several perspectives and frameworks about students' mathematics-related beliefs were suggested in the literature. In this study, Op't Eynde, De Corte and Verschaffel (2002)'s framework about students' mathematic-related beliefs was used because it provides a more contemporary perspective on students' beliefs. Moreover, the framework was used in studies with different samples from different countries which provide some evidence for its cross cultural validity (Andrews, Diego-Mantecon, Op't Eynde & Sayers, 2007; Diego-Mantecon, Andrews & Op't Eynde, 2007; Op't Eynde & De Corte, 2002; Yıldırım-Çayır, 2003). Their framework is mainly based on based on Schoenfeld's (1983) view about the cognitive actions. According to their framework, mathematics-related beliefs are determined by both the context and personal needs. It consists of three main categories which are beliefs about mathematics education, beliefs about the self, and beliefs about social context. The detailed information about the framework was given in Chapter 2.

The current study focuses on specific aspects of the framework under the certain requirements of the curriculum. The main reason behind this is that the framework is too comprehensive to examine in a single scale with 5th graders. The current curriculum put emphasis on problem solving and contructing relationship between mathematics concepts in middle school mathematics, and teachers' facilitating and guiding role for students' learning since 2005 (MONE, 2005, 2013). Hence, the related aspects of the framework which are beliefs about nature of mathematics, beliefs about learning mathematics, self-efficacy beliefs and views about teacher role were examined in the study.

1.2.Research Questions

The aims of this study are (1) to develop a valid and reliable mathematics related belief scale for relatively young students; (2) to investigate 5th grade students' mathematics-related beliefs in Turkey; and (3) to examine the possible gender differences in 5th grade students' mathematics-related beliefs. Following research questions were investigated in the scope of this study:

1. Is mathematics-related belief scale for 5th grade students a valid and reliable scale?
2. What are the mathematics-related beliefs of the 5th grade students in Turkey?
3. Is there a gender difference in 5th grade students' mathematics-related beliefs?

The hypotheses related to the third research question are as follows:

H_0: There is no gender difference in students' mathematics- related beliefs.

H_1: Students' mathematics-related beliefs differ with respect to their genders.

1.3. Significance

Students' mathematics-related beliefs have an important effect on their mathematics learning. Pehkonen (1995) indicates that students who hold negative beliefs towards mathematics and mathematics learning generally have a tendency to become passive learners and prioritize memorization. Indeed, beliefs are formed by the direct or indirect experiences of students (Lester Jr., 2002). Therefore, classroom practice becomes an important component in the formation of students' beliefs. As Green (1971) mentioned, teaching is very much related with modifying and forming belief systems. However, in order to shape students belief systems in the most enhancing way for their learning, educators need to identify and understand the beliefs students have (Kloosterman, 1996). Understanding the nature of and changes in students' beliefs can provide information about what happens in their classroom (Carte & Norwood, 1997). It is especially important to identify younger students' beliefs because younger students are subject to relatively short period of school mathematics experiences which makes their beliefs more open to be influenced by classroom experiences and to change. Fifth grade is important because it is the grade level which students start middle school and are taught by a mathematics teacher. Knowing their beliefs right in the beginning of the 5th grade will provide primary and middle school mathematics teachers, textbook writers and curriculum developers with the knowledge of the effectiveness of the elementary school mathematics instruction on mathematics related beliefs, and possible mathematical experiences in the middle school which will help students learn mathematics. The beliefs that students hold can be considered as the reflection of their teachers' beliefs and practices (De Corte, Verschaffel & Depaepe, 2008; Polly et al, 2013). Indeed, students' mathematics-related beliefs are an indicator of their classroom experiences (Pehkonen, 1995). Hence, the results of the current study might guide teachers and enhance them about reconsidering their own beliefs about mathematics and their classroom practices. Moreover, as younger students' beliefs are more open to change through direct experience, textbooks might have an influence on their beliefs as students have more interaction with them. Therefore, the results of this study might provide a feedback for textbook writers and curriculum developers about how the content of the curriculum and textbooks are likely to shape students' beliefs. For these reasons, current study aims to identify 5th grade students' mathematics-related beliefs.

1.4. Assumptions and Limitations

The results of the study are limited by the data collected by instrument. The scale consists of items only in the specified four domains which are beliefs about nature of mathematics, beliefs about learning mathematics, self-efficacy beliefs and views about role of the teacher. However, there are other domains which affect students' mathematics-related beliefs in general. The results are limited by the subscales included in the study.

One assumption of the current study was that students read each item, understood the belief expression and responded honestly. Moreover, it was also assumed that students were in the normal level of physical, mental and psychological development.

Data were collected from 14 randomly-selected public schools in Sivas city center by the researcher in students' regular classrooms in one class hour. Hence, it was assumed that scale was administrated under the same conditions. The results can be generalized to some extent to the 5th grade students in Sivas public schools. However, it couldn't be generalized to the whole country because one city is not a reasonable sample for the entire country. On the other hand, as there is a national curriculum which is implemented throughout the whole country and it can be assumed that the results might be similar in similar regions of Turkey.

1.5. Definition of Important Terms

Mathematics-related beliefs: Beliefs about mathematics were defined as "The implicitly or explicitly held subjective conceptions students hold to be true, that influence their mathematical learning and problem solving" (De Corte & Op'T Eynde, 2002, p.28). In this study, 5th grade students' mathematics-related beliefs were considered as their implicitly or explicitly held conceptions of mathematics which they attributed truth and which influenced their mathematical learning and problem solving, and these beliefs were identified by the mathematics-related beliefs scale.

Self-efficacy beliefs: Self-efficacy beliefs were defined as “Students’ judgments of confidence to perform academic tasks or succeed in academic activities” (Pajares & Grahman, 1999, p.124). In the current study, self-efficacy beliefs were considered as students’ judgments of confidence to perform mathematics-related tasks.

Teacher role views: Students’ views about role and functioning of the teacher.

Availing beliefs: The beliefs which enhance desired learning outcomes (Muis, 2004).

Nonavailing beliefs: The beliefs which have no or negative influence on learning (Muis, 2004).

CHAPTER 2

LITERATURE REVIEW

In this chapter, nature of beliefs, mathematics related beliefs and theoretical framework of the study explained respectively. Then, studies conducted about mathematics-related beliefs both in Turkey and other countries mentioned briefly.

2.1.Nature of Beliefs

There are several definitions of beliefs in the literature. These definitions focus on different aspects of beliefs. Fishbern and Ajzen (1975) define beliefs as information that a person has about an object or idea. Hart (1989, p.44) describes beliefs as "reflection of certain types of judgments about a set of objects." According to Richardson (1996, p.2) beliefs are "psychologically held understandings, premises, or propositions about the world that are felt to be true." Kloosterman, Raymond and Emenaker (1996, p.39) make definition of beliefs as "the personal assumptions from which individuals make decisions about the actions they will undertake." Schoenfeld (1998, p.21) indicates that "beliefs are mental constructs that represents the codification of people's experiences and understandings." Pehkonen (1995) defines beliefs as 'one's stable subjective knowledge.' He categorized beliefs as basic (unconscious) beliefs which are more affective and conceptions (conscious beliefs) which are more cognitive.

In the scope of these definitions, it can be inferred that knowledge and beliefs are two interrelated constructs. They determine students' learning and thinking process together. Even, knowledge is defined as "justified true belief" (McDowell, 1987, as cited in Furinghetti & Pehkonen, 2002, p.42). However, there are also main differences between knowledge and belief systems. Scheffler (1965) indicated that a truth condition was required for knowledge, whereas beliefs did not require such condition (as cited in Op'y Ende, De Corte, & Verschaffeffel, 2002). Moreover, Pehkonen (1995) indicates that knowledge needs objectivity and it should be publicly accessible in order to test its truth.

2.1.1. Belief Systems

Beliefs are placed in a belief system (Green, 1971). The belief system may be defined as socially or culturally shared, comprehensive belief structure (Goldin, 2002). There are some characteristics of belief systems. First of all, belief systems have a cluster structure. Green (1971) indicates that beliefs are not held independently and isolated, and they are always placed in a cluster of other beliefs. Abelson (1979) mentions that belief clusters are generally shaped by results of the some evaluations. In general, individuals have big clusters such as 'good' and 'bad'. People evaluate the situations and place the belief in clusters. In general, these evaluations are based on quasi-logical processes. Quasi-logicalness is another characteristic of belief systems. The relationship between beliefs and belief clusters and also the reasons that individuals attribute for holding a specific belief are the product of quasi-logical processes. Green (1971) argues that belief systems consist of two types of beliefs, primary and secondary or derivative beliefs. Primary beliefs are the beliefs that a person doesn't address any reason for holding that belief. These beliefs are the sources of other beliefs named as derivative beliefs. This relation is quasi-logical because the relationship between primary and derivative beliefs is similar to a cause-effect relationship, but not completely a logical relationship. For example, a teacher may believe that it is important to construct their own understanding for students while learning mathematics as a primary belief. Then, teacher believes that it is important to use manipulatives in lessons to help students make sense of the concept which is a derivative belief.

Another characteristic mentioned by Green (1971) is that beliefs are psychologically centered. It is actually about the degree of intensity of a specific belief. Some beliefs are stronger than others or some are more influential than other beliefs for that individual, or the importance of the same belief is different for different individuals. These are related to the psychological centrality of that belief. Actually, the more central the belief, the more important for the individual and the more difficult it is to change it. Psychologically centered beliefs may be seen as primary beliefs. However, this may not always be the case. People may have beliefs which are psychologically centered but not primary or same individual may have conflicting beliefs. Since conflicting beliefs are generally held in different clusters, the conflicts between them are not recognized by the individuals. For example, a teacher may both believe that student-centered classroom is important for students' mathematics learning and that teacher should provide the knowedge in the mathematics lessons (Haser, 2006). In this case, if the teacher holds the latter belief more central, then s/he would dominate the classroom environment himself/herself.

Green (1971) also mentions another feature of the beliefs which is evidentiality of the beliefs. This characteristic also is about the way people hold beliefs. It is explained as if a person holds a belief with good evidence or reason, then this belief is held evidentially. On the other hand, if the person has no evidence to hold a specific belief then it is held nonevidentially. The nonevidential beliefs are more difficult to change because they don't have reasonable evidences and are not affected by rational criticism. This characteristic is different from the quasi-logical structure of the beliefs. In quasi-logical structure, the bases of the beliefs are other beliefs but these basis beliefs don't have to be logical. In evidentiality, the beliefs are based on the certain reasons, but not other beliefs.

2.1.1.1. Knowledge System versus Belief System

Knowledge and beliefs are two interrelated constructs. They determine students' learning and thinking process together. However, there are also main differences between knowledge and belief systems. Scheffler (1965) indicated that a truth condition was required for knowledge, whereas beliefs did not require such condition (as cited in De Corte, Op'y Ende & Verschaffeffel, 2002). Moreover, Pehkonen (1995) indicates that knowledge needs objectivity and it should be publicly accessible in order to test its truth.

When the characteristics of belief system are considered, there are certain differences between belief and knowledge systems, as Philipp (2007) explained. Belief systems have a quasi-logical structure while knowledge systems are purely logical. Moreover, knowledge systems don’t have psychological centrality. In beliefs, individuals may have different degrees of assurance which depends on that belief’s psychological centrality, as central or peripheral (Philipp, 2007). On the other hand, if the person has the knowledge, then s/he is 100% sure about it.

2.1.1.2. Availing and Nonavailing Beliefs

There is generally a tendency to assign a degree or label to the beliefs both in quantitative and qualitative studies while interpreting research results. In the literature, there are different labels for desirability level of beliefs. Schommer-Aikens (2002) prefers using sophisticated and less sophisticated terms. In her manner, sophistication indicates quality and sophisticated beliefs mean beliefs that enable adaptable thinking, support ability to assimilate and accommodate the knowledge and motivation for the tasks.

On the other hand, Muis (2004) criticizes labeling beliefs such as sophisticated, inappropriate, or naïve as they have a negative implication and are not adequate for describing beliefs and behaviors. Instead, she suggests using availing and non-availing terms. While availing beliefs indicate the beliefs which enhance desired learning outcomes, non-availing beliefs indicate the beliefs which have no or negative influence on learning. For example, if a student believes that mathematics concepts are related to each other which is a belief associated with better learning outcomes in a constructivist learning perspective, then it can be said that s/he has availing beliefs. On the other hand, if a students believes mathematics concepts are isolated from each other which prevents students’ effective learning in a constructivist learning environment, then it can be said that s/he has nonavailing beliefs

In the current study, Muis’s (2004) approach is taken into consideration and results were interpreted with respect to availing and non-availing categorization.

2.2. Mathematics-Related Beliefs

Beliefs influence the quality of the learning as it affects the ways that students get, monitor and aggregate the knowledge (Schommer, 1990). Indeed, mathematics-related beliefs determine how students are involved in the mathematical tasks (Schoenfeld, 1989), how much effort they will spend for the task (Kloosterman, 2002), and how they connect real life activities and school mathematics (Lester Jr., 2002). Hence, mathematics-related beliefs might enhance or prevent effective learning depending on what kind of beliefs students hold (Pehkonen, 1995).

As mathematics-related beliefs affect students' mathematics learning and achievement (Beghetto & Baxter, 2012; Duel, Hutter, & Schommer-Aikines, 2005; Kloosterman & Cougan, 1994) how students' mathematics-related beliefs could be enhanced in an availing way for their learning has become an important concern. To answer this question, the factors affect students' mathematic-related beliefs should be investigated. The major factor that shapes students' mathematics-related beliefs is their mathematics-related experiences (Lester Jr., 2002). This implies that learning environment and teachers are the key issues in students' formation of beliefs. Indeed, teaching is very much related with modifying and forming belief systems (Green, 1971) and teachers are the ones who have the most influence on students' mathematics-related beliefs (Kislenko 2009). In a more general perception, the beliefs that students hold can be considered as the reflection of their teachers' beliefs and practices (De Corte, Verschaffel & Depaepe, 2008; Polly et al, 2013). To conclude, mathematics-related beliefs is an important construct in students' learning process which is mainly shaped by students' mathematical experiences and their teachers' perceptions.

Several definitions of mathematics-related beliefs mentioned in the literature by mathematics educators might be applicable in the case of mathematics teaching and learning. In this study, the emphasis on how beliefs would operate on learning mathematics was considered as an important issue in defining students' beliefs. According to Schoenfeld (1992, p.358) mathematics-related beliefs are "an individual's understandings and feelings that shape the ways that the individual conceptualizes and engages in mathematical behavior." While Schoenfeld (1992) addresses engagement in mathematics in his definition, he states feelings, a highly unstable construct, as a component of beliefs, which is more stable than feelings (Hannula, 2011). Op't Eynde, De Corte, and Verschaffeffel, (2002, p.28) give a comprehensive definition for mathematics-related beliefs as "the implicitly or explicitly held subjective conceptions students hold to be true, that influence their mathematical learning and problem solving." In this study, this working definition is used as mathematics-related belief because it focuses more on the students' learning of mathematics as well as the structure of the belief construct common in the belief literature.

2.3. Theoretical Framework

Different approaches for students' mathematics-related beliefs' are given in the field. Some brief information about them is given below.

2.3.1. Schoenfeld's Social Cognitive Perception

Schoenfeld (1983) conducted a study about students' problem solving behaviors and their cognitive processes during the problem solving. According to the results of his study, he proposed a framework for the dimensions of cognitive behaviors of students. He indicated that there has been almost no construct that was composed of only cognition. Instead, most cognitive actions actually take place in social and metacognitive place which indicates that cognitive behaviors are also a result of people's beliefs. He worked on problem solving processes of students and described a model which explained cognitive behaviors. According to him, the cognitive actions were explained in three dimensions: (1) setting, (2) knowledge, belief and value system, and (3) awareness. Figure 2.1 explains what each dimension is composed of.

The first dimension indicates cognitive part which includes facts, procedures and strategies. The second dimension is knowledge, belief and value system composed of beliefs about self, the task and the environment. Students' beliefs about the nature of the task or about their success or failure determine the students' approach to the tasks. Beliefs also affect students' preferences about which resources they will use such as strategies or procedures that might work. For example, if a student believes that mathematical knowledge can be gathered throughout memorization, s/he will probably quit the task when s/he forgets something; while the one who believes mathematical knowledge can be derived will continue to work on the task. The last dimension includes person's level of awareness about his/her knowledge, belief and value system. It is indicated that in order to use it, students should be aware of their knowledge. Unconscious beliefs of individuals may affect the behavior and these beliefs are more difficult to change (Schoenfeld, 1983).

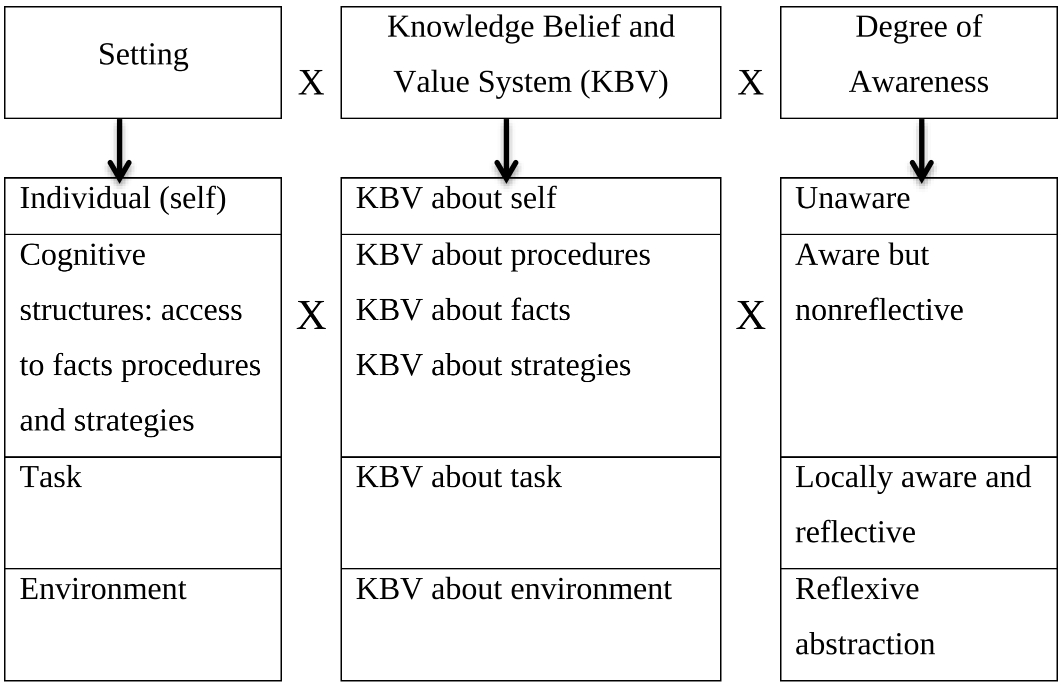

Figure 2. 1 The dimensions of matrix within which pure cognition resides (Schoenfeld, 1983, p. 349).

Later, Schoenfeld (2000) constructed a teaching process model which was generated from this idea. The model indicates that teachers have certain knowledge, beliefs and goals which they may aware of or not. These constructs determine teachers' decision making processes and their actions. Indeed, teachers' beliefs determine their goals and goals determine their action plan. In an in-dept analysis of a teacher and her lesson, Schoenfeld (2008) indicated that teacher's goals are reflections of her beliefs about mathematics, students, learning and teaching and her pedogocical knowledge, content specific knowledge and knowledge about students related to both their personalities and their background determines the orientation of the lessons.

According to this framework belief system has three main components which are beliefs about the object or task, beliefs about the social environment in which the experiences take place, and beliefs about the self within the task. Several belief frameworks in the literature are mainly based on this framework.

2.3.2. McLeod's Belief Framework

McLeod (1992) modeled mathematics-related beliefs in four components which are beliefs about mathematics, beliefs about self, beliefs about mathematics teaching, and beliefs about the social context. Beliefs about mathematics mainly consist of beliefs about the nature of mathematics and learning mathematics. This subdomain is about usefulness, importance, difficulty of mathematics as well as the beliefs about the nature of the mathematics such as mathematics is computation, rule-based, and memorization. Beliefs about self include self-concept, self-confidence and causal attributions of students about their success and failure. This domain focuses on how students perceive themselves as learners as either good or bad. Their reasons for their success and failure are also related to this dimension. Beliefs about mathematics teaching contain students' perceptions about the nature of instruction. Lastly, social context is another factor that shapes students' affective reaction. Social context addresses cultural context of schools as well as home environment.

McLeod (1992) mentioned that students' mathematics-related beliefs may enhance or weaken their mathematical and problem solving ability. For example, If a student believes that mathematics problems can be solve quickly, then s/he doesn't want to put effort on some non-routine problems which prevents him/her to improve his/her ability. Moreover, it is also emphasized that mathematics-related beliefs should be taken into account as a complete structure rather than distinct subdomains. For example, a student may have high self-confidence and at the same time s/he believes that mathematics is only about computation. In this case, students' beliefs about the nature of mathematics and self-confidence are placed in different perspective. Hence, in order to get clearer picture of students' beliefs, there is a need to consider the whole picture about not only mathematics-related subdomains but also whole mathematics-related affect.

2.3.3. Kloosterman's Model

Kloosterman (1996) suggested a model of belief, motivation, and achievement process. He introduces a framework with the light of the interview data gathered from 29 upper elementary grade students. He basically combines McLeod's (1992) four factors into two basic factors. These are beliefs about mathematics as a discipline and beliefs about learning mathematics. Beliefs about mathematics are the same as the first category of McLeod's framework. The second category is composed of three sub-categories which are beliefs about self as a learner of mathematics, beliefs about the role of the teacher, and other beliefs about learning mathematics such as 'anyone can learn mathematics' or 'students learn in different ways.' Although these two frameworks are similar, Kloosterman mainly focuses on motivational aspects of the beliefs.

In this framework, beliefs about mathematics affect students' motivational decisions which directly affect their achievement. For example, if a student believes that mathematics is computation then s/he will be motivated to improve his/her skills on computation or if a student believes that s/he is not capable of solving non-routine problems, then s/he will be unmotivated towards solving them. In the course of teacher role, students who believe teacher is the transmitter of the knowledge would be less motivated to construct their knowledge. Therefore, this framework mainly implies that when students have consistent beliefs with learning goals, then they will be motivated in an enhancing way for learning.

2.3.4. Pehkonen's Model

Pehkonen (1995) categorized mathematics related beliefs in four dimensions. His categorization is somehow different from the frameworks mentioned above. The first dimension is beliefs about mathematics and it contains beliefs about the birth of mathematics, mathematics as a school subject or as a university discipline. The beliefs Pehkonen mentioned in this dimension are not much emphasized in other frameworks. The second category is beliefs about oneself within mathematics which includes beliefs such as self-confidence, students' perceptions about their success, or themselves as a learner and problem solver. This category includes similar dimensions with McLeod's (1992) beliefs about self. Third category is beliefs about mathematics teaching which includes beliefs about the role of the teacher and student and the nature of the teaching, which is close to the McLeod's categorization of beliefs about mathematics teaching. Last dimension is beliefs about mathematics learning and it contains beliefs about the role of learner, the nature of learning, and the criteria for correctness. This dimension includes Kloosterman's (1996) category of beliefs about learning mathematics and McLeod's beliefs about social context.

Pehkonen (1995) approaches beliefs as evaluative and regulative system. Individuals generally evaluate their beliefs with their new experiences and others' beliefs which imply that beliefs are developed in social settings. Indeed, teachers and classroom environment are the basic factors affect students' beliefs and, students' mathematics-related beliefs are the indicators of what kind of mathematical experiences they had in the classroom. Second, beliefs form a regulative system which students behave accordingly. For example, students who believe mathematics is calculation approach every problem to make calculation only and they have trouble when they face a non-routine problem. Hence, students' beliefs about mathematics directly impact students learning and the ones who hold negative beliefs tend to become passive learners.

2.3.5. Op't Eynde, De Corte, and Verschaffeffel's Framework

In general, when different categorizations are examined, it can be inferred that they have common and distinct aspects. While McLeod (1992) and Kloosterman (1996) categorize beliefs in a similar way, Kloosterman mainly focuses on motivational implications of beliefs. Pehkonen (1995) adds some other domains like mathematics as a school subject or university subject and he focuses more on social aspects. A more comprehensive framework is given by Op't Eynde, De Corte and Verschaffel (2002). This framework is based on Schoenfeld's (1983) view about the cognitive actions. According to him, cognitive actions are determined by the nature of the task, social environment, and the perception of the individual. Hence, belief systems are comprised of the effects of self, belief object and the context. From this framework, Op't Eynde et al (2002) elaborated a triangular representation of mathematics-related belief system presented in Figure 2.2. According to this system, mathematics-related beliefs are determined by both the context, which is classroom environment, and personal needs.

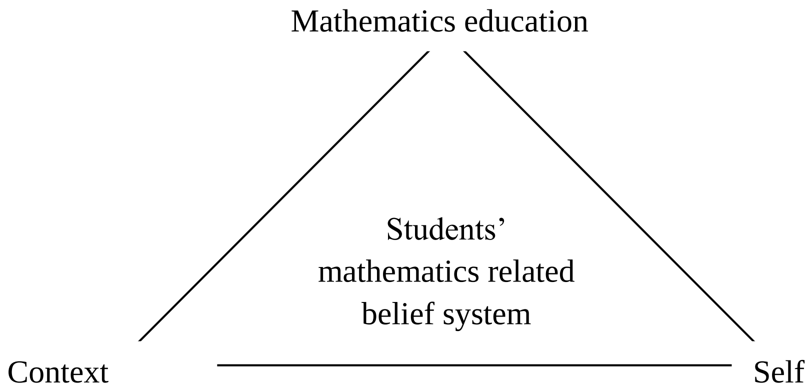

Figure 2. 2 Constitutive dimensions of students' mathematics-related belief systems (Op't Eynde et al, 2002, p. 27)

Op't Eynde et al (2002) framework consists of three main categories which are beliefs about mathematics education, beliefs about the self, and beliefs about social context. Beliefs about mathematics consist of three subcategories: beliefs about mathematics as a subject, beliefs about mathematics learning and problem solving, and beliefs about mathematics teaching in general. The first category is about the answer of the question 'what is mathematics?' in students' mind. The second category, beliefs about self consists of self-efficacy, control, task value, and goal orientation beliefs. These are motivational beliefs of the students. Lastly, beliefs about social context consist of beliefs about social norms in their own classroom which includes role and the functioning of the teacher and student; and beliefs about socio mathematical norms in their class. Socio-mathematical norms are explained as "normative understandings of what counts as mathematically different, mathematically sophisticated, mathematically efficient, mathematically elegant and acceptable mathematical explanation and justification in a classroom" (Cobb & Yackel, 2014, p. 461). Op't Eynde et al (2002) framework is more contemporary. Moreover, the framework was used in studies with different samples from different countries which provide some evidence for its cross cultural validity (Andrews, Diego-Mantecon, Op't Eynde & Sayers, 2007; Diego-Mantecon, Andrews & Op't Eynde, 2007; Op't Eynde & De Corte, 2002; Yıldırım-Çayır, 2008). Therefore, in this study, this framework was used as theoretical framework. Table 2.1 summarizes the framework.

Table 2.1. The framework of students' mathematic related beliefs

Beliefs about mathematics education	Beliefs about self	Beliefs about the social context
*Beliefs about mathematics as a subjects *Beliefs about mathematical learning and problem solving *Beliefs about mathematics teaching in general	*Self-efficacy beliefs *Control beliefs *Task value beliefs *Goal-orientation beliefs	*Beliefs about social norms in their own class -The role and functioning of the teacher -The role and functioning of the students *Beliefs about socio-mathematical norms in their own class

As the framework is considerably comprehensive for a single study, four subdomains as beliefs about nature of mathematics, beliefs about learning mathematics, self-efficacy beliefs and views about the role of the teacher were considered as the focus of the study. The current curriculum emphasize more on problem solving and building relationships in middle school mathematics, and teachers' facilitating and guiding role for students' learning (MONE, 2005, 2013). In order to address curriculum requirements about students' mathematics-related beliefs, these subdomains were chosen. Moreover, in order to get information about the social environment of students' mathematics classrooms, students' views about their teacher was included.

2.4. Students' Mathematics-Related Beliefs

Students' mathematics related beliefs were investigated in many research in several grade levels from primary school to college. These studies focused on identifying students' beliefs, the relationship between beliefs and achievement, change in beliefs and constructing scales to investigate beliefs. As the scope of the current study is related to 5th graders' beliefs, studies related especially to young children's beliefs were briefly summarized in this part in order to provide an account of the field.

Kloosterman and Cougan (1994) examined 62 students' mathematics related beliefs and the relationship between their beliefs and success from grade 1 to 6. Students were asked 8 interview questions. With respect to their responses, students were ranked low, medium and high in five categories: liking school, liking mathematics, parental support for school in general, parental support for mathematics, and self-confidence in mathematics. Students were grouped as high, medium and low achievers with respect to their mathematics success in California achievement test. According to the results of the study, it is indicated that young children have difficulty to express themselves and most of them haven't been considered the issues asked in interview questions before. On the other hand, 4-6 graders gave more clear answers and expressed themselves easily. In general, students believed that anyone who tries can learn mathematics. Students expressed their self-confidence with respect to their teachers' feedback or their grades. This result indicates that teachers have an important influence on students' beliefs. Students who liked mathematics also had high self-confidence. While there was no significant relationship between achievement and liking mathematics in first and second graders, there was a relationship between achievement, confidence and liking mathematics in 3-6 graders. In general, the results of the study indicated that first and second graders did not have strong beliefs about mathematics yet.

In their study, Beghetto and Baxter (2012) investigated the relationship between mathematics-related beliefs and mathematical understanding of 3rd, 4th and 5th grade students. Students were implemented a Likert type scale for mathematics-related beliefs and teachers' ratings were used as an indicator of mathematical understanding. The scale measures four subdomains which are source and certainty beliefs, intellectual risk taking, perceived competence and creative self-efficacy beliefs. The results of the study indicated that students' creative self-efficacy beliefs were positively related to their mathematical understanding and creative self-efficacy beliefs were also related to intellectual risk taking and perceived competence beliefs. This result indicates that students who are more confident about their ability are more likely to generate mathematical understanding and more willing to take risks. On the other hand, naive source beliefs were negatively related to students' mathematical understandings. This means that students who believe the source of the knowledge is mainly external produce lower mathematical understanding. This result implies that instruction which enhance students' source beliefs will help their mathematical understanding.

Jansen (2008) investigated the relationship between students' beliefs about classroom participation and their participation to whole class discussions. Data were collected from 15 7th grade students from two classrooms. While the course textbook is the same for two classes, the nature of discussions was different. The relationship between beliefs and participation and the difference between students' participations who hold the same beliefs from different classes were investigated. Data related to students' beliefs were collected through interviews and classroom videotapes were taken to document students' participation on discussions. Moreover, the nature of discussions for each class was determined. The results of the study indicated that while eight students perceived discussions threatening, others believed that it was helpful in learning mathematics. Students who believed discussion was helpful generally talked more conceptually in discussions while others avoided talking. The results indicated that students who held similar beliefs behaved in a similar way in different classes and students' beliefs played an important role in their classroom practices.

Kislenko (2009) investigated 7th, 9th and 11th grade students' mathematics related beliefs in Estonia. The difference between students' beliefs with respect to gender and grade level was also investigated. The study was conducted by 580 students and data were collected through a Likert type scale. The scale consisted of six factors which were interest, self-confidence, hard-working, usefulness, mathematics as an absolute discipline, and insecurity. The results of the study indicated that mathematics was important for students but it was also a difficult subject. Students could not decide whether mathematics was boring or not. When gender difference was examined, girls were more tended to be insecure in mathematics lessons and boys were generally more confident about their ability. Moreover, when differences in students' beliefs among the grade levels were examined, 7^{th} graders seemed to have more unavailing beliefs about mathematics in contrast to the previous findings, which generally argued that while grade levels increased, unavailing beliefs also increased.

Schommer-Aikens, Duell and Hutter (2005) investigated 7^{th} and 8^{th} grade students' general epistemological beliefs, mathematical problem solving beliefs, the relationship between these two constructs and relationship between beliefs and achievement. Students were implemented epistemological belief scale which was adapted from Schommer (1996), Indiana Mathematics Related Belief scale (Kloosterman & Stage, 1992) and Fennema-Sherman (1976) usefulness scale. In order to indicate students' problem solving achievement, they were asked to solve and explain the rationale of two problems. Their responses were evaluated by 4 teachers and scored in 6 point scale. Moreover, as the problems students solved included reading ability, students' reading scores on Kansas State Assessment were used as norm reference. The results of the study indicated that epistemological beliefs of the students might be a predictor of students' mathematics related beliefs. The results of the path analysis indicated that students' domain specific and epistemological beliefs can estimate their problem solving achievement. Moreover, gender was a predictor of some subdomains of the mathematics related beliefs. The result of this study also supported that the relationship between beliefs and achievement was significant.

Multon, Brown and Lent (1991) investigated 39 journals aiming to investigate the relation between self-efficacy beliefs and academic outcome and persistence with different samples from elementary school to college. The results of the study indicated that self-efficacy is account for a considerable variance in achievement. It is also indicated in the study that when students gets older the variance on the achievement explained by self-efficacy increases. However, it is also indicated in the study that enhancing young students' efficacy beliefs increase the rate of the change in their beliefs caused by the time. Hence, the intervention studies with younger students are important. The results of this study imply that students' self-efficacy beliefs affect their achievement and younger students are open to enhance their beliefs.

The studies summarized above imply that there is a relationship between mathematics-related beliefs and students' mathematical understanding and their classroom practice. Hence, belief is an important component in teaching and learning process.

As it is mentioned before, beliefs and achievement are two interrelated concepts. Hence, in order to enhance students' learning, how beliefs change and how to modify students' beliefs are other concerns. Kloosterman, Rymond and Emeneker (1996) examined students' beliefs from first to sixth grade for three years. The purpose of the study was to determine the change in students' beliefs. Students were interviewed in each year. The interview protocol was composed of five categories of beliefs which were about what students liked about mathematics, how important studying mathematics was, self-confidence beliefs, ability in learning mathematics, and group learning. Moreover, teachers were also interviewed in the second year of the study about their students. At the end of the study, four themes about students' beliefs were emerged: usefulness of mathematics, individual versus group work, relation between confidence and ability, and liking mathematics. About usefulness of mathematics, while younger students thought that it was necessary to pass to the next grade, older ones gave more personal uses. However, the perceptions of students didn't change much in three years. Students had different beliefs about the group work. While some students thought that group work was useful in younger ages, they changed their stand as problems should be solved individually. The main reason behind this change was the difference between teachers' perceptions about group work and how they used it. While some teachers implemented group work by creating a cooperative learning environment and instructing and guiding students, others gave time to students work with their peers on assignments if they wished without guidance. This result showed the importance of classroom experiences on students' beliefs. When the relationship between students' confidence and achievement is considered, although there were some exceptions, the relationship went consistently through three years by corresponding high achievement with high confidence. Last, about liking mathematics, while some students gave tentative responses, some indicated that they liked mathematics more when it became more challenging. In general terms, the results indicated that although students' beliefs were relatively stable, they might change with respect to learning experiences and teachers' practice in the classroom.

Mason and Scrivani (2004) conducted a study in order to examine the effects of a specific intervention on 86 5th grade students' mathematics-related beliefs. Two groups were formed and one of them received the intervention which focused on creating a learning environment in which students were encouraged to generate alternative solutions, evaluate their solutions and take responsibility of their own understanding while teacher's role was to encourage students' cognitive and metacognitive engagement of the task. The intervention was implemented by the researcher throughout 12 sessions, each last one and half hour. A 28 item Likert type scale was implemented to the students before and after the intervention. The scale was created by the researchers based mainly on Indiana Mathematics Belief Scale (Kloosterman & Stage, 1992) and Fennemea-Sherman (1976) usefulness scale. Students were also asked to evaluate themselves. Moreover, students were given pre and post-test including usual and unusual problems. In the analysis, differences between students' beliefs and performance on usual and unusual mathematics' test scores were compared. The results of this study indicated that the intervention had a positive effect on both students' mathematics-related beliefs and their problem solving performance. Moreover, students' mathematics- related beliefs contributed their success in mathematics for both groups. This study implied that students' mathematics-related beliefs can be changed through a careful intervention. Moreover, there was a relationship between beliefs and performance on mathematics problems.

When studies are examined, it appears that scales developed to address specifically younger students' beliefs were scarce in the available literature. In general, the existing scales were adopted with respect to the older grade levels. An earlier scale was developed by Schoenfeld (1985) to investigate high school students' beliefs. In the process of the development of this scale, problem solving sessions were videotaped, students were interviewed and the geometry lessons were observed. At the end of the this process, a scale was constructed including 70 close ended and 10 open ended items in five domains. The scale was implemented to 230 high school students. However, there is no information about the reliability or the validity of the scale.

One of the most implemented or used mathematics related belief scale in investigating students' mathematics-related beliefs is Indiana Mathematics Belief Scale developed by Kloosterman and Stage (1992). The scale mainly addresses collage level students' beliefs. The scale consists of five sub domains as effort in difficult problems, step by step problem solving process, word problems, understanding mathematical concepts and effort. The reliability of the scale is determined by Cronbach's Alpha coefficient and validity is determined by criterion related evidence. The results indicated that scale was valid and reliable. However, there is a need for construct validity evidence of the scale in order to ensure that the construct consisted of given sub domains and these domains measured students' beliefs.

Op't Eynde and De Corte (2002) conducted a study in order to validate the framework they suggested. They developed a Likert type scale consisting of three subscales as beliefs about mathematics, beliefs about self and beliefs about teacher role and functioning. They conducted the scale 365 junior high school Flemish students. The results of the study indicated that the four factor solution model is appropriate. These factors are beliefs about role and functioning of their own teachers, beliefs about significance of and competence in mathematics,

mathematics as a social activity, and mathematics as a domain of excellence. It is indicated that the four factor solution indeed explains the hypothetical framework as first factor refers to beliefs about social context, second one indicates beliefs about self and last two indicated beliefs about mathematics. Indeed, although these results gave some clue about validity of the framework, there is no mention about confirmatory factor analysis of the construct. Hence, this individual study is not adequate to validate the framework. Op't Eynde, Andrews and Mantecon (2007) refined this scale and conducted another study with English and Spanish students between 12 and 15 ages. The factor analysis results indicated that the scale consisted of similar four subscales and Cronbach's Alpha coefficient indicated that the scale was reliable. However, there is still need to conduct confirmatory factor analysis with different samples in order to ensure the construct validity of the scale.

2.5. Studies in Turkey

Students' mathematics-related beliefs have also been investigated in Turkey with different grade levels form elementary to college level. In general, there are not many studies about younger students' beliefs in Turkey in the available literature.

Aksu, Demir and Sümer (2002) examined students' mathematics related beliefs in grades 4 to 8. They developed a scale addressing beliefs about mathematics in three subscales which were beliefs about the nature of mathematics, beliefs about the process of learning mathematics and beliefs about the use of mathematics. They investigated students' beliefs, the relationship between students' beliefs and achievement and the relationship between beliefs and grade level. Students' grades were used as the achievement indicator and students were grouped as achievers and underachievers. The results indicated that students believed that in order to be successful, questions should be solved by using teachers' methods and quickly. These beliefs might be the result of our education system which is composed of national examinations in each level. On the other hand, students believed that mathematics was useful. There was a significant difference between students' belief scores in beliefs about the process of learning mathematics and about the nature of mathematics with respect to grade level. The results indicated that 4th graders' scores on beliefs about process of learning mathematics were different from 5th, 6th, and 7th graders; and 6th graders' scores on beliefs about process of learning mathematics were different from 8th graders, which might imply that experience in school mathematics affected students' beliefs. However, 4th graders' beliefs were not different from 8th graders' beliefs. Conducting the same instrument from 4th to 8th graders might also cause these results because 4th and 5th grades might not understand the same thing from the same items that older students understand and younger children might require simpler statements and narrow scale points. Moreover, the validity evidence of the scale was another problematic aspect of the study. There was no information about the factor analysis results in the study which could have ensured the construct validity of the scale. Hence, the reason behind the inconsistency in the results might be the poor psychometric properties of the scale.

Kayaaslan (2006) investigated 4th and 5th grade students' beliefs about the nature of mathematics and problem solving. The relationship between beliefs and achievement and the effect of grade level on beliefs were also investigated in this study. Data were collected from 276 students by two Likert type scales: beliefs about the nature of mathematics scale and beliefs about teaching mathematics. Students' achievement levels were determined with respect to their grades. The results of the study indicated that there was a significant difference between students' belief scores in both scales with respect to their achievement level. Hence, students who were more successful in mathematics had higher scores on beliefs scale. These results might imply that there is a relationship between students mathematics related beliefs and their achievement. The difference between students' belief scores with respect to grade level was not significant. Hence, 4th and 5th grade students had similar mathematics-related beliefs. However, there were some problematic aspects of this study. The scales were originally developed for pre-service teachers, then adopted for high school students, and lastly the researcher adapted the same scale for 4th and 5th graders. The researcher conducted a pilot study and revised the items with respect to students' comments. However, after the pilot study, there was still no information about the factor analysis which would give evidence for the construct validity of the adopted scale. Hence, the validity of the data collection instrument was questionable and it might have affected the quality of the results.

The studies targeting 5th grade students in Turkey are very limited. However, there are other studies addressing elementary grade (6th, 7th, 8th) students. Akkaş, Uçar, Pişkin and Taşçı (2010) investigated 6th, 7th, and 8th grade students' beliefs about mathematics, mathematics teachers and mathematicians. Nineteen students were interviewed and also asked to draw a picture of the mathematician in their mind. The results of this study indicated that students perceived mathematics mainly as calculations, numbers and operations. They interpreted success in mathematics as making calculations quickly and correctly. Moreover, students believed that mathematicians were alone, asocial, quiet and angry people who always worked with numbers. Furthermore, most students indicated that the ones who are successful in mathematics are smart people. Although this study was qualitative and not generalizable in its nature, results were considerably remarkable. Students' beliefs about mathematics seemed non-availing for their mathematics learning.

Another study investigating 7th and 8th grade students' beliefs and attitudes toward problem solving and mathematics was conducted by Uğurluoğlu (2008). Mathematics attitude scale, problem solving attitude scale, mathematics and problem solving belief scale and demographic information form was implemented to 3556 students. The relationships between students' beliefs and attitudes and demographic variables such as socio economic status, grade level, gender, type of the school were investigated. The results of the study indicated that, when average income and education level of the parents increased, students' belief and attitude scores increased. Seventh grade students had more positive attitude and beliefs than 8th graders and students who attended private schools had more positive attitude and beliefs than the ones who attended public school. In the course of gender, while students attitude scores don't change with respect to gender, girls significantly get higher scores on beliefs about mathematics and problems scale and boys significantly get higher scores on beliefs about self which implies that gender differences on beliefs may be domain specific.

Yıldırım-Çayır (2008) conducted a study in order to develop a mathematics related belief scale for students according to Op't Eynde et al (2002) framework. She constructed items within three subscales as beliefs about mathematics education, beliefs about self and beliefs about social context. Data were collected from 300 conveniently selected 8^{th} grade students. The results of the study indicated that three factor model was validated. However, there were some problematic aspects of the analysis. The pilot study was conducted with 65 students which was inadequate for a scale consists of 65 items. Moreover, there was no information about exploratory factor analysis (EFA). The items were generated with respect to the framework and only confirmatory factor analysis was conducted. However, the nature of the factors may differ between cultures and countries and it should be controlled by EFA (Brown, 2006). Hence, the factor structure of the scale should be validated by different samples in order to get a valid and reliable scale.

In general, when the studies in Turkey were examined, it appears that there are limited numbers of studies about young students' beliefs. Moreover, the instruments used in quantitative studies generally have problematic psychometric properties. Some of them didn't mention confirmatory factor analysis and others indicate poor factor analysis result wich make their validity questionable. Hence, the results and relationships found in these studies might be questionable. Indeed, there is still a need to develop a valid and reliable scale which measures younger students' mathematics related beliefs.

2.6. Gender Related Issues

Several belief studies have focused on gender-related differences on students' mathematics-related beliefs and they are discussed below. While some indicates there is a gender difference on students' mathematics-related beliefs, others argue that gender difference is not significant.

Gender was found to be a significant predictor of some subdomains of the mathematics-related beliefs which were usefulness, self-confidence and understanding mathematics concept for 7th gand 8th graders (Schommer-Aikens, Duell & Hutter, 2005). Boys were found to consider mathematics as domain of excellence more than girls and they seemed more self-confident than girls in high school grades (De Corte & Op't Eynde, 2003). In their meta analysis, Hyde, Fennema and Ryne (1990) examined seventy studies with different samples and different grade levels, and they indicated that there were more gender differences on self confidence and mathematical attitudes favoring males in high school and college. Kishlenko (2009) examined 580 students' mathematics related beliefs from grade 9 to 11 and reported that boys were more self-confident about their ability and felt more secure in mathematics lessons than girls. Uğurluoğlu (2008) conducted a study with 7th and 8th graders and she indicated gender difference on some domains of mathematics-related beliefs. In her study, while girls get significantly higher scores on belief about mathematics and problems, boys get significantly higher scores on self-beliefs subdomains. These results may indicate that the gender difference on students' mathematics related beliefs may be domain specific. Brandell and Staberg (2008) examined 1300 students' mathematics perceptions who were between 15 and 17 years old. They reported that boys considered mathematics as a male domain and gender stereotyping was more common in older students.

On the other hand, there are also several studies indicating no gender difference. Ağaç (2013) investigated 527 8th grade students problem solving skills, beliefs, learned helplessness and abstract thinking in mathematics and indicated that there was no significant gender difference in all domains. Nordlander and Nordlander (2009) examined the effect of 13-19 year-old students' beliefs and attitudes on their performance on solving problems with irrelevant information and indicated that gender did not make any difference. Aksu, Demir and Sümer (2002) investigated mathematics-related beliefs of 563 primary school students within three subscales as beliefs about the nature of mathematics, beliefs about process of learning mathematics and beliefs about the use of mathematics. The results of their analysis also indicated no gender difference in all subscales. Forgasz (2001) investigated secondary school students and preservice teachers' views about whether mathematics was a gender related domain and compared the Australian and USA students. His findings showed that both secondary school students and preservice teachers perceive mathematics as a neutral domain in both USA and Australia.

When the studies in the literature were examined, it appeared that gender has been a focus of interest and results have been still inconsistent with each other. However, there is a trend that when students get older they become more open to stereotyping (Brandel & Staberg, 2008). Hence, there is a need to investigate gender difference on students' mathematics related beliefs with different samples and different grade levels.

2.7. Summary of the Research Results

The studies summarized above investigated students' mathematics-related beliefs in different perspectives. Although different research designs and measurement instruments were used in each study, in general terms, the findings imply that students' mathematics-related beliefs have an influence on students' mathematical behavior. This implies that in order to have a clear understanding of students mathematical behaviors, beliefs should be taken into consideration. It is also mentioned that beliefs of students can be modified in order to enhance learning, which actually indicates the importance of classroom experiences of the students on their beliefs. Moreover, gender is still a controversial issue and there are contradicting results in the literature. These results imply that although the gender difference on students' mathematics related beliefs becomes dissappearing, it still exists in some way. Hence, there is a need for more research on possible gender differences on students' beliefs and the reasons behind this.

In general, there are limited numbers of studies addressing young children's mathematics-related beliefs in Turkey. Moreover, the measurement instruments used in these studies have lack of validity evidences which make their results questionable. Hence, there is a need to investigate young students' beliefs with valid and reliable instruments.

CHAPTER 3

METHOD

In this chapter, the methodology of the study is explained in four main parts. First, the design of the research and sampling was stated. In the second part, the instrumentation process was explained in detail including the pilot study. Third, data collection procedure was explained. Last, data analysis procedure was documented.

3.1. Research Design

The study is composed of two phases. In the first phase, it is aimed to investigate 5^{th} grade students' mathematics related beliefs. Therefore, the first phase of the study is designed as a survey study. Survey studies aim to "describe some aspects or characteristics of a population" (Franken, Huyn & Wallen, 2012, p.393). They are used to investigate how these aspects or characteristics spread over the population (Franken, Huyn & Wallen, 2012). For this purpose, the mathematics related belief scale was developed by the researcher based on the theoretical framework by Op't Eynde, De Corte and Verschaffel (2002). In this process, in the pilot study, exploratory factor analysis (EFA) was conducted in order to determine the subscales and validity of the scale. Factor analysis aims to identify both the number and the nature of the hidden factors that explain the variance on a group of observed measure. A factor is a variable that is not directly observable and has an effect on observed measures. These observed measures are correlated by each other as they are under the effect of the same factor (Brown, 2006). Indeed, factor analysis is a way of data reduction in order to make data easy to handle. The processes of development of the scale and pilot study are explained in detailed below.

In the main study, the scale developed and revised after the pilot study, was implemented to the participants and descriptive statistics including mean, standard deviation and frequencies were computed. Moreover, confirmatory factor analysis was conducted in order to test the construct validity of the scale. Confirmatory factor analysis (CFA) tests the relationship between factors and observed measures. In order to conduct CFA, there is a need to have a prior knowledge about the factors and the observed measures that are related to these factors (Brown, 2006). Indeed, the model constructed with the EFA was tested with CFA.

In the second phase, it is aimed to investigate possible gender related differences in 5^{th} grade students' mathematic related beliefs. Therefore, the second phase of the study is designed as a causal-comparative study. Causal-comparative studies aim to investigate how individuals' existing characteristics affect some other variables (Franken, Huyn & Wallen, 2012). For this purpose, multivariate analysis of variance and independent-samples t-test analysis was conducted.

3.1.1. Population and Sampling

The target population of the study is all 5th grade students in Turkey. As the target population is considerably wide, it is difficult to reach all students. Therefore, the accessible population is defined as the 5th grade students in Sivas in Turkey. Students were accessed through cluster random sampling of the schools. There were 72 schools in Sivas listed in the Ministry of National Education (MONE) website. From this list, 14 schools were chosen randomly by the researcher and data were collected from these schools.

3.2.Instrumentation

In this part, the development process of data collection instrument was explained. The procedures in the construction of the belief scale were addressed in detail.

3.2.1. Data Collection Instrument

Mathematics-Related Belief Scale (MRBS) was used as the data collection tool in the present study. The existing literature was considered in the construction of the instrument. MRBS consisted of two main parts as (1) demographic information and (2) mathematics related belief scale. In the demographic part, students' age and gender were asked. Age was asked to understand the student profile and gender was asked in order to help researcher to analyze the possible differences in students' beliefs with respect to gender.

In the mathematics related belief scale part, students were asked to point out their level of agreement on each belief statement. MRBS consisted of 25 items in the form of 3 point Likert type scale and an open-ended question which was not in the scope of this study. Students' ages were taken into consideration when deciding the number of the Likert scale. Kayaaslan (2006) indicated that 4^{th} and 5^{th} grade students have difficulty in understanding partially agree or partially disagree statements. Hence, 3-point scale was preferred. Scale items were scored as Disagree (1), Neutral (2), and Agree (3). The maximum score can be taken from the scale is 75 and minimum score is 25. The development process of the scale is explained in detail below.

3.2.2. Development of MRBS

The development process of the scale consists of three main steps. First of all, related literature was reviewed in detail and items were written. Second, experts' opinions were gathered and items were revised. Last, pilot study was conducted.

3.2.2.1. Survey of mathematics related belief scales in literature

The literature review about the scale construction process was carried out in two phases. In the first phase of the scale construction process, the mathematics-related beliefs frameworks in the literature were examined in detail. After the examination of the available literature, the framework suggested by Op't Eynde, De Corte and Verschaffel (2002) was considered as the basis is the current study. The reason behind this preference is that this framework suggests the most contemporary belief structure in the literature. Moreover, the framework was used in studies with different samples from different countries which provide some evidence for its validity (Andrews, Diego-Mantecon, Op't Eynde & Sayers, 2007; Diego-Mantecon, Andrews & Op't Eynde, 2007; Op't Eynde & De Corte, 2002; Yıldırım-Çayır, 2003). The framework consists of three domains as beliefs about mathematic education, beliefs about self and beliefs about social context. Beliefs about mathematics education consists of three subscales as beliefs about mathematics as a subject, beliefs about mathematical learning and problem solving and beliefs about mathematics teaching in general. Beliefs about self consist of four subdomains as self-efficacy beliefs, control beliefs, task value beliefs, and goal orientation beliefs. Beliefs about social context consist of two subdomains as beliefs about social norms in their own class, and beliefs about socio-mathematical norms in their own class (Op't Eynde et al, 2002). The related aspects of the framework were examined in the study. In general, these factors were studied individually in many studies in the literature.

In the second phase, an extensive review was made specifically about determined subscales. In each subscale, the scales about students' mathematics-related beliefs constructed in the literature were examined in order to understand what kinds of items explained the construct. These scales have both common and different aspects. In the process of item construction, both common and different perceptions were taken into consideration in order to get a more comprehensive instrument. After these studies, the first version of the instrument was developed. The first version of the scale consisted of 68 items. Items are given with respect to the factors in Appendix A.

3.2.2.2. Experts' opinion

In the first phase, the first version of the scale was shared by two researchers working on beliefs in mathematics education. They were asked to examine the items with respect to the content, comprehensibility and coherence with the factors. They indicated that factors are coherent with items and they suggested using 'I' language instead of the general sentences. After they reviewed and suggested changes in the items, revised items were shared by two specialists in the field of educational measurement. They were asked to examine the items with respect to their properness of the scale in terms of measurement principles. They eliminated the items which addressed the same meaning in order to make the scale more manageable for 5th graders. Then, two middle school mathematics teachers reviewed the items for whether the items were clear and understandable for students as they have more interaction with the students. Teachers suggested certain changes about wording of the items and some of the items were revised. After the expert opinions 35 items remained in the scale.

3.2.2.3. Students' Interviews

After the expert revisions, five 5th grade students from a public school were interviewed about clarity of the statements. Students were asked about whether they had any difficulty in understanding the statements, word or phrase in the scale. They indicated that they had struggle in three items. In the item "our teachers guide us when we are learning," students interpreted guiding as teaching and they could not realize the difference between them. Indeed, they perceived all activities that their teacher did as guiding. Hence, this item was deleted. Some students had problems in the item about relationship construction between old and new knowledge. When students were asked what it means, the ones who were seemed to be able to build the relationship were able to explaine, but the others couldn't understand the item and preferred undecided. Hence, in order to make the item clearer, it was revised as 'I need to remember the things I learned before when I am learning new things.' Last, some students didn't understand the item about being capable in classroom discussions and this item also was revised. After the student interviews, items were reviewed once more and the fourth version of the scale was constructed. The pilot version which was the pilot version of the scale consists of 34 items is (see, Appendix B). Moreover, in order to get a prior knowledge about the time students needed to complete the scale, how much time students spent in answering questions was observed. Thirty minutes seemed adequate for students to complete the whole scale.

3.2.2.4. Pilot Study

Pilot study is an important step in the construction process of a scale. It ensures the construct validity and reliability of the scale. Construct is a characteristic that is not directly observable but it is assumed that people behave differently with respect to having that characteristic or not (Best & Kahn, 2006). Construct validity of a scale refers to the degree in which the items of the scale "can be account for by the explanatory constructs of a sound theory" (Best & Kahn, 2006, p.296). Therefore, it is very important to ensure whether the items of the scale measure students' beliefs or not.

Data were collected from two public middle schools in Ankara. The sampling procedure in pilot study was convenient. There are different suggestions about the sample size for getting proper factor analysis results in the literature. Tabachnick and Fidell (2007) argue that sample size should be 10 times of the item number or at least 300 for proper factor analysis. On the other hand, Gorsuch (1983) indicates that it should be 5 times of the number of items in the scale (as cited in MacCallum & Widaman, 1999). Although there are many other suggestions, it is indicated that larger the sample sizes produce more proper results. In the pilot study, all suggestions are taken into consideration and data were collected from 390 students for the factor analysis.

Data in the pilot study were collected by the researcher. Before distributing the instrument, the researcher reminded students that there was no correct answer and their thoughts were important for the research. Moreover, students were also informed that no information would be shared with their teachers, their answers would not affect their grades, and there was no need for writing their names.

3.2.2.4.1. Data Analysis of Pilot Study

The pilot version of the scale, which consisted of 34 items, was administrated to 390 students from two schools in Ankara. Among the participants, 182 students were females and 201 were males, and 7 students didn't mention their genders.

Principle Component Analysis (PCA) was conducted in order to determine the subscales and the validity of the scale.

Before conducting PCA, negatively worded items (items 1, 9, 16, 18, 20, 21, 26, 28, 29) were reversed. Before conducting the analysis, it should be ensured that data are appropriate for factor analysis. First of all, sample size should be adequate for factor analysis. This was ensured by implementing the scale to 390 students. Second, data should be factorable which means that some correlations between the items should exist (Tabachnick & Fidell, 2007). For this assumption PCA provides two analyses as Bartlett Sphericity Test and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy. In order to be appropriate for the factor analysis, Bartlett Sphericity Test should be significant, which means that p value should be smaller than 0.05 and KMO value should be at least 0.6 (Tabachnick & Fidell, 2007). The analysis indicated that data set was appropriate for factor analysis ($F=0.797$, $p<0.05$).

In the selection process of the items which fit the factor structure, item communalities were checked in the first phase and items whose communalities were smaller than 0.2 were deleted as small communalities indicated that the variable was not related to the other variables in the data set (Tabachnick & Fidell, 2007). For this reason 11 items (items 1, 2, 5, 7, 9, 10, 14, 15, 16, 18 and 27) were removed from the analysis.

For proper factor solution items should have factor loadings 0.3 or above for and they should load one factor prominently which means that the difference between factor loadings should be greater than 0.1 (Tabachnick & Fidell, 2007). When deciding the number of factors, the eigenvalues should be taken into consideration first and the ones below one should not be taken as factors. However, only eigenvalues might not be sufficient for the final decision. Another estimate can be made by interpreting the scree plot, but there is still need for more analysis for a proper factor solution (Tabachnick & Fidell, 2007). Based on these criteria, the factor analysis was conducted.

The results of the first analysis showed that there were 11 factors whose eigenvalues were more than 1. However, the scree plot seemed very complicated to reduce the factors and factor loadings were not appropriate. In order to get the best factor solution, the Promax rotation method, which is a kind of oblique rotation, was used because according to Tabachnick and Fidell (2007), oblique rotation gives more reasonable results in identifying the factor which correlates than the one doesn’t. After this reduction, the analysis was conducted once more and it was decided that the most appropriate factor solution was three factor solution. The scree plot which is shown in Figure 3.1 also supported three factor solution. According to results of this analysis, the items which loaded to an unrelated factor (items 11, 25), whose factor loadings were smaller than 0.3 (item 31), and which loads almost equal to more than one factor (items 17, 19) were removed from the scale.

After deciding the factor structure, the items important for the research were added one by one and 5 items (items 2, 10, 15, 16, and 19) were included as they didn’t conflict with the factor structure. Moreover, two items (item 18, 25) whose factor loadings were smaller than 0.3 were also added to the scale as they were important. However, the wordings which might cause conflict for students were determined and their wordings were changed for the actual implementation.

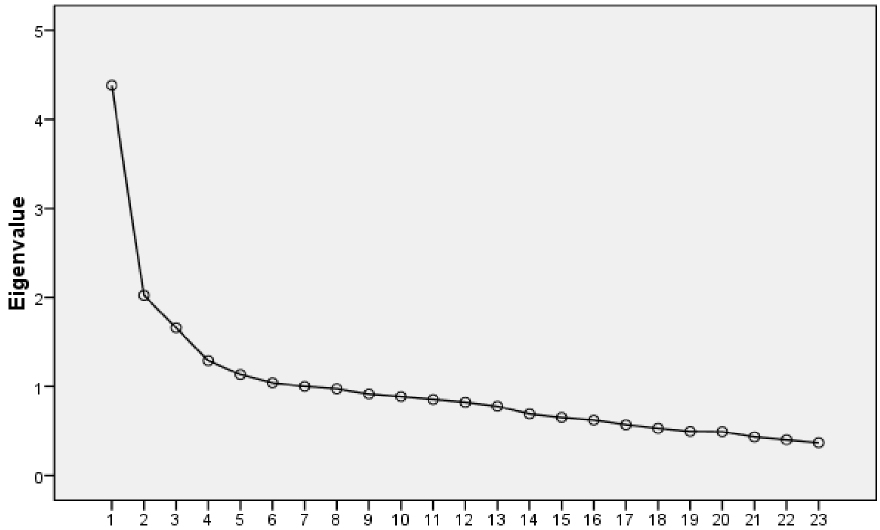

Figure 3.1 Scree plots of eigenvalues of trial version of the scale.

According to the results of the analysis, 6 items (items 28, 29, 30, 32, 33, 34) loaded under the first component, 7 items (items 16, 20, 21, 22, 23, 24, 26) loaded under the second component and 10 items (items 2, 3, 4, 6, 8, 10, 12, 13, 15, 19) loaded under the third component. This structure explained 35% of the total variance in dependent variable. Item 18 was placed under the third component and item 25 was placed under the second component. Component 1 was named as "views about teacher role", component 2 was named "self-efficacy beliefs" and component 3 was named "beliefs about mathematics and learning mathematics." The factor loadings of the items are given in Table 3.1.

Table 3.1 Rotated factor analysis results for 23 items in the pilot study

	Teacher role	**Self-efficacy**	**Mathematics and learning**
Item2	.126	.152	**.218**
Item3	-.139	.096	**.596**
Item4	-.139	.144	**.598**
Item6	.155	-.028	**.504**
Item8	-.150	.088	**.509**
Item10	-.075	-.111	**.298**
Item12	.150	-.183	**.657**
Item13	.218	-.120	**.423**
Item15	-.126	.105	**.395**
Item16	-.106	**.484**	**-.203**
Item19	.054	-.124	**.517**
Item20	.127	**.714**	-.039
Item21	.088	**.695**	.065
Item22	.230	**.312**	.223
Item23	.085	**.677**	-.040
Item24	.084	**.529**	.099
Item26	-.172	**.717**	.041
Item28	**.527**	-.050	.194
Item29	**-.630**	.000	-.004
Item30	**.432**	.033	-.024
Item32	**.795**	.000	-.183
Item33	**.698**	-.014	-.144
Item34	**.709**	.078	-.111
Variance explained	19.62%	8.67%	7.1%

Reliability of the scale is another important feature. Cronbach's Alpha coefficient is a common reliability measure in social studies. Cronbach's Alpha coefficient takes values between 0 and 1 and in order to get a reliable scale it should be above 0.7 (Tabachnick & Fidell, 2007). In the current study, Cronbach's Alfa coefficient was computed for the reliability measure and it was calculated as 0.77 for the pilot study which indicated a satisfactory reliable measure. The Cronbach's Alpha value for components of *teacher's role* was 0.48, *self-efficacy* was 0.73, and *mathematics and mathematics learning* was 0.6. The overall reliability of the scale was high, but *teacher's role* component had lower reliability measure. The reason might be related to the number of items and the teacher's role component had 6 items. Cronbach's Alpha value is very sensitive to number of items and when the number of items is fewer than ten, it may take lower values. In this case mean inter-item correlations were suggested to use for reliability measure. The optimal values for mean inter-item correlations are between .2 and .4 (Tabachnick & Fidell, 2007). The mean inter-item correlation value for teacher role subscale was .22 which is in acceptable range for reliability.

After the analysis, a last open-ended item was added to the scale asking about students' understanding about what mathematics was and the final version of the mathematics-related belief scale was created. This last question was not included in the current study. The final version of the scale which consists of 25 items is in Appendix C.

3.2.2.4.2. Limitations of the Pilot Study

In the pilot study, sampling procedure was convenient. This was an important limitation for the study because sampling procedure affects the variance in data set. In order to minimize this affect, it was aimed to increase the sample size in the study for EFA.

3.3. Data Collection Procedure

Prior to application of the MRBS, the researcher applied the ethics committee of Middle East Technical University in order to ensure that there was no ethical issue in the application of the scale. After that, the researcher applied for permission to

Ministry of National Education (MONE) in order to conduct research on the middle schools in Sivas. The ethics approval form is given in Appendix E.

Data were collected from beginning 5th grade students in September 2014 from 14 primary schools in Sivas. Data were collected by the researcher in one class hour in each classroom considering the time for the distribution of the scale, implementation, and collecting the filled-out scales. The aim of the study and how the data would be used were explained to teachers and school administrators. Students were also informed about the aim of the study and how they should respond the items. Before distributing the scale, the researcher reminded students that there was no correct answer and their thoughts were important for the research. Moreover, students were also informed that no information would be shared with their teachers, their answers would not affect their grades, and there was no need for writing their names.

3.4. Analysis of Data

Data analysis was conducted in five parts as (1) descriptive statistics, (2) confirmatory factor analysis, (3) internal and external validity analysis of data, (4) reliability analysis, and (5) the effect of gender.

3.4.1. Descriptive Statistics

The main purpose of the study is describing 5th grade students' mathematics related beliefs. For this purpose the mean, standard deviation and frequencies of students' agreements on scale items were computed. Before this process, negatively worded items were reversed and students' scores from the scale were computed. The SPSS 16 package program was used for these analyses.

3.4.2. Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) aims to measure the relationship between observed measures and factors. In order to conduct CFA, there is a need to have a prior knowledge about the factors and the observed measures that are related to these factors (Brown, 2006). Indeed, the model constructed with the EFA was tested with CFA. CFA is conducted in order to ensure construct validity of the scale. For CFA analysis, LISREL program was used.

3.4.3. Internal and External Validity Analysis

Validity is one of the most important features of a research design. Validity is defined as “the appropriateness, meaningfulness, correctness, and usefulness of any inferences a researcher draws based on data obtained through the use of an instrument” (Franken, Huyn & Wallen, 2012). Hence, in order to get proper inferences, the data should be gathered in a valid way. There are two types of validity as internal and external validity. The analysis of the validity requires both elimination of validity treats and examination of validity evidences.

3.4.3.1. Analysis of Validity Treats

In this part, internal validity treats and external validity of the study were explained in detail.

3.4.3.2. Internal Validity

In survey studies, there are four main internal validity treats which are mortality, location, instrumentation and instrument decay (Franken, Huyn & Wallen, 2012). In causal-comparative studies there are two more validity treats as subject characteristics and data collector bias. These threats and how they were handled in the present study are explained below.

Mortality means losing some of the participants during the study. It generally occurs in studies which take time (Franken, Huyn & Wallen, 2012). In the current study, data were collected in one class hour. Hence, mortality was not a treat for this study because there was no subject loss.

Franken, Huyn and Wallen (2012) indicated that the place where the data collected may influence participants’ responses which is called as location treat. In the current study, location treat may occur because data were collected from different schools. However, the data were collected in students' regular classrooms. Hence, all students were familiar with their classrooms, it may be assumed that locations were similar and this reduces location treat.

Instrumentation is another internal validity treat. It is indicated that the way instrument administrated might influence the responses of participants (Franken, Huyn & Wallen, 2012). In order to minimize this effect, data were collected by the researcher and researcher did her best to behave in similar ways in different classrooms.

The last internal validity treat of survey studies mentioned by Franken, Huyn and Wallen, (2012) is instrument decay. It is occurs when instrument's nature is changed throughout the study. In the current study there was no change in the nature of the instrument.

In causal-comparative studies, existing groups are compared. However, these groups may or may not be equivalent with respect to some other variables which are influential for the study (Franken, Huyn & Wallen, 2012). In this case, subject characteristics treat occurs. Three steps were suggested in the handling process of this treat. First, what other variables are known or logically expected to influence the study should be examined, then the distribution of these variables between groups should be determined, and finally how these variables affect the results should be investigated (Franken, Huyn & Wallen, 2012). In belief studies, the effect of age, socioeconomic status and academic achievement are generally investigated. Ages of the students were similar as the study conducted with 5^{th} grade students. It is assumed that the socioeconomic status and academic achievement variables were similar because of the random sampling of public schools.

The last treat is data collector bias which occurs when the data collector behaves in a different way between groups (Franken, Huyn & Wallen, 2012). However, this is not the case in the current study because data were collected from males and females in the same classes at the same time.

3.4.3.3. External Validity

External validity is defined as “the extent to which the results of a study can be generalized” (Franken, Huyn & Wallen, 2012, p.103). The target population of the current study is all 5th grade students in Turkey. As the target population is quite large, the accessible population is defined as all 5th grade students in Sivas. There are 72 secondary schools in Sivas at the time of the study. Cluster random sampling procedure was used as a sampling procedure. Random sampling is a way of ensuring the generalizability of the results (Franken, Huyn & Wallen, 2012). Hence, the results of the study can be generalized the whole 5th grade students in Sivas. Moreover, as the curriculum is the same all over the country, the results also may give an idea about students’ beliefs in similar cities.

3.4.3.4. Analysis of Validity Evidences

Validity is one of the most important features that an instrument should have. There are three main evidences of validity: content-related, construct-related and criterion-related validity. For the current study, content- and construct-related validity evidences were checked.

Content-related evidence of validity is about appropriateness, comprehensiveness, logicalness and adequateness of the content and the format for the instrument (Franken, Huyn & Wallen, 2012). In order to ensure content related validity, two researchers working on mathematics related beliefs examined the scale items for whether they were measuring students’ beliefs or not. The experts agreed on that the content was appropriate and adequate for the targeted purposes.

Construct-related validity of the scale is determined by EFA and CFA analysis. In the pilot study, EFA analysis results indicated that scale consisted of three factors which explained 35% of the total variance. In the main study, CFA analysis was conducted and results indicated that the factors solution model fit the data and model was significant. Therefore, it can be inferred from these results that scale is measuring the construct. The more detailed information about CFA is given in part 4.1.

3.4.4. Reliability Analysis

Reliability indicates the level of consistency of the results taken from the instrument (Best & Khan, 2006). There are different reliability measures. In general Cronbach's Alpha coefficient was used as reliability measure. It is indicated that Cronbach alpha coefficient should be at least 0.7 in order to get reliable scale. However, when the number of items is less than 10, Cronbach alpha coefficient may take very small values. In order to overcome this issue, it is suggested that the mean inter-item correlations should be reported with small number of items. The optimal values for mean inter-item correlations are between .2 and .4 (Tabachnick & Fidell, 2007). In the current study, both reliability measures were used with respect to the number of items in each subscale.

3.4.5. Gender

For the third research question, gender related differences in students' mathematics-related beliefs were examined. For this purpose, multivariate analysis of variance (MANOVA) and independent-samples t-test was conducted. In the analysis SPSS 21 package program was used.

CHAPTER 4

RESULTS

Results of the data analysis were reported in this section. Results were given in five main parts. First, the descriptive statistics were given. Second, reliability of the scale was provided. Next, results of CFA analysis, which indicated the validity of the model constructed in the pilot study, were given. Then, results regarding students' mathematics-related beliefs were documented. Last, MANOVA and independent-samples t-test results, which address gender differences, were reported.

4.1. Descriptive Statistics

Data were collected form 14 schools in Sivas city center. The descriptive statistics with respect to school and gender is given in Table 4.1.

A total of 750 students participated in the study. However, 10 students answered all items as agreed. Hence, these students were removed from the analysis and all analysis was conducted by data gathered from 740 students. Among the participants, 359 participants were females, 356 participants were males and 25 participants didn't mention their genders.

A final review of the scale by researchers working on self-efficacy resulted in removal of 3 items from the *self-efficacy* subscale because these three items did not directly represent the self-efficacy construct. All analyses were conducted after removing these three items.

Table 4.1 Descriptive statistics with respect to school and gender.

	Gender			
School	**Girl**	**Boy**	**Missing**	**Total**
School 1	31	18	2	51
School 2	27	25	3	55
School 3	25	18	3	46
School 4	34	42	3	79
School 5	42	27	0	69
School 6	27	32	2	61
School 7	23	29	5	57
School 8	19	26	1	46
School 9	18	30	0	48
School 10	16	20	2	38
School 11	26	35	3	64
School 12	34	32	1	67
School 13	20	15	0	35
School 14	17	7	0	24
TOTAL	359	356	25	740

4.2.Reliability Analysis

In the current study, the scale consisted of 3 subscales. Hence, the reliability coefficient should be computed with respect to each subscale. In *mathematics and mathematics learning* subscale, there were 11 items and the Cronbach's Alpha value was found as 0.7, which is an acceptable value. In *self-efficacy* subscale, there were 5 items and in *teacher role* subscale there were 6 items. Hence, the mean inter-item correlations were computed for these scales. The mean inter-item correlation value for *self-efficacy* subscale was 0.27 and for *teacher role* subscale was 0.2, which are in the acceptable range for reliable scale. Hence, the scale can be considered as reliable.

4.3. Confirmatory Factor Analysis

In order to ensure the validity of the scale and appropriateness of the model constructed in the pilot study, confirmatory factor analysis (CFA) was conducted. Data were analyzed by the LISREL program.

4.3.1. Preliminary Analysis

Before conducting any analysis, the data should be prepared for the analysis and assumptions of that analysis should be checked. Dealing with missing data is an important first step before conducting any analysis. There may be different types of missing data with different reasons. Data may be missing at random or some of the participants may prefer not to answer specific questions. In each case, the solution approaches are different and non-random missing data should be taken into consideration (Brown, 2006). However, in the current study there were no missing data and this issue was not taken into consideration.

Normality is an important assumption in CFA because non-normal distributions cause inflated chi square values and underestimation of fit indexes (Brown, 2006). In order to ensure normality, one way is detecting outliers and removing them from the analysis. In multivariate statistics, one of the currently used methods to detect outliers is Mahalanobis distance (Tabachnick & Fidell, 2007). Mahalanobis distance is available in SPSS program. As the current scale consisted of 3 subscales, Mahalanobis distances were computed with respect to these subscale scores for each participant. Tabachnick and Fidell (2007) propose the chi square value with $p<0.001$ and degrees of freedom as number of variables and the distances greater than this value indicates outliers. For the current study, the Mahalanobis distances greater than 16.68 indicated outliers. The Mahalanobis distance for each participant was computed and resulted in 13 outliers. These participants were removed from the data set to get more proper factor solution model.

After outliers were removed, normality tests were computed for each subscale. The skewness and kurtosis values for each subscale are given in Table 4.2 and the histograms and normal Q-Q plots are given in Appendix D.

After cleaning the outliers, the skewness and kurtosis values were in acceptable range. Hence, data with 727 participants were appropriate for CFA.

Table 4.2 Normality values for each subscale.

Subscales	Skewness	Kurtosis
Mathematics and Learning mathematics	-1.037	1.688
Self-efficacy	-0.828	0.011
Teacher role	-0.953	1.331

4.3.2. Model Evaluation

The model specified in the current study is given in Figure 4.1. According to Brown and Moore (2012), model evaluation should be based on two aspects as general goodness of fit statistics and significance of the models' parameter estimates.

4.3.2.1. Goodness of Fit Indices

General goodness of fit indices give information about the level of correspondence between parameters produced in CFA solution and relationships observed in sample data (Brown, 2006). The classic index for goodness of fit statistics is chi square. However, as chi square index is too sensitive to the sample size, another index χ^2/ df is commonly used instead. Standardized root mean square residuals (SRMR) and root mean square error of approximation (RMSEA) are also widely used and accepted goodness of fit indexes (Brown & Moore, 2012). Goodness of indices of the model and acceptable values are given in Table 4.3. The acceptable values for indices are taken from Tabachnick and Fidel (2007) and Hu and Bentler (1999).

Table 4.3 Goodness of fit indices

Fit Indices	Good fit	Acceptable fit	Model value
χ^2 / df	$0 \leq \chi^2$ / df ≤ 2	$2 < \chi^2$ / df < 8	2.64
SRMR	$0 \leq$SRMR $\leq .05$	$.05 <$ SRMR $< .10$	.052
RMSEA	$0 \leq$RMSEA$\leq .05$	$.05 <$ RMSEA $< .08$	.048
GFI	$.95 \leq$GFI ≤ 1	$.90 <$ GFI $< .95$	.94
AGFI	$.90 \leq$AGFI ≤ 1	$.85 <$ AGFI $< .90$	.92

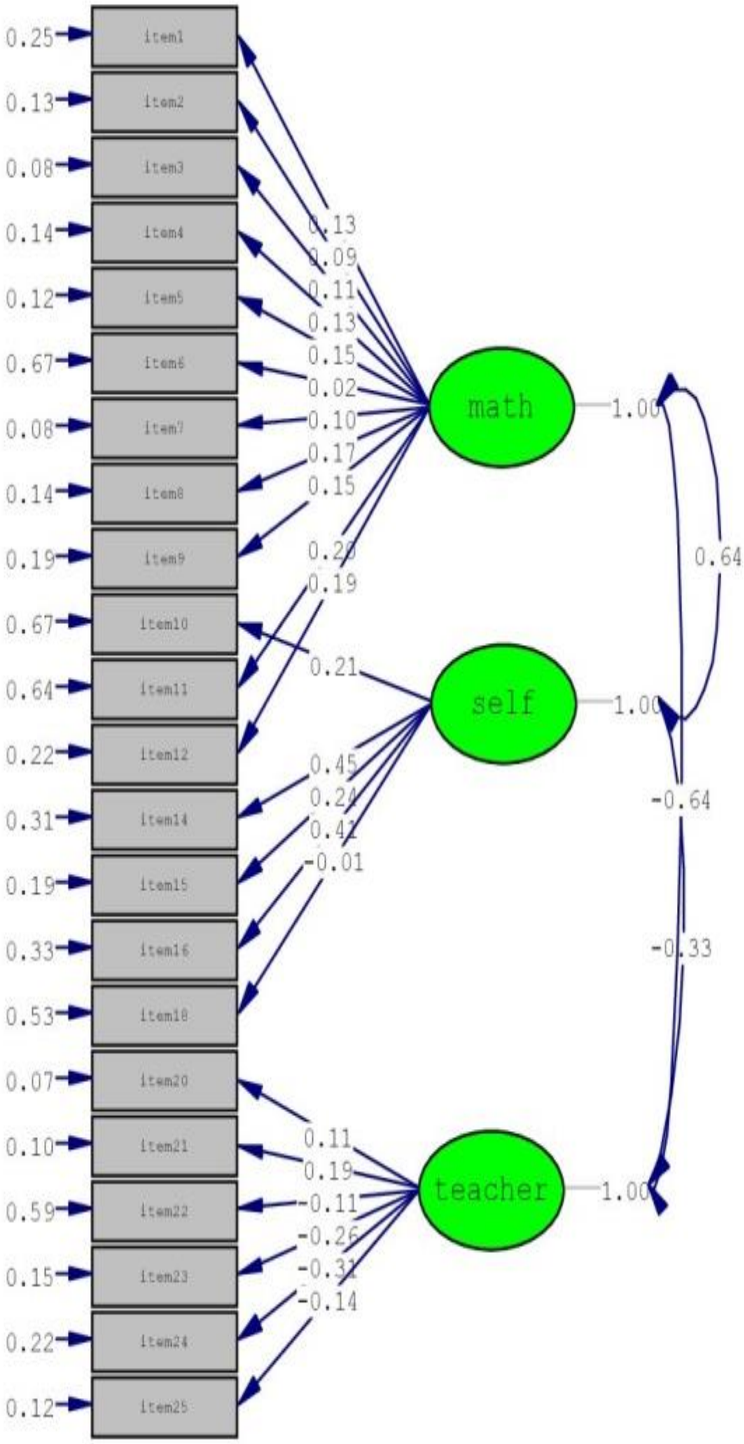

Figure 4. 1 CFA Model with Estimates

According to RMSEA, GFI and AGFI values model indicated good fit. χ^2 / df and SRMR indices indicated acceptable fit. Hence, the model was considered as appropriate. When the factor loadings were examined, the factor loadings of item 6 and item 18 are very low. These items seem problematic and their significance will be examined in section 4.3.2.3.

4.3.2.2. Significance of Model Parameters

The last step of the model evaluation is interpreting the significance of model parameters because it can be interpreted for only good fitting factor solutions. It gives information about significance of the relationship between factors and items, and magnitude and direction of the relationship. Estimates which are not statistically significant imply that either the parameter is unnecessary or it is not a good measure for specified factor (Brown & Moore, 2012). In Figure 4.2, t-values for significance of the relationship are given with respect to .05 alpha value. When the figure is examined, item 6 and item 18 indicated non-significant relationship. Therefore, these items were removed from the scale. Indeed, factor loadings of item 18 was less than 0.30 in the pilot analysis but that item was important for the research, and it was revised and included the scale. However, it is proved in the analysis that this item was not significant.

After removing two items from the model, the new model with 23 items was evaluated. The fit indices of model 2 were summarized in Table 4.4.

Table 4.4 Goodness of fit indices for model 2

Fit Indices	Good fit	Acceptable fit	Model value
χ^2 / df	$0 \le \chi^2 / df \le 2$	$2 < \chi^2 / df < 8$	2.9
SRMR	0 ≤SRMR ≤ .05	.05 < SRMR < .10	.052
RMSEA	0 ≤RMSEA ≤ .05	.05 < RMSEA < .08	.051
GFI	.95 ≤GFI ≤ 1	.90 < GFI < .95	.93
AGFI	.90 ≤AGFI ≤ 1	.85 < AGFI < .90	.91

The new fit indices (χ^2 / df=2.9, SRMR=0.052, RMSEA=0.051, GFI=0.93) indicated acceptable fit and AGFI=0.91 indicated good fit. Hence, 23 items model was appropriate. Moreover, the modification indices were not changed and new estimates didn't produce any items with non-significant relationship. Therefore, the construct validity of the scale was ensured.

4.4.Students' Mathematics-Related Beliefs

In order to determine students' mathematics related beliefs, descriptive statistics was computed. Students' mathematics-related beliefs were examined both item by item and with respect to subscales. The mean and standard deviation of each item are given in Table 4. In the table, items were given with respect to their subscale as MML indicates *mathematics and mathematics learning*, SE indicates *self-efficacy*, and TR indicates *teacher role.* In *mathematics and mathematics learning* subscale, students believed that mathematics was useful in daily life (M=2.87) and it made their lives easier (M=2.91). Most of the students agreed that understanding was important while learning mathematics (M=2.92) and they tended to believe that studying could increase their ability in mathematics (M=2.87). Moreover, remarkable number of students agreed that mathematics concepts were related to each other (M=2.72), they needed to remember previous knowledge while learning mathematics (M=2.79), and developing different solution methods was important in problem solving (M=2.75). On the other hand, students were not sure about whether making mistakes would help their learning or not (M=2.15).

In the case of *self-efficacy* beliefs, more than half of the students indicated that mathematics was not difficult for them (M=2.65) and they had ability in mathematics (M=2.51). However, they were not much sure about the only correct way of solving problems was their teachers' method or not (M=2.30).

When the *teacher role* views were examined, although they believed their teachers were friendly (M=2.80), listened to them carefully (M=2.88), and mathematics courses were fun (M=2.71), they had nonavailing beliefs that teacher was the one who transferred the knowledge (M=1.07) and showed them how to solve problems step by step (M=1.11). Moreover, students also mentioned that their teachers did not enable them to discuss mathematics problems with their classmates (M=1.93).

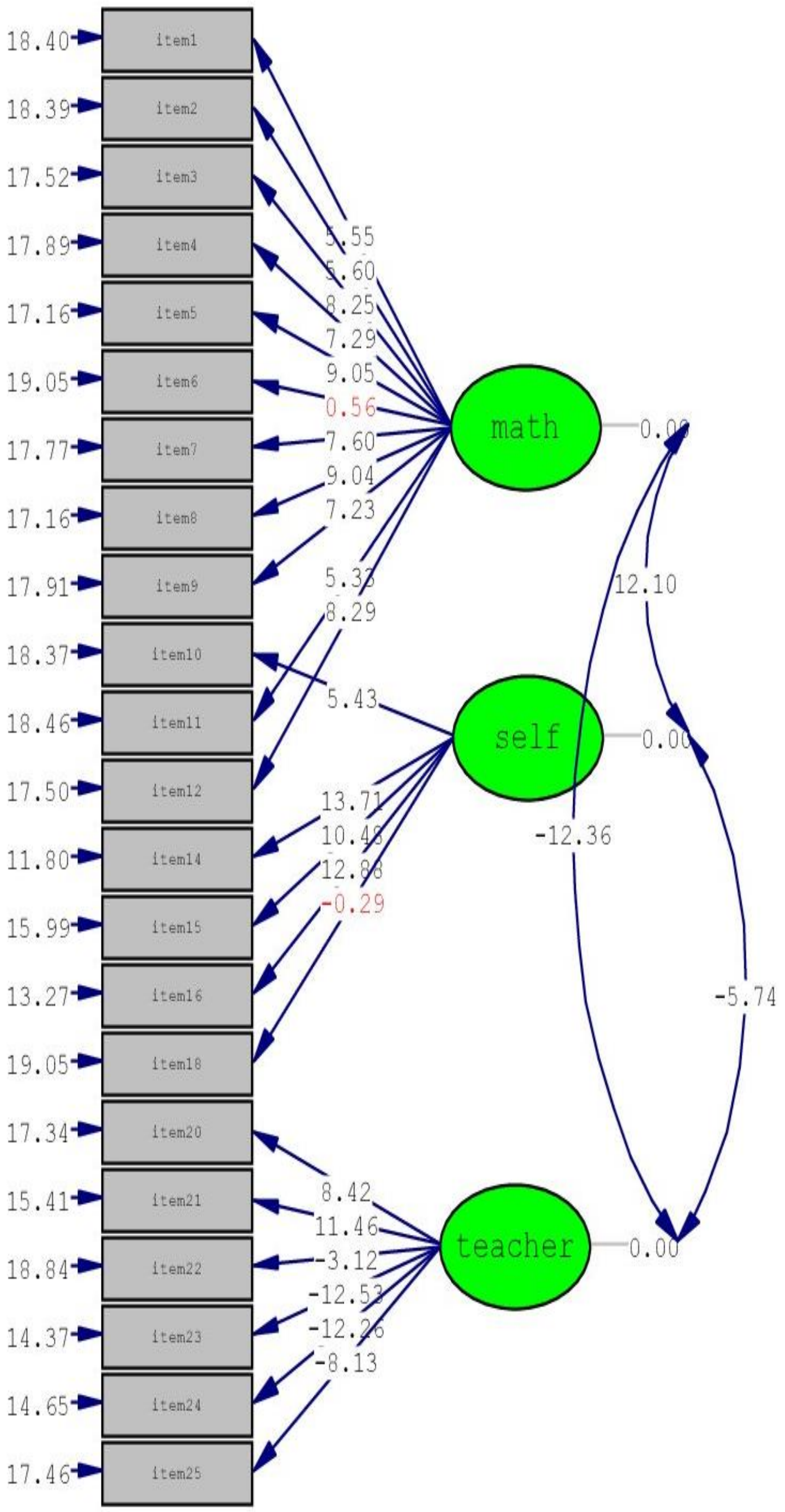

Figure 4. 2. T- values for model 1

Table 4.5 Descriptive statistics for each item

Items	Mean	S.D
MML1: Mathematics concepts are related to each other.	2.72	.541
MML2: We use school mathematics concepts in our daily life.	2.87	.398
MML3: Knowing mathematics makes our life easier.	2.91	.338
MML4: Mathematics homework helps me understand mathematics better.	2.86	.423
MML5: Studying mathematics increases our mathematics ability.	2.87	.417
MML6: Making mistakes in mathematics helps in learning.	2.15	.821
MML7: Understanding is important while learning mathematics.	2.92	.335
MML8: There may be more than one solution path for mathematics problems.	2.83	.434
MML9: While learning mathematics, I need to remember my previous knowledge.	2.79	.494
SE10 When we don't understand a mathematics concept for the first time, we cannot understand it later.*	2.26	.844
MML11 Mathematics problems can be solved correctly only by our teachers' solution methods.*	2.30	.829
MML12: It is important to develop different solutions while solving a mathematics problem.	2.75	.535
SE 13: Mathematics is a difficult subject for me.*	2.65	.647
SE 14: I think I don't have ability in mathematics.*	2.51	.724
SE 15: I can make mathematics homework easily.	2.75	.517
SE 16: While studying mathematics, I feel that my self-confidence is decreasing.*	2.58	.710
SE 17: Mathematics is easy for me to understand.	2.69	.568
SE 18: When I studied enough, I can understand the mathematics lesson	2.54	.732
SE 19: I panic when I come across a different mathematics problem.*	2.33	.795
TR 20: Teacher is the one who transfers knowledge to us.*	1.07	.331
TR 21: Teacher shows us how to solve mathematics problems step by step.*	1.11	.404
TR 22: Our teacher enables us to discuss mathematics problems with our classmates.	1.93	.776
Item	2.80	.498
TR 23: Our teacher behaves us friendly.		
TR 24: Our teacher teaches mathematics lessons in a fun way.	2.71	.585
TR 25: When we ask questions, our teacher listens to us carefully.	2.88	.401

* Indicates negative items

-All items were translated by the researchers.

Students' belief scores with respect to each subscale were computed. The descriptive statistics related to each subscale is given in Table 4.2. Beliefs about *mathematics and mathematics learning* subscale consisted of 11 items, where maximum score that could be taken from this subscale was 33 and minimum score was 11. Beliefs about *self-efficacy* subscale consisted of 5 items, with maximum score of 24 and minimum score of 8. Views about *teacher roles* subscale consisted of 6 items where maximum score that can be taken from this subscale was 18 and minimum score was 6.

Table 4.6 Descriptive statistics with respect to subscales.

Factors	**Min.**	**Max.**	**Mean**	**S.D.**
Mathematics and Mathematics Learning (MML)	14	33	29.98	2.60
Self-efficacy (SE)	9	24	20.30	3.01
Teacher Role (TR)	6	17	12.51	1.38

When the Table 4.5 was examined, students seemed to have rather availing beliefs in *mathematics and mathematics learning* (m=29.98) and *self-efficacy* (m=20.30) subscales. On the other hand, in *teacher's role* (m=12.51) subscale, students seemed neutral.

4.5.Gender

The gender related differences among students' mathematics-related beliefs were also investigated in this study through multivariate analysis of variance (MANOVA). The mean scores of *mathematics and mathematics learning, self-efficacy* and *teacher role* were examined separately. The hypothesis tested for gender effect is given below.

> H_0: There is no gender difference in students' mathematics and mathematics learning beliefs.
>
> H_1: Students' mathematics and mathematics learning beliefs differ with respect to their genders.

H_0: There is no gender difference in students' self-efficacy beliefs.

H_1: Students' self-efficacy beliefs differ with respect to their genders.

H_0: There is no gender difference in students' views about teacher role.

H_1: Students' teacher role views differ with respect to their genders.

Prior to conduct MANOVA, the assumptions of the analysis were checked.

4.5.1. Assumptions of MANOVA

MANOVA has five main assumptions which are sample size, normality, homogeneity of regressions, multicollinearity and singularity and homogenity of varainces and covariance matrices (Tabachnick & Fidell, 2007).

The outlier analysis and normality evidences of the data were mentioned in section 4.3.1. For the sample size, MANOVA analysis requires that the number of cases in each cell should be more than the number of dependent variables. In the current study, the sample size was large and there were much more cases than it. Hence, there were no problems related to the sample size. The homogeneity of regression assumption is an issue only in the cases that the order of dependent variables areissue of interest (Tabachnick & Fidell, 2007). In the current study, there was no need to consider this assumption.

Multicollinearity and singularity is the next assumption. MANOVA analysis gives the most appropriate results when the relationships between dependent variables are moderate. When there are high correlations between the variables then this implies the existence of multicollinearity and in this case it is better to removing one of the dependent variables or combining these variables into one. On the other hand, if the correlations are too low, then it is better to analyse these varables into separate univariate analysis. The easiest way to examine this assumption is computing the correlations between dependent variables (Tabachnick & Fidell, 2007). The Pearson correlations between dependent variables are given in Table 4.7.

When the table was examined, it appeared that *teacher role* views had very low correlations with the other two scales, while *self-efficacy* and *mathematics and mathematics learning* correlated moderately. This result implied that it was better to analyse *teacher role* views subscale with a single independent-samples t test while MANOVA was appropriate for examining gender differences on self-efficacy and mathematics and mathematics learning.

Table 4.7 Correlations between dependent variables

	MML	SE	TR
MML	1	.325	.121
SE		1	-.003
TR			1

The last assumption of the MANOVA is homogeneity of the variance and covariance matireces. This assumption requires that the variance and covariance matireces of each cell are taken from the same population' the variance and covariance matireces. For this assumption Box's M test was examined for dependent variables of *self-efficacy* and *mathematics and mathematics learning* scores. It is indicated that is signifigance value of this test is larger than .001 than the assumption is ensured (Tabachnick & Fidell, 2007). The results of the Box's M indicated that the homogeneity of variance and covariance assumption was ensured (F=1.719, p=.161)

4.5.2. Assumptions of Independent-Samples t-Test

T-test has five main assumptions which are level of measurement, random sampling, independence of observation, normality, and homogeneity of variances (Tabachnick & Fidell, 2007).

Level of measurement indicates that the independent variable should be at least interval level (Tabachnick & Fidell, 2007). As the scale is Likert type, it is assumed that it measures at interval level (Norman, 2010). Random sampling is required for the analysis in theory. However, it is generally violated in the real implementations. In the current study, sampling procedure was cluster random sampling, therefore there was no problem about randomization.

Another assumption is independence of observation which means that the responses of each participant should not be affected by others' responses. In the current study, data were collected from different schools. Hence, the responses of individuals from different schools didn't affect each other. The scale was implemented by the researcher in each school. Students were informed that their own responses were important and there was no right or wrong answer. Students were warned about completing the scale themselves and researcher also didn't let students share their responses during the implementation process.

Normality is another basic assumption of t-test. Section 4.3.1 explains the normality of the data.

The last assumption of the t-test is homogeneity of the variances. This assumption requires that the different samples taken from the same population have the same variances (Tabachnick & Fidell, 2007). For this assumption Levene's equality of variance statistics was examined. Levene's test of equality tests the null hypothesis that the variances are not equal. Hence, the non-significant result of the Levene's test indicates equal variances. The results of the Levene's test are given in Table 4.8

Table 4.8 Levene's test of equality of variances

	F	df_1	Sig
Teacher role	3.175	713	0.075

When the results of Levene Test are examined teacher role subscale ensures the equality of variance assumption.

4.5.3. Descriptive Statistics

The descriptive statistics with respect to gender and subscales are given in terms of mean and standard deviation. Results are given at Table 4.9. When the table was examined, it seemed that the mean scores of male and female students were close in *mathematics and mathematics learning* and *self-efficacy* subscales and were equal in *teacher role* subscale.

Table 4.9 Descriptive statistics with respect to gender versus subscales

Subscale	Gender	Mean	SD
Mathematics and Mathematics Learning	Female	30.35	2.25
	Male	29.70	2.78
Self-efficacy	Female	20.37	2.95
	Male	20.32	3.04
Teacher role	Female	12.50	1.30
	Male	12.50	1.44

4.5.4. Inferential Statistics

In order to determine the gender related differences on *mathematics and mathematics learning* and *self-efficacy* subscale scores, MANOVA was conducted. The results of the multivariate analysis are given in the Table 4.10.

Table 4.10 Multivariate analysis results

Effect		Value	Hyp. *df*	Error *df*	Sig.
Intercept	Pillai’s Trace	.995	2	704	000
	Wilks’ Lambda	.005	2	704	000
	Hottelings’ Trace	210.21	2	704	000
	Roy’s Largest Root	210.21	2	704	000

The results of the all analysis indicated that there was a gender difference in students’ belief scores ($p<.0005$). In order to indicate in which subscale there was a significant difference, the test of between subjects effect should be examined. The test results are given in Table 4.11. The results indicated that while there were no significant differences between male and female students on *self-efficacy* subscale, female students had significantly higher scores on *mathematics and mathematics learning* subscale than male students.

Table 4.11 Test of between subjects effect

Source		**Type III Sum of Squares**	***df***	**F**	**Sig.**
Gender	MML	51.126	1	11.509	.001
	SE	2.434	1	.672	.413

In order to determine the gender related differences on students' *teacher role* views independent-samples t-test was conducted. The result of the independent-samples t-test indicated that there were no significant difference on students teacher role views score between male and female students (F=-.041, p=.97).

CHAPTER 5

DISCUSSION AND CONCLUSION

This chapter presented a brief summary of major findings and their discussions. Moreover, implications and recommendations for future research were mentioned respectively.

5.1.Summary of the Study

Research on students' mathematics related beliefs has been considered as very important because they affect teaching and learning process (Op't Eynde, De Corte, & Verschaffeffel, 2002; Philipp, 2007). Indeed, students' beliefs about the mathematics affect how much effort they will spend for the tasks, their interest about mathematics, and enjoyment with the task (Kloosterman, 2002). Many studies support this idea and indicate that there is a reciprocal relationship between mathematics learning and mathematics related beliefs (Duel, Hutter, & Schommer-Aikines, 2005; House, 2010; Jansen, 2008; Kloosterman & Cougan, 1994; Köller, 2001).

The current study aimed to investigate 5th grade students' mathematics related beliefs. For this purpose, mathematics-related belief scale was developed by the researcher in the first phase. Op't Eynde et al (2002) belief framework was used as a basis in the scale development process. Items were written according beliefs about nature of mathematics, beliefs about learning mathematics, self-efficacy beliefs and teacher role subdomains of the framework. Afterwards, the researcher developed the scale by the help of expert opinions and pilot study. The pilot study revealed that the scale consisted of 3 subscales. The final version of the scale was implemented to 750 5th grade students from 14 randomly chosen schools in Sivas city center. Data were analyzed to validate the model constructed in the pilot study. After proving the validity and reliability of the scale, students' mathematics related beliefs and the possible differences on students' beliefs based on gender were examined. The results indicated that although students have authoritarian *teacher role* views, they have availing *self-efficacy* and *mathematics and mathematics learning* beliefs in general. For the gender-related differences, independent-samples t-test was conducted. The results indicated that girls had significantly greater scores in *mathematics and mathematics learning* subscale than boys. On the other hand, in *self efficacy* and *teacher role* subscales, gender-related difference in students' scores was not significant.

5.2.Major Findings and Discussion

In this part mathematics-related belief scale (MRBS), students' mathematics-related beliefs and gender difference in students' beliefs were discussed.

5.2.1. Mathematics-Related Belief Scale

In the current study, MRBS was developed with respect to the framework constructed by Op't Eynde, De Corte, and Verschaffeffel (2002). This framework was preferred as it reflected the important issues emphasized by the curriculum (MONE, 2013), it has been considered as contemporary and it was used in studies with different samples from different countries which provided some evidence for its cross cultural validity (Andrews, Diego-Mantecon, Op't Eynde & Sayers, 2007; Diego-Mantecon, Andrews & Op't Eynde, 2007; Op't Eynde & De Corte, 2003; Yıldırım-Çayır, 2008).

Op't Eynde and De Corte's (2003) study is similar with the current study as it used the same framework and constructed a new scale addressing students' mathematics-related beliefs. The scale constructed by Op't Eynde and De Corte (2003) which indicateed four subscales was refined and adapted in English and Spanish by Andrews et al. (2007) and Diego-Mantecon et al. (2007). These adaptations resulted in the same subscales as beliefs about role and functioning of their own teachers indicating beliefs about social context, beliefs about significance of and competence in mathematics indicating beliefs about self, mathematics as a social activity, and mathematics as a domain of excellence indicating beliefs about mathematics. On the other hand, Yıldırım-Çayır, (2008) developed a new scale for Turkish students using the same framework. Her results indicated three-factor solutions as beliefs about nature of mathematics, beliefs about self and beliefs about social context. Although these studies have some validity issues, their results are parallel to each other and they mainly address the similar factor structures.

The development process of MRBS started with the four factor model as beliefs about nature of mathematics, beliefs about learning mathematics, self-efficacy beliefs and beliefs about teacher role. The results indicated that the beliefs about nature of mathematics and learning mathematics formed a single subscale and self-efficacy beliefs and teacher role views formed separate subscales. The main difference between the current study and previously conducted studies with the same framework is that while the MRBS addressed particular subscales of the framework, others have addressed the whole framework. Hence, the current study gives information about validity of the subscales of the framework, not the whole framework. However, the subscales validated in this study confirmed the previous studies and the structure of the framework as (i) beliefs about nature and learning mathematics addressed beliefs about mathematics, (ii) self-efficacy beliefs addressed beliefs about self, and (iii) views about teacher role provided insight about belief about social context.

5.2.2. Students' Mathematics-Related Beliefs

In the current study, data were collected in November 2014 which was 2 mounths after students had started the middle school. Hence, it is assumed that students' responces to the scale mostly adressed their primary school experiences as they didn't have much experience on 5th grade. Hence, while interpreting the results, it should be taken into consideration that their responses might be more related to their experiences in the primary school.

The results of the analysis indicated that students had a tendency to hold authoritarian teacher role views. Students' responses indicated that their teachers did not support discussion in the mathematics classroom. This situation may cause students to afraid of and avoid participating classroom discussions. On the other hand, if students believed that they could learn mathematics through discussion, they engaged in discussion in the mathematics class (Jansen, 2008). Moreover, discussion participation affects the quality of students' communication with their peers and teacher (Turner & Patrick, 2004). Hence, not supporting an effective discussion environment may prevent students to develop beliefs about discussion and construct effective communication in the classroom. Therefore, guiding mathematics teachers for effective discussion in the classroom could be considered in order to help students develop beliefs about and practice effective discussion in the middle school mathematics classrooms.

Students had more availing beliefs about nature of mathematics and mathematics learning. This showed that students' classroom experiences helped them to develop beliefs about the connected nature of the mathematics concepts and existence of multiple solutions in mathematics problems. This might be due to the role of the learning environment in development of students' beliefs (Mason & Scrivani, 2004). Almost all students believed that understanding was important while learning mathematics. Indeed, young students are willing to understand and learn mathematics (Tuohilampi, Hannula & Varas, 2012). Students believed that mathematics was useful and they could use it in their daily lives, a belief that elementary school students tended to develop as they progressed towards higher grades (Kloosterman, Raymond, & Emenaker, 1996). Therefore, findings in this study might suggest that Turkish 5^{th} grade students tend to have similar beliefs that their counterparts develop in other countries.

Students seemed to believe that spending effort in mathematics resulted in learning. Similarly, students tended to believe that anyone who tries can learn mathematics (Kloosterman & Cougan, 1994). This might also indicate that fifth grade students might not have developed beliefs about quick learning, which indicates answering the questions as quick as possible regardless of the understanding meaning of the concept. It generally relates learning quickly to ability rather than hard work. Beliefs about quick learning could be attached to the examination systems that require students to find the correct answer quickly. As Turkish students take national examinations after the 8th grade, they may not feel the examination pressure much in the 5th grade and they tend to develop such beliefs in older ages (Akkaş, Uçar, Pişkin & Taşçı, 2010).

The results of the study indicated that although students had nonavaling views about *teacher role*, they mostly had availing beliefs on *mathematics and mathematic learning*. This may address the cluster and quasilogical structure of belief systems. People may have contradictory beliefs in the same time and overcome the tension between them by holding these beliefs in different clusters (Abelson, 1979).

Fifth grade students in this study had considerably higher self-efficacy beliefs. Mathematics was not a difficult subject for them. Indeed, they believed that they could improve their ability by studying. These findings addressed that there might be a promising cumulative influence of elementary school and initial 5th grade mathematics classroom experiences on students' beliefs. On the other hand, Yılmaz (2011) examined 6th, 7th and 8th grade students' mathematics self-efficacy and indicated that when students get older they become less self-confident. Hence, understanding the nature of the experiences students had throughout elementary school could provide middle and high school mathematics teachers with ideas for their practices resulting in higher efficacy beliefs in students.

5.2.3. Beliefs in Terms of Gender

Gender is a controversial issue in mathematics education research. Earlier studies have reported a general perception as mathematics is a male domain (Hyde, Fennema & Ryan, 1990). However, rather recent studies indicated that mathematics is no longer seen as male domain instead, it seems as a neutral domain (Forgasz, 2001). Although there are some studies indicating the gender difference in mathematics-related affect (Duell & Hutter 2005; Reçber, 2011; Schommer-Aikens & Kislenko 2009), there are also several studies indicating no gender difference (Ağaç, 2013; Aksu, Demir, & Sümer, 2002; Nortlander & Nortlander, 2009).

Although girls seem less confident about their ability in mathematics in previous studies (De Corte & Op't Eynde, 2003; Kislenko, 2009), results of this study indicated that girls are as self-confident in mathematics as boys. Indeed, similar results were reported in the study conducted by Yıldırım-Çayır (2008) with 8^{th} graders. Another important finding of the study is that girls had significantly higher scores on beliefs about the *mathematics and learning mathematics* subscale than boys. Girls are found to be less rule-oriented than boys (Kishlenko, 2009), which might have resulted in a more flexible and broader understanding of mathematics for girls.

5.3 Implications

The results of the study mainly indicated that 5^{th} grade students generally have availing beliefs about mathematics which may help them in learning meaningful mathematics and have better self-efficacy beliefs. Indeed, they are enthusiastic to learn and understand mathematics and they believe in themselves and their ability. Hence, they are starting the middle school with a relatively positive image of mathematics and mathematics learning. On the other hand, when students get older, they have more nonavailing beliefs (Kislenko 2009; Kloosterman & Caugan, 1994) for learning meaningful mathematics most probably due to their school mathematics experiences (Lester Jr., 2002). Findings of previous studies seem to address that as students have more experience in the mathematics classrooms, they tend to develop more nonavailing beliefs for their learning. The results of the current study support this idea as it indicates 5^{th} graders have availing beliefs about mathematics in general. Similarly, although students have beliefs parallel to constructivist ideas about nature and learning of mathematics, teachers' role in their minds is still very dominant. Students believe that teacher is the one who transfers the knowledge which is a nonavailing belief with respect the current curriculum perspective in Turkey addressing teachers as guide for students' learning.

What is the nature of this experience? It has been reported in several studies in Turkey that middle school mathematics teachers tended to teach mathematics in a traditional way where students' errors and possible misconceptions are not used as opportunities for their learning (Tortop, 2011) and teachers have not adopted the guidance role despite curriculum's emphasis since the change of the curriculum in 2005 towards constructivist ideas and practices (Avcu, 2014; Enki, 2014; Tortop, 2011). The nature of the classroom experiences and teachers' role is an important issue which teachers and policy makers need to consider in several ways. First, teachers are one of the most influential factors in the formation of students' beliefs (Kislenko 2009) and mathematics teachers should provide students efficient learning environments where they can develop more availing beliefs for learning meaningful mathematics. They should also consider their teaching practices and how these practices are in line with the major ideas emphasized in the curriculum documents. Therefore, both teacher education programs and inservice training sessions should focus on emphasizing teachers' roles in effective mathematics classrooms and helping teachers establish meaningful learning environments for mathematics teaching and learning.

Last, 5^{th} grade students did not differ in their self-efficacy beliefs based on gender. Actually, the perception of and beliefs about mathematic as a male domain develop when students get older (Brandel & Staberg, 2008). Hence, when students get older, some of their experiences might result in these beliefs. One possible reason behind this issue might be teachers. There is a possibility that teachers have different interaction with male and female students regarding mathematics and they might communicate different messages about their mathematics ability, which result in differences in self-efficacy beliefs favoring males (Hannula, 2011; Keller, 2001). Moreover, the textbooks may influence students' gender related beliefs about mathematics. Doğan (2012) argued that mathematics textbooks for 6^{th} to 8^{th} grades communicated certain messages to the students where males were portrayed in most competitive professions requiring mathematical abilities, which may direct students towards specific gender related beliefs about mathematics. Hence, teachers, textbook writers and curriculum developers should consider if their practices would result in gender stereotyping. Training of preservice and inservice teachers should also focus on gender stereotyping.

5.4. Recommendations for future studies

In the current study, students' mathematics-related beliefs were examined with respect to the Op't Eynde et al (2002)'s framework. However, as the framework is very comprehensive, limited number of subscales focusing on curriculum priorities was chosen for the study and scale was developed with respect to these subscales. In the future studies, other aspects of the framework may be taken in to consideration. Moreover, the content- and construct-related validity evidences of the scale were examined but criterion-related evidence wasn't considered. The future studies may examine the criterion-related evidence of the scale.

The study was carried out in a single city (Sivas). The sample may be enlarged and study may be repeated with different samples in order to understand students' mathematics related beliefs in all over the country.

In the current study, students' mathematics-related beliefs and possible gender related differences were investigated. However, the relationship between students' mathematics-related beliefs and other variables such as achievement, attitude, and motivation can be investigated in order to have a more detailed picture of students' mathematics-related related affect and cognition.

Current study aimed to examine 5th grade students beliefs on mathematics. The study may be conducted longitudinally in order to have a more comprehensive idea about how students' mathematics-related beliefs change as they have more experience with school mathematics. Moreover, how gender related difference occurs when students get older and teacher, textbook and parent effect on students' gender stereotyping might be studied longitudinally.

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APPENDICES

A. FIRST VERSION OF MATHEMATICS-RELATED BELIEF SCALE

Beliefs about mathematics as a subject

1. Matematik hesaplamadan ibarettir.
2. Matematikte konular birbirleriyle ilişkilidir.
3. Okulda öğrenilen Matematik gerçek hayatta kullanılabilir.
4. Matematik öğrenmek hayatı kolaylaştırır.
5. Matematik sürekli değişen ve gelişen bir alandır.
6. Matematik dersinde öğrendiklerimi diğer derslerde de kullanabilirim.
7. Pekçok insan günlük hayatta matematiği kullanır.
8. Matematik öğrenmek zekamızı geliştirir
9. Matematikte öğrendiklerimi diğer derslerde nadiren kullanabilirim.
10. Sınıfta öğrendiğim matematikle gerçek hayat arasında bağlantı kurmak benim için kolaydır.
11. Matematiği anlamak sadece matehmatikçiler için önemlidir, diğer insanlar için önemli değildir.
12. Matematiğe çalışıyorum çünkü gerekli olduğunu düşünüyorum.
13. Matematik problem çözmektir.
14. Diğer derslerde başarılı olabilmek için matematik gereklidir.
15. Matematik dersinde yaptığım ödevler beni geliştirir.
16. Matematikte farklı düşünmeye yer yoktur.
17. Matematik gerekli bir derstir.
18. Matematik düzenli ve belirli kurallar çerçevesinde düşünmeyi öğretir.
19. Matematikte yaratıcılığımızı kullanabilir ve yeni şeyler keşfedebiliriz.

Beliefs about mathematical learning and problem solving

1. Matematik öğrenirken ezberlemek önemlidir.
2. Matematikte hata yapmak öğrenmenin bir parçasıdır.
3. Matematik tek başına çalışılabilecek bir derstir.
4. Grup çalışması yapmak Matematik öğrenmede önemlidir.
5. Herkes Matematik öğrenebilir.
6. Matematik öğrenmede anlamak önemlidir.
7. Matematik problemlerini çözmenin birden fazla doğru yolu vardır
8. Matematik problemlerinin tek bir doğru cevabı vardır.
9. Matematikte problemi çözdükten sonra cevabın neden doğru olduğunu bilmiyorsan soruyu çözmüş sayılmazsın.
10. Herkes matematiği farklı şekilde öğrenir
11. Matematik öğrenmek eski bilgilerle yenileri arasında bağlantı kurmaktır.
12. Matematiği kendi başıma öğrenemem.
13. Matematiği öğrenebilmek için öğretmenin iyi olması gerekir.
14. Benim için sonucun neden doğru olduğu değil problemin nasıl çözüleceği önemlidir.
15. Zor bir problemle karşılaştığımda problemi çözene kadar uğraşırım.

16. Matematikte ilk karşılaştığımızda anlamadığımız bir konuyu daha sonrada anlayamayız.
17. Matematik dersinde konuları arkadaşlarımızla tartışarak öğrenebiliriz.
18. Problem çözme becerisini geliştirmek matematik öğrenmenin en önemli amaçlarından biridir.
19. Matematik dersinde doğru çözüm yolları bulmak, doğru sonuca ulaşmak kadar önemlidir.
20. Matematik problemrini doğru çözmek öğretmenimizin çözüm yönteminin aynısını kullanarak çözmektir.
21. Matematik problemi çözerken kendi çözüm yolunu bulmak önemlidir.

Self efficacy beliefs

1. Matematik zor bir derstir.
2. Matematikte zor olan konuları bile rahatlıkla anlayabilirim
3. Matematikte yetenekli olmadığımı düşünüyorum
4. Matematik dersinde anlatılanları anlarım.
5. Matematikte yeni şeyler öğrenebilirim ancak doğuştan gelen matematik yeteneğimi geliştiremem.
6. Günlük hayatta matematiği kullanabilirim.
7. Matematik yeteneği doğuştan gelen birşeydir.
8. Bazı insanlar matematikte yetenekli olarak doğarlar.
9. Matematiği anlamak için çok çalışmama gerek yoktur.
10. Matematik benim için anlaşılması kolay bir derstir.
11. Yeterince çalıştıysam Matematik dersinde anlatılanları anlayabilirim
12. Ne kadar çalışırsam çalışayım Matematik dersini anlamak benim için zordur
13. Matematiğe çalışmak matematikteki yeteneği artırır
14. Matematik çalışırken kendime olan güvenimin azaldığını hissediyorum.
15. Matematikte farklı bir problemle karşılaştığımda telaşa kapılırım

Views about role and functioning of the teacher

(Aşağıdaki soruları matematik öğretmeninizi düşünerek cevaplandırınız)

1. Öğretmenimiz bize yakın davranır.
2. Öğretmenimiz matematikte zorlandığımızda bize yardımcı olur.
3. Öğretmenimiz matematik dersini eğlenceli bir şekilde işler.
4. Soru sorduğumuzda öğretmenimiz bizi dikkatlice dinler.
5. Öğretmenimiz matematik öğrenirken yaşadığımız zorlukları anlar.
6. Öğretmenimiz matematik dersinde nasıl hissettiğimiz ile ilgilenmez.
7. Matematik dersinde biz matematikle uğraşırken öğretmenimiz bize rehberlik eder.
8. Matematik dersinde sık sık grup çalışması yaparız.
9. Öğretmenimiz matematiği en iyi kendisinin bildiğini düşünür.
10. Öğretmenimiz matematik problemlerini nasıl çözeceğimizi bize adım adım gösterir.
11. Öğretmenimiz matematik problemlerine farklı çözüm yolları bulmamız için bize zaman verir.
12. Öğretmenimiz bilgiyi aktaran kişidir.
13. Öğretmenimiz matematik ile ilgili bütün soruların cevaplarını bilir.

B. PILOT VERSION OF MATHEMATICS-RELATED BELIEF SCALE

Sevgili öğrenciler, aşağıda matematikle ilgili 34 cümle bulunmaktadır. Cümlelerin doğru bir cevabı yoktur. Her bir cümleyi dikkatlice okuyarak size en uygun olan kutuyu işaretleyiniz.

Cinsiyetiniz: kız( ) erkek ( )

1.Matematik sadece hesaplama demektir.	katılıyorum	kararsızım	katılmıyorum
2.Matematik konuları birbirleriyle ilişkilidir.	katılıyorum	kararsızım	katılmıyorum
3.Okulda öğrendiğimiz matematik konularını günlük hayatımızda kullanırız.	katılıyorum	kararsızım	katılmıyorum
4.Matematik bilmek hayatımızı kolaylaştırır.	katılıyorum	kararsızım	Katılmıyorum
5.Diğer derslerde başarılı olabilmemiz için matematik bilmemiz gereklidir	katılıyorum	kararsızım	Katılmıyorum
6.Matematik dersinde yaptığım ödevler matematiği daha iyi anlamamı sağlar.	katılıyorum	kararsızım	Katılmıyorum
7.Matematikte yaratıcılığımızı kullanabilir ve yeni şeyler keşfedebiliriz.	katılıyorum	kararsızım	Katılmıyorum
8.Matematiğe çalışmak matematikteki yeteneğimizi artırır	katılıyorum	kararsızım	Katılmıyorum
9.Matematik öğrenirken ezberlemek önemlidir.	katılıyorum	kararsızım	Katılmıyorum
10.Matematikte hata yapmak öğrenmeye yardımcı olur.	katılıyorum	kararsızım	Katılmıyorum
11.Grup çalışması yapmak matematik öğrenmede önemlidir.	katılıyorum	kararsızım	Katılmıyorum
12. Matematik öğrenirken anlamak önemlidir.	katılıyorum	kararsızım	Katılmıyorum
13.Matematik problemlerinin birden fazla çözüm yolu olabilir.	katılıyorum	kararsızım	Katılmıyorum
14.Herkes matematiği farklı şekilde öğrenir.	katılıyorum	kararsızım	Katılmıyorum
15. Matematik öğrenirken önceden öğrendiğim bilgileri hatırlamam gerekir	katılıyorum	kararsızım	Katılmıyorum

16.Matematikte ilk karşılaştığımızda anlamadığımız bir konuyu daha sonra da anlayamayız.	katılıyorum	kararsızım	Katılmıyorum
17.Matematik dersinde konuları arkadaşlarımızla tartışarak öğrenebiliriz.	katılıyorum	kararsızım	katılmıyorum
18.Matematik problemlerini sadece öğretmenimizin öğrettiği çözüm yöntemi ile doğru çözebiliriz	katılıyorum	kararsızım	Katılmıyorum
19.Matematik problemi çözerken bir problem için farklı çözüm yolları geliştirmek önemlidir.	katılıyorum	kararsızım	Katılmıyorum
20.Matematik benim için zor bir derstir.	katılıyorum	kararsızım	Katılmıyorum
21.Matematikte yetenekli olmadığımı düşünüyorum.	katılıyorum	kararsızım	Katılmıyorum
22.Matematik dersinde verilen ödevleri kolaylıkla yapabilirim.	katılıyorum	kararsızım	Katılmıyorum
23.Matematik çalışırken kendime olan güvenimin azaldığını hissediyorum.	katılıyorum	kararsızım	Katılmıyorum
24.Matematik benim için anlaşılması kolay bir derstir.	katılıyorum	kararsızım	Katılmıyorum
25.Yeterince çalıştıysam matematik dersinde anlatılanları anlayabilirim.	katılıyorum	kararsızım	Katılmıyorum
26.Matematikte daha önce öğrendiklerimden farklı bir türde problemle karşılaştığımda telaşa kapılırım.	katılıyorum	kararsızım	Katılmıyorum
27.Sınıfta matematik tartışırken tartışmalara ben de katılabilirim	katılıyorum	kararsızım	Katılmıyorum

Öğrencilerin öğretmenleri hakkındaki görüşleri

Aşağıdaki soruları matematik öğretmeninizi düşünerek cevaplandırınız

28.Öğretmen bilgiyi bize aktaran kişidir.	katılıyorum	kararsızım	Katılmıyorum
29.Öğretmenimiz problemleri nasıl çözeceğimizi bize adım adım gösterir	katılıyorum	kararsızım	Katılmıyorum
30.Öğretmenimiz matematik dersinde problemleri arkadaşlarımızla tartışmamızı sağlar	katılıyorum	kararsızım	Katılmıyorum

31.Öğretmenimiz matematik derslerinde sık sık grup çalışması yaptırır	katılıyorum	kararsızım	Katılmıyorum
32.Öğretmenimiz bize yakın davranır.	katılıyorum	kararsızım	Katılmıyorum
33.Öğretmenimiz matematik dersini eğlenceli bir şekilde işler.	katılıyorum	kararsızım	Katılmıyorum
34.Soru sorduğumuzda öğretmenimiz bizi dikkatlice dinler.	katılıyorum	kararsızım	Katılmıyorum

☺ TEŞEKKÜRLER ☺

C. FINAL VERSION OF MATHEMATICS-RELATED BELIEF SCALE

Sevgili öğrenciler, aşağıda matematikle ilgili 25 cümle bulunmaktadır. Her bir cümleyi dikkatlice okuyarak size en uygun olan kutuyu işaretleyiniz. Cümlelerin doğru bir cevabı yoktur sadece sizin verdiğiniz yanıt önemlidir.

Cinsiyetiniz: kız( ) erkek ( )

Okulunuz:……………………………………………………………………..

1.Matematik konuları birbirleriyle ilişkilidir.	Katılıyorum	Kararsızım	katılmıyorum
2.Okulda öğrendiğimiz matematik konularını günlük hayatımızda kullanırız.	Katılıyorum	Kararsızım	katılmıyorum
3.Matematik bilmek hayatımızı kolaylaştırır.	Katılıyorum	Kararsızım	Katılmıyorum
4.Matematik dersinde yaptığım ödevler matematiği daha iyi anlamamı sağlar.	Katılıyorum	Kararsızım	Katılmıyorum
5.Matematiğe çalışmak matematikteki yeteneğimizi artırır.	Katılıyorum	Kararsızım	Katılmıyorum
6.Matematikte hata yapmak öğrenmeye yardımcı olur.	Katılıyorum	Kararsızım	Katılmıyorum
7. Matematik öğrenirken anlamak önemlidir.	Katılıyorum	Kararsızım	Katılmıyorum
8.Matematik problemlerinin birden fazla çözüm yolu olabilir.	Katılıyorum	Kararsızım	Katılmıyorum
9. Matematik öğrenirken önceden öğrendiğim bilgileri hatırlamam gerekir.	Katılıyorum	Kararsızım	Katılmıyorum
10.Matematikte ilk karşılaştığımızda anlamadığımız bir konuyu daha sonra da anlayamayız.	Katılıyorum	Kararsızım	Katılmıyorum
11. Öğretmenimiz matematik problemlerini sadece onun çözdüğü yol ile çözmemizi ister.	Katılıyorum	Kararsızım	Katılmıyorum
12.Matematik problemi çözerken bir problem için farklı çözüm yolları geliştirmek önemlidir.	Katılıyorum	Kararsızım	Katılmıyorum
13.Matematikte yetenekli olmadığımı düşünüyorum.	Katılıyorum	Kararsızım	Katılmıyorum
14.Matematik dersinde verilen ödevleri kolaylıkla yapabilirim.	Katılıyorum	Kararsızım	Katılmıyorum

15.Matematik çalışırken kendime olan güvenimin azaldığını hissediyorum.	Katılıyorum	Kararsızım	Katılmıyorum
16. Matematik dersinde anlatılanları anlayabilmem için iyi çalışmam yeterlidir.	Katılıyorum	Kararsızım	Katılmıyorum

Öğrencilerin öğretmenleri hakkında görüşleri

Aşağıdaki soruları matematik öğretmeninizi düşünerek cevaplandırınız.

17.Öğretmen bilgiyi bize aktaran kişidir.	Katılıyorum	Kararsızım	Katılmıyorum
18.Öğretmenimiz problemleri nasıl çözeceğimizi bize adım adım gösterir.	Katılıyorum	Kararsızım	Katılmıyorum
19.Öğretmenimiz matematik derslerinde sık sık grup çalışması yaptırır.	Katılıyorum	Kararsızım	Katılmıyorum
20.Öğretmenimiz bize yakın davranır.	Katılıyorum	Kararsızım	Katılmıyorum
21.Öğretmenimiz matematik dersini eğlenceli bir şekilde işler.	Katılıyorum	Kararsızım	Katılmıyorum
22.Soru sorduğumuzda öğretmenimiz bizi dikkatlice dinler.	Katılıyorum	Kararsızım	Katılmıyorum

23. Sizce matematik nedir? Kısaca yazınız.

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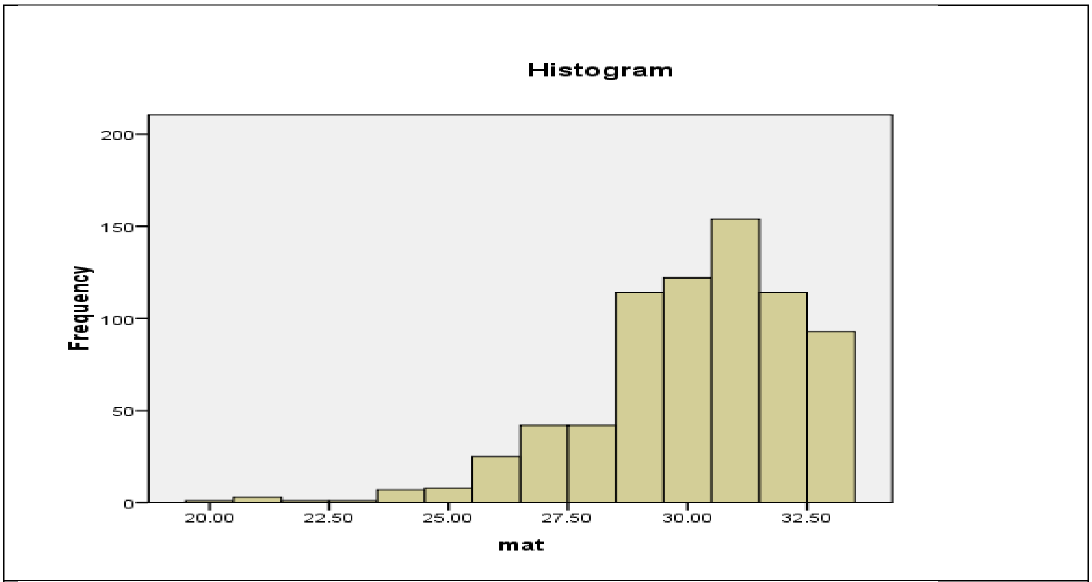
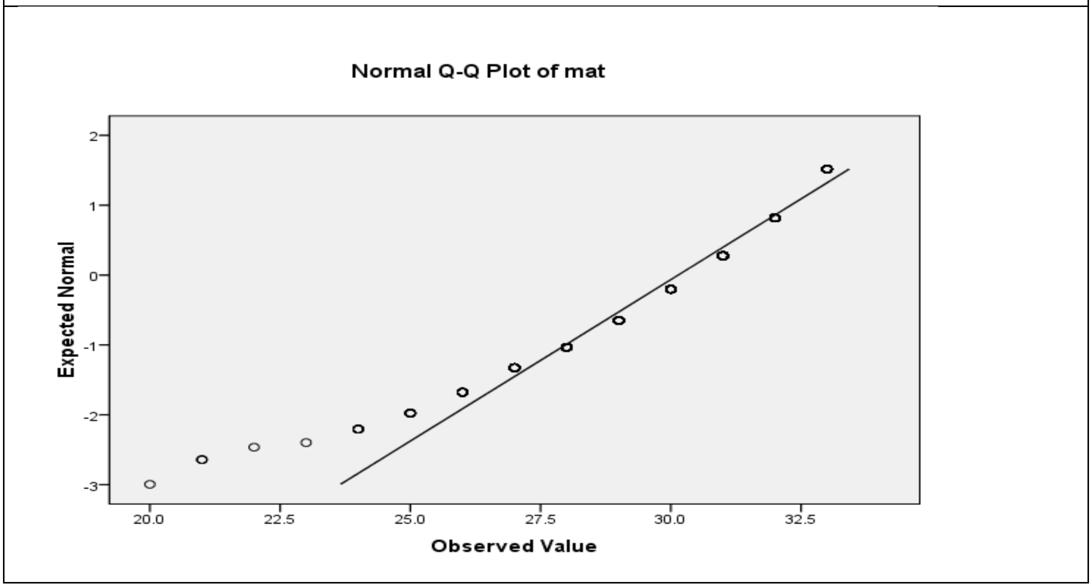
☺ TEŞEKKÜRLER ☺

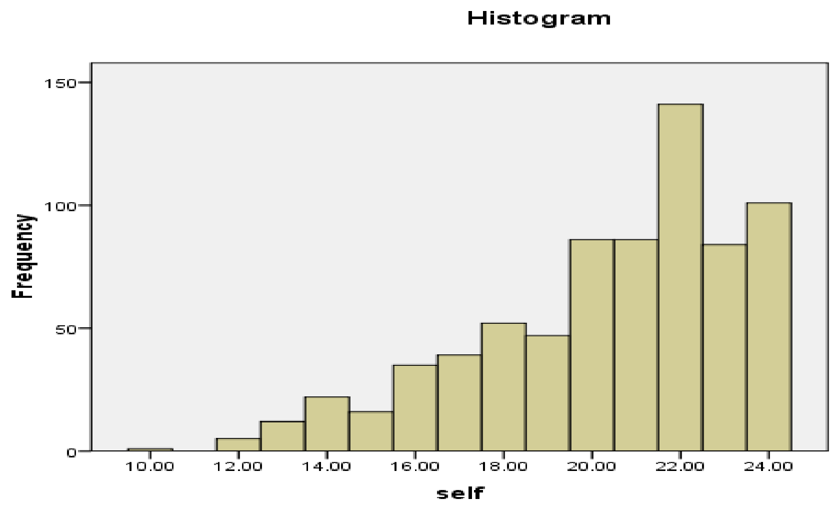
D. HISTOGRAMS AND NORMAL Q-Q PLOTS

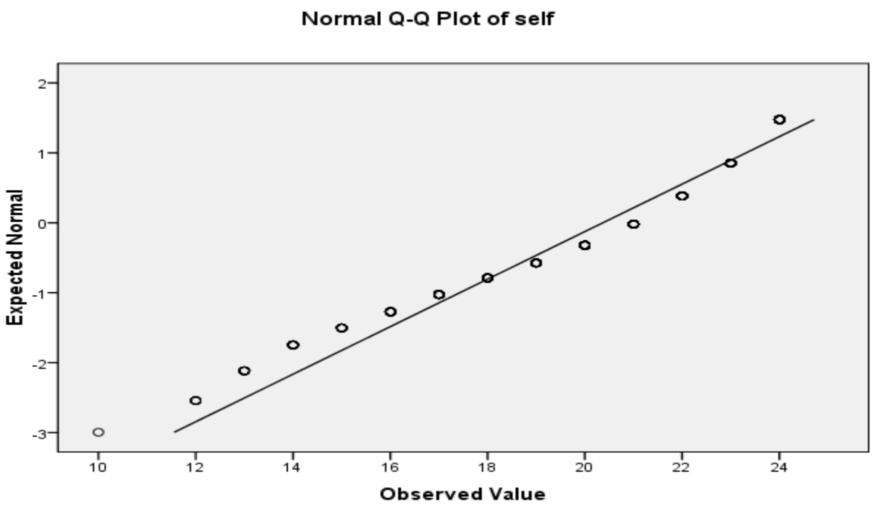
1. Beliefs about nature of mathematics and learning mathematics



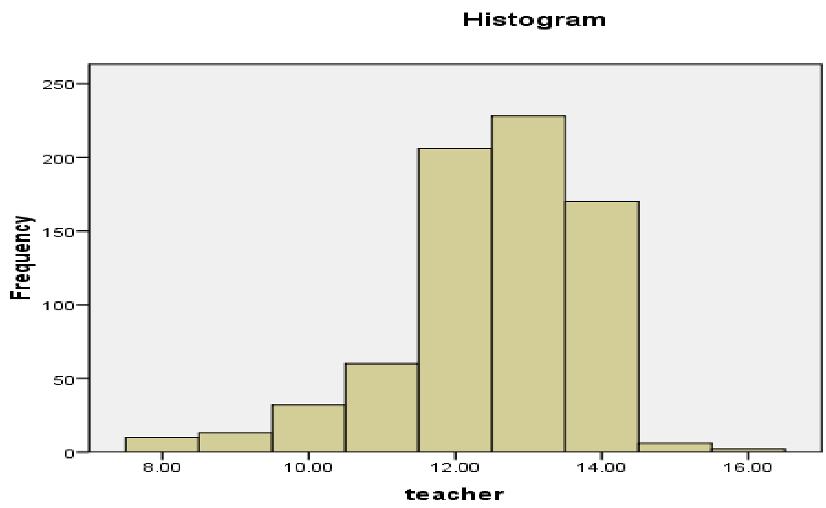


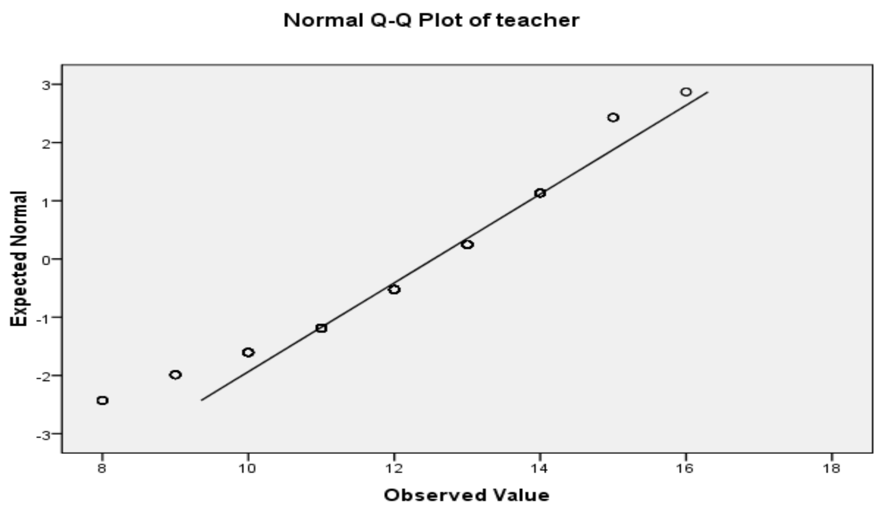
2. Self efficacy beliefs





3. Beliefs about teacher role





E. TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ☐

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı: KIBRISLIOĞLU

Adı : Nermin

Bölümü: İlköğretim fen ve matematik eğitimi

TEZİN ADI (İngilizce): Fifth grade students' mathematics related beliefs

TEZİN TÜRÜ: Yüksek Lisans ☐ Doktora ☐

1. Tezimin tamamından kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
2. Tezimin içindekiler sayfası, özet, indeks sayfalarından ve/veya bir bölümünden kaynak gösterilmek şartıyla fotokopi alınabilir. ☐
3. Tezimden bir bir (1) yıl süreyle fotokopi alınamaz. ☐

TEZİN KÜTÜPHANEYE TESLİM TARİHİ:

F. ETİK KURUL İZİN FORMU

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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24.07.2014

Gönderilen : Y. Doç. Dr. Çiğdem HASER
İlköğretim Bölümü

Gönderen : Prof. Dr. Canan Özgen
IAK Başkanı

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz İlköğretim Fen ve Matematik Eğitimi Bölümü öğrencisi Nermin Kıbrıslıoğlu'nun "Orta Öğretim 5. Sınıf Öğrecilerinin Matematik Hakkındaki İnanışlarının Belirlenmesi" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

24/07/2014

Prof.Dr. Canan Özgen
Uygulamalı Etik Araştırma Merkezi
(UEAM) Başkanı
ODTÜ 06531 ANKARA

G. TÜRKÇE ÖZET

5. SINIF ÖĞRECİLERİNİN MATEMATİK HAKKINDAKİ İNANIŞLARI

GİRİŞ

Matematik öğrenme ve öğretme sürecinde bilişsel unsurlar kadar duyuşsal unsurlarda etkilidir (Forgasz & Leder, 2002). Öğrencilerin matematik hakkındaki inanışları onların matematik öğrenme sürecinde oldukça etkilidir, çünkü bu inanışlar öğrencilerin bilgiyi nasıl aldığını, yönettiğini, ilişkilendirdiğini (Schommer, 1990) ve belirli bir konuyu anlamak için ne kadar çaba göstereceklerini, o konuya yönelik ilgilerini etkiler (Kloosterman, 2002). Ayrıca pek çok çalışmada öğrencilerin matematik hakkındaki inanışları ile onların matematik başarılarının ilişkili olduğu sonucuna varılmıştır (Beghetto & Baxter, 2012; Duel, Hutter, & Schommer-Aikines, 2005; Eleftherios & Theodosis, 2007; House, 2010; Jansen, 2008; Kloosterman & Cougan, 1994; Köller, 2001). Bu nedenle öğrencilerin matematik hakkındaki inanışları matematik eğitim araştırmalarında önemli bir yer tutmaktadır.

Diğer yandan inanışlar kendi kendilerine ortaya çıkmazlar, aksine öğrencilerin inanç objesi ile ilgili deneyimleri sonucunda oluşurlar (Lester Jr, 2002). Yani öğrenme ortamları ve öğretmen özellikleri öğrencilerin inanışları üzerinde oldukça etkilidir (Greer, Verschaffel & De Corte, 2002; Yackell & Ramussen, 2002). Öğrencilerin matematik hakkındaki inanışları, onların öğretmenleri ve sınıf içi etkinliklerinin bir yansımasıdır (Carte & Norwood, 1997). Bu nedenle öğrencilerin bakış açılarını anlamak ve onların inanışlarını matematik öğrenmelerini destekleyecek şekilde yönlendirebilmek için öğrencilerin ne tür inanışlara sahip olduğunu belirlemek oldukça önemlidir (Kloosterman, 1996).

Bu çalışmanın amacı 5. sınıf öğrencilerinin matematik hakkındaki inanışlarının belirlenmesi ve bu inanışların cinsiyetler arasında farklılaşıp farklılaşmadığının incelenmesidir. 5. Sınıf, ortaokulun başlangıcıdır ve 5. sınıf programında ilkokuldaki işlem yapma gibi temel becerilerin yanı sıra problem çözme ve ilişki kurma da oldukça önemli yer tutar. Bu nedenle 5. sınıf öğrencilerinin inanışları ilkokul eğitiminin öğrencilerin matematik hakkındaki inanışlarını nasıl şekillendirdiği hakkında bilgi verir. Ayrıca, alan yazına bakıldığında Türkiye'de 5. sınıf öğrencilerinin inanışlarına yönelik çalışmaların sayısı oldukça sınırlıdır. Bu bakımdan, bu çalışma alandaki bir eksikliği gidermeyi de amaçlamaktadır. Cinsiyetin matematik hakkındaki inanışlar üzerindeki etkisi ise hala tartışmalı bir konudur. Araştırmaların bir kısmı, öğrencilerin matematik hakkındaki inanışlarının cinsiyetler arasında farklılık göstermediğini söylerken (Ağaç, 2013; Aksu, Demir, & Sümer, 2002; Nortlander & Nortlander, 2009) diğerleri cinsiyetin önemli bir etken olduğunu belirtmektedir (Duell & Hutter 2005; Leedy, Lalonde & Runk, 2003; Reçber, 2011; Schommer-Aikens & Kislenko 2009). Bu nedenle, bu çalışmada cinsiyet farklılığı da araştırılmıştır.

Çalışma kapsamında ilk olarak 5. sınıf öğrencilerin matematik hakkındaki inanışlarını ölçmeye yönelik bir ölçek geliştirilmiştir. Literatürde birkaç ölçek geliştirme çalışması olsa da bu çalışmalarda elde edilen ölçeklerin güvenirlikleri hakkında net bilgiler bulunmamaktadır. Bu çalışmaların bir kısmında doğrulayıcı faktör analizinden hiç bahsedilmezken bir kısmının örneklem büyüklüğü sıkıntılıdır. Bu nedenle bu çalışmada literatürdeki ölçekleri kullanmak yerine yeni bir ölçek geliştirmek tercih edilmiştir.

Araştırma Soruları

Araştırmanın amacı (i) küçük yaştaki öğrencilerin matematik hakkındaki inanışlarını belirlemek amacıyla güvenilir ve geçerli bir ölçme aracı geliştirmek, (ii) Türkiye'deki 5. Sınıf öğrencilerinin matematik hakkındaki inanışlarını belirlemek ve (iii) öğrencilerin matematik hakkındaki inanışların cinsiyetlerine göre farklılık gösterip göstermediğini incelemektir. Bu kapsamda aşağıdaki araştırma sorularına cevap aranacaktır:

1. 5. sınıf öğrencileri için geliştirilen matematik hakkındaki inanışlar ölçeği güvenilir ve geçerli bir ölçek midir?
2. Türkiye'deki 5. sınıf öğrencilerinin matematik hakkındaki inanışları nelerdir?

3. 5. Sınıf öğrencilerinin matematik hakkındaki inanışları cinsiyetlerine göre farklılık göstermekte midir?

Üçüncü araştırma sorusunu incelemeye yönelik aşağıdaki hipotezler kurulmuştur.

H_0: Öğrencilerin matematik hakkındaki inanışları cinsiyetler arasında farklılık göstermemektedir.

H_1: Öğrencilerin matematik hakkındaki inanışları cinsiyetler arasında farklılık göstermektedir.

ARAŞTIRMANIN KURAMSAL TEMELİ

Alanda inanışın pek çok tanımı bulunmaktadır. Fishbern ve Ajzen (1975) inanışı bireylerin bir fikir ya da nesneyle ilgili bilgileri olarak tanımlarken, Richardson (1996, p.2) "bireylerin dünya ile ilgili doğru olduğunu hissettikleri anlayışları, sayıltıları ve önermeleri" olarak tanımlamaktır. İnanışlar genellikle objeye özgü nitelikte olduğu için matematik hakkındaki inanışların ayrıca tanımlanması önemlidir. Bu çalışmanın temel odağı öğrencilerin matematik öğrenme sürecini nasıl yönettiği olduğu için Op't Eynde, De Corte, ve Verschaffeffel (2002) tarafından yapılan tanımlama temel alınmıştır. Op't Eynde ve arkadaşlarına (2002, p.28) göre öğrencilerin matematik hakkındaki inanışları "öğrencilerin doğru olduğunu hissettikleri açıkça ya da üstü kapalı kabul ettikleri onların matematik öğrenme ve problem çözme sürecini etkileten öznel görüşleridir."

Araştırmada Op't Eynde, De Corte, ve Verschaffeffel (2002) nin ortaya attığı kuramsal çerçeve temel alınmıştır. Bu çerçeveye göre öğrencilerin matematik hakkındaki inanışları üç temel alt boyuttan oluşmaktadır. Bunlar matematik eğitimi hakkındaki inanışlar, öz inanışlar ve sosyal bağlamdaki inanışlardır. Kuramsal çerçeve ile ayrıntılı bilgi Tablo 1 de verilmektedir. Bu kuram en yeni geliştirilen kuram olduğu için tercih edilmiştir. Ayrıca son zamanlarda faklı dil ve kültürlerden öğrencilere uygulanmıştır (Andrews, Diego-Mantecon, Op't Eynde & Sayers, 2007; Diego-Mantecon, Andrews & Op't Eynde, 2007; Op't Eynde & De Corte, 2002; Yıldırım-Çayır, 2008) ve bu da ölçeğin kültürler arasında geçerliği ile ilgili bilgi verebilir. Ancak kuram çok kapsamlı olduğu için belirli alt boyutları seçilmiş ve ölçek bu alt boyutlara yönelik olarak geliştirilmiştir. Araştırma öğrencilerin matematik hakkındaki inanışları, öz yeterlik inanışları ve öğretmen rolüne yönelik görüşleri bağlamında oluşturulmuştur.

Tablo 1. Öğrencilerin matematik hakkındaki inanışları

Matematik eğitimi hakkındaki inanışlar	Öz inanışlar	Sosyal bağlamdaki inanışlar
*Matematik ile ilgili inanışlar *Matematik öğrenme ve problem çözme ile ilgili inanışlar *Matematik öğretimi ile ilgili inanışlar	*Öz yeterlik inanışları *Kontrol inanışları *Değer İnanışları *Amaç yönelimi ile ilgili inanışlar	*Sınıflarındaki sosyal normlara yönelik inanışlar -Öğrenci rolü -Öğretmen rolü *Sınıflarındaki sosyo-matematik normlara yönelik inanışlar

YÖNTEM

Araştırma iki aşamadan oluşmaktadır. İlk aşamada 5. sınıf öğrencilerinin matematik hakkındaki inanışları incelenmiştir. Bu nedenle bu aşama tarama araştırması olarak düzenlenmiştir. İkinci aşamada öğrencilerin matematik hakkındaki inanışlarının cinsiyetler arasında farklılaşıp farklılaşmadığına bakılmıştır. Bu kapsamda ikinci aşama nedensel karşılaştırmalı araştırma desenine göre düzenlenmiştir.

Evren ve Örneklem

Araştırmanın hedef evreni Türkiye'deki tüm 5. sınıf öğrencileridir. Ulaşılabilir evren ise Sivas merkezdeki tüm 5. sınıf öğrencileri olarak tanımlanmıştır. Veriler küme örnekleme yöntemiyle rastgele seçilen 14 okulda öğrenim gören 5. sınıf öğrencilerin toplanmıştır. Araştırma toplamda 740 5. sınıf öğrencisi ile yürütülmüştür.

Veri Toplama Aracı

Araştırmada ilk aşamada veri toplama aracı olarak kullanılacak olan matematik hakkındaki inanış ölçeği geliştirilmiştir. Ölçek dört alt boyuttan oluşacak şekilde oluşturulmuş ve Ankara ilinde elverişli örnekleme yöntemi ile belirlenen iki okulda öğrenim gören 390 öğrenciyle pilot çalışması yapılmıştır. Pilot çalışmanın sonuçları ölçeğin üç alt boyutta 25 maddeden oluştuğunu göstermiştir.

Verilerin Analizi

Verilerin analizi beş temel aşamada gerçekleştirilmiştir. Sırasıyla betimsel istatistikler, doğrulayıcı faktör analizi (DFA), iç ve dış geçerlik analizleri, güvenirlik ve cinsiyet etkisi araştırılmıştır. Betimsel istatistikler, güvenirlik ve cinsiyet etkisi için SPSS 21 programı, DFA için LISREL programı kullanılmıştır. Araştırmanın dış geçerliği rastgele örnekleme yöntemi ile sağlanmıştır. İç geçerliliği tehdit edebilecek durumlar incelenerek araştırma sürecinde bu etmenler minimize edilmiştir.

BULGULAR

Araştırmaya 14 okuldan toplamda 740 öğrenci katılmıştır. Bunların 359 u erkek ve 356 sı kızdır, 25 öğrenci cinsiyetini belirtmemiştir. Araştırmanın bulguları sırasıyla DFA sonuçları, öğrencilerin matematik hakkındaki inanışları, güvenirlik ve cinsiyet etkisi başlıkları altında özetlenmiştir.

Doğrulayıcı Faktör Analizi

Her analizde olduğu gibi analizlere başlamadan önce veri setinin analize uygunluğu ve söz konusu analizin sayıltıları değerlendirilmelidir. İlk olarak veri setinde kayıp veri olup olmadığı kontrol edilmiş ve kayıp veri olmadığı görülmüştür. Doğrulayıcı faktör analizinin en önemli sayıltısı normalliktir ve normalliği etkileyen en önemli unsur uç değerlerdir. Bu nedenle normallik testlerine geçmeden önce Mahanalobis uzaklığı temel alınarak uç değerler belirlenmiş ve uç değer olan 13 kişi veri setinden çıkarılmıştır. Sonrasında verinin çarpıklık, basıklık değerleri, histogramlar ve normallik grafikleri incelenmiş ve verinin normal dağıldığı sonucuna varılmıştır.

Doğrulayıcı faktör analizi sonuçları iki aşamada değerlendirilmiştir. İlk olarak genel uyum indekslerine bakılmıştır. Uyum indeksleri (χ^2 / *sd*=2.64, SRMR=.052, RMSEA=.048, GFI=.94, AGFI= .92) verinin modele uygun olduğunu göstermiştir. İkinci aşamada her bir maddenin belirtilen faktörle anlamlı bir ilişkisi olup olmadığına bakılmıştır. Bu aşamada iki maddenin faktörleriyle olan ilişkisinin istatistiksel olarak anlamlı olmadığı görülmüş ve bu iki madde ölçekten çıkarılmıştır ve doğrulayıcı faktör analizi yinelenmiştir. İkinci modelin uyum indeksleri verinin modele uyumlu olduğunu göstermiştir (χ^2 / *sd*=2.9, SRMR= 0.052, RMSEA=0.051, GFI=0.93). Ayrıca ikinci modelde tüm maddeler faktörlerle anlamlı bir ilişki göstermiştir.

Sonuç olarak, ölçeğin yapı geçerliği üç faktöre dağılan 23 madde ile sağlanmıştır.

Güvenirlik Analizleri

Ölçek üç alt boyuttan oluştuğu için her bir alt boyut için ayrı ayrı güvenirlik testi yapılmıştır. Güvenirlik analizlerinde matematik ve matematik öğrenme alt boyutu için Cronbach Alfa değeri, öz yeterlik inanışları ve öğretmen rolü görüşleri için ortalama maddeler arası korelasyon değeri kullanılmıştır. Cronbach Alfa değeri en yaygın olarak kullanılan güvenirlik istatistiği olmakla beraber, ölçekteki madde sayısının 10 dan az olduğu durumlarda çok küçük değerler alır. Böyle durumlarda ortalama maddeler arası korelasyon değeri kullanılması önerilir (Tabachnick & Fidell, 2007). Bu nedenle bu araştırmada alt ölçeklerdeki madde sayıları göz önünde bulundurularak her iki güvenirlik değeri de kullanılmıştır. Cronbach Alfa değeri için .7 den büyük olması ve ortalama maddeler arası korelasyon değeri için .2 ile .4 arasında olması ölçeğin güvenilir olduğunu göstermektedir.

Öğrencilerin Matematik Hakkındaki İnanışları

Öğrencilerin matematik hakkındaki inanışlarını belirlemek amacıyla betimsel istatistikler hesaplanmıştır.

Matematik ve matematik öğrenmeyle ilgili alt boyut incelendiğinde, öğrencilerin çoğu matematiğin günlük hayatta kullanışlı olduğunu (M=2.87) ve hayatlarını kolaylaştırdığını belirtmektedir (M=2.91). Öğrencilerin büyük bir çoğunluğu matematik öğrenirken anlamanın önemli olduğuna (M=2.92) ve çalışmanın matematik yeteneklerini arttıracağına inanmaktadır (M=2.87). Ayrıca öğrencilerin dikkate değer bir kısmı da matematik konularının birbirleri ile ilişkili olduğuna (M=2.72), yeni bir konu öğrenirken önceden öğrendiklerini hatırlamaları gerektiğine (M=2.75) ve matematik problemleri için farklı çözüm yolları geliştirmenin önemli olduğuna (M=2.75) inanmaktadır. Diğer yandan sonuçlar öğrencilerin matematikte hata yapmanın öğrenmeye yardımcı olup olmayacağı konusunda kararsız olduklarını göstermiştir (M=2.15).

Öz yeterlik inanışlarına bakıldığında öğrencilerin yarıdan fazlası matematik dersinin onlar için zor bir ders olmadığını (M=2.65) ve matematik yeteneğine sahip olduklarını (M=2.51) belirtmiştir. Ancak sonuçlar öğrencilerin problemleri çözmenin tek doğru yolunun öğretmenin çözdüğü yöntemi kullanmak olduğu konusunda kararsız olduklarını göstermiştir (M=2.30).

Öğrencilerin öğretmen rolü ile ilgili görüşleri incelendiğinde, öğrenciler; öğretmenlerinin arkadaş canlısı olduğunu (M=2.80) onları dikkatli bir şekilde dinlediğini (M=2.88) ve matematik derslerinin eğlenceli olduğunu (M=2.71) belirtmiştir. Bunların yanı sıra öğrenciler matematik öğretmenlerini bilgiyi aktaran kişi olarak görmekte (M=1.07) ve öğretmenlerinin problemleri nasıl çözeceklerini adım adım anlattığını söylemiştir (M=1.11). Ayrıca, araştırmanın sonuçları öğretmenlerin öğrencilerin matematik problemlerini sınıfta arkadaşlarıyla tartışmalarına olanak sağlamadığını ortaya çıkarmıştır (M=1.93).

Öğrencilerin matematik hakkındaki inanışları, alt boyut bakımından incelendiğinde öğrencilerin matematik ve matematik öğretimi (M=29.98) ve öz yeterlik (M=20.30) alt boyutlarında genel olarak yararlı inançlara sahip olduğu görülmüştür. Diğer yandan öğrencilerin öğretmen rolüne yönelik görüşlerinin (M=12.51) yansız olduğu görülmüştür.

Cinsiyet Etkisi

Araştırmada cinsiyet etkisi her bir alt boyut için ayrı ayrı incelenmiştir. Cinsiyet karşılaştırılmasında MANOVA kullanılmıştır. Araştırma kapsamında aşağıdaki hipotezler test edilmiştir.

I. H_0=Öğrencilerin matematik ve matematik öğretimine yönelik inanışları cinsiyetler arasında farklılık göstermemektedir.

   H_1=Öğrencilerin matematik ve matematik öğretimine yönelik inanışları cinsiyetler arasında farklılık göstermektedir.

II. H_0=Öğrencilerin öz yeterlik inanışları cinsiyetler arasında farklılık göstermemektedir.

   H_1=Öğrencilerin öz yeterlik inanışları cinsiyetler arasında farklılık göstermektedir.

III. H_0=Öğrencilerin öğretmen rolüne yönelik görüşleri cinsiyetler arasında farklılık göstermemektedir.

   H_1=Öğrencilerin öğretmen rolüne yönelik görüşleri cinsiyetler arasında farklılık göstermektedir.

Hazırlık Analizleri

Analizlere başlamadan önce MANOVA testinin sayıltıları kontrol edilmelidir. MANOVA analizlerinin temelde 5 sayıltısı vardır bunlar: örneklem büyüklüğü, normallik, regresyonların homojenliği, çoklu bağlantılılık ve varyans ve kovaryans matrislerinin homojenliğidir (Tabachnick & Fidell, 2007). Uç değerler ve normallik sayıltıları DFA analizleri öncesinde kontrol edilmiş ve verinin normalliği sağlanmıştır. Regresyonların homojenliği sayıltısı ise bağımlı değişkenlerin sıralamasının önemli olduğu çalışmalarda test edilmesi gereken bir sayıtıdır (Tabachnick & Fidell, 2007) ve bu çalışmanın kapsamı dışındadır.

Çoklu bağlantılık sayıltısı için bağımlı değişkenlerin birbirleri ile olan ilişkileri önemlidir. MANOVA analizleri, bağımlı değişkenler arasında orta derecede ilişki olduğunda en iyi sonucu verir. Eğer bağımlı değişkenler arasındaki ilişki çok küçükse bu değişkenler ayrı ayrı analiz edilmelidir. Eğer bu ilişki çok büyükse (.8

ve üzeri) bu durumda da bu değişkenlerden biri analizden çıkarılmalı ya da bu değişkenler birleştirilerek tek bir değişken haline getirilmelidir (Tabachnick & Fidell, 2007). Bağımlı değişkenler arasındaki Pearson korelasyonuna bakıldığında matematik ve matematik öğretimi alt boyutu ile öz yeterlik alt boyutu arasında orta derecede (.33) ilişki olduğu görülürken, öğretmen rolü alt boyutunun öz yeterlik (-.003) ve matematik ve matematik öğretimi (.12) arasındaki ilişkilerin çok düşük olduğu görülmüştür. Bu nedenle de cinsiyetin matematik ve matematik öğretimi alt boyutu ve öz yeterlik alt boyutu üzerindeki etkisi MANOVA ile öğretmen rolü üzerindeki etkisi ise bağımsız gruplarda t-testi analizi kullanılarak incelenmiştir.

MANOVA analizinin son sayıltısı varyans ve kovaryans matrislerinin homojenliğidir. Bu sayıltı için Box un M testine bakılır. Bu testin anlamlılık düzeyi p> .001 ise bu sayıltı karşılanmış olur (Tabachnick & Fidell, 2007). Box testi sonuçları verinin analiz için uygun olduğunu göstermiştir (F= 1.719, p= .161).

Çıkarımsal İstatistikler

Öğrencilerin öz yeterlik ve matematik ve matematik öğretimi alt boyutlarındaki inanışlarının cinsiyetler arasında farklılaşıp farklılaşmadığını test etmek içim MANOVA, öğretmen rolüne yönelik görüşlerinin cinsiyetler arasında farklılaşıp farklılaşmadığını test etmek için bağımsız gruplarda t-testi analizi yapılmıştır.

MANOVA analizinin sonuçları Tablo 2 de verilmiştir. Bu sonuçlar öğrenci inanışlarının alt boyutlardan en az birinde cinsiyet arasında anlamlı olarak farklılaştığını göstermektedir.

Table 2. Çok değişkenli analiz sonuçları

Etki		**Değer**	**Hip. *df***	**Hata *df***	**Sig.**
Etkileşim	Pillai’s Trace	.995	2	704	000
	Wilks’ Lambda	.005	2	704	000
	Hottelings’ Trace	210.21	2	704	000
	Roy’s Largest Root	210.21	2	704	000

Hangi alt boyutta inanışların farklılık gösterdiğini öğrenmek için denekler arası etki testine bakılmıştır. Bu testin sonuçlarına göre öğrencilerin öz yeterlik inanışları cinsiyetler arasında farklılık göstermezken (F=.67, p=.41) kız öğrencileri matematik ve matematik öğretimi alt boyutunda erkeklerden daha yüksek puan almıştır (F= 11.51, p= .001).

Bağımsız gruplarda t-testi sonuçlarına bakıldığında ise kız ve erkek öğrencilerin öğretmen rolüne yönelik görüşleri arasında farklılık olmadığı görülmüştür (F= -.041, p=.97).

SONUÇ VE TARTIŞMA

Bu çalışmada 5. sınıf öğrencilerinin matematik hakkındaki inanışları araştırılmış ve bu inanışların cinsiyetler arasında farklılaşıp farklılaşmadığına bakılmıştır. Bu amaç için öncelikle matematik hakkında inanışlar ölçeği geliştirilmiş ve ölçeğin güvenirlik ve geçerlik analizleri yapılmıştır.

Ölçek Op't Eynde ve arkadaşlarının (2002) ortaya attığı teorik çerçeve temel alınarak geliştirilmiştir. Her ne kadar teorik çerçevenin bir kısmı bu araştırmanın kapsamına alınmış olsa da bulgular, aynı teoriyi temel alan diğer çalışmalarda olduğu gibi (Andrews, Diego-Mantecon, Op't Eynde & Sayers, 2007; Diego-Mantecon, Andrews & Op't Eynde, 2007; Op't Eynde & De Corte, 2003; Yıldırım-Çayır, 2008) teorik yapıyı destekler niteliktedir. Öğrencilerin matematik ve matematik öğrenimine yönelik inanışları tek bir boyutta toplanmıştır ve teorik çerçevedeki matematik hakkındaki inanışlar boyutuna karşılık gelmektedir. Öz yeterlik inanışları ayrı bir boyut oluşturmuş ve teorideki öz inanışlara dahil edilmiştir. Öğretmen rolü görüşleri ise ayrı bir boyut oluşturarak teorideki sosyal inanışları içeren alt boyutla ilişkilendirilebilir.

Sonuçlar öğrencilerin daha çok otoriter öğretmen rolünün benimsediklerini göstermektedir. Ayrıca öğrenciler öğretmenlerinin onların matematik problemlerini tartışabilecekleri ortamlar oluşturmadığını da belirtmiştir. Bu durum öğrencilerin sınıf içi tartışmalardan korkmalarına ve bundan kaçınmalarına sebep olabilir. Diğer yandan, eğer öğrenciler sınıf içi tartışmaların öğrenmelerini destekleyeceğine inanırlarsa sınıf içi tartışmalara aktif olarak katılırlar (Jansen, 2008). Ayrıca, sınıf içi tartışmalar öğrencilerin birbirleriyle ve öğretmenleriyle olan iletişimlerini de destekler (Turner & Patrick, 2004). Bu nedenle, öğrencilere etkili bir tartışma ortamı sağlamamak, onların tartışma ile ilgili inanışlar geliştirmelerini ve sınıf içinde etkili bir iletişim kurmalarını engelleyebilir. Öğretmenleri etkili sınıf içi tartışma ortamı sağlamaları yönünde yönlendirmek öğrencilerin tartışma ile ilgili inanış geliştirmeleri ve etkili bir tartışmayı deneyimleyebilmeleri açısından oldukça önemlidir.

Araştırmanın sonuçları öğrencilerin genel olarak matematik ve matematik öğretimi alt boyutunda yararlı inanışlara sahip olduğunu göstermektedir. Bu durum öğrencilerin sınıf içi deneyimlerinin onlara matematik konuların ilişkisi ve problemlerin birden fazla çözüm yolunun varlığı konularında yararlı inanışlar geliştirmelerine olanak sağladığını göstermektedir. Öğrencilerin neredeyse tamamı matematikte anlamanın önemli olduğuna inanmaktadır. Aslında küçük yaştaki öğrenciler matematiği anlama ve öğrenme konusunda daha isteklidir (Tuohilampi, Hannula & Varas, 2012). Öğrenciler matematiğin faydalı olduğunua ve günlük hayatlarını kolaylaştırdığına inanmaktadır. Bu inanış ilkokul öğrencilerinin büyüdükçe geliştirdikleri bir inanıştır (Kloosterman, Raymond, & Emenaker, 1996). Yani Türkiye’deki 5. sınıf öğrencileri diğer ülkelerdeki yaşıtlarıyla benzer inanışlara sahiptir.

5. sınıf öğrencileri genel olarak yüksek öz yeterlik inanışlarına sahiptir. Matematik onlar için zor bir ders değildir ve öğrenciler çalışarak matematikteki yeteneklerini arttırabileceklerine inanmaktadır. Bu sonuçlar ilkokul eğitiminin ve bu süreçte öğrencilerin edindikleri deneyimlerin öğrencilerin inanışları üzerindeki birikimli etkisini göstermektedir. Diğer yandan Yılmaz’ın (2011) 6., 7. ve 8. sınıflarla yaptığı çalışmanın sonuçları öğrencilerin büyüdükçe öz yeterlik inanışlarının azaldığını göstermektedir. Bu nedenle öğrencilerin ilkokul eğitimi boyunca edindikleri deneyimlerin doğasını anlamak ortaokul ve lise öğretmenleri için öğretim yöntemlerini geliştirecek fikirler verebilir.

Cinsiyet farklılıkları incelendiğinde kızların da erkekler kadar öz yeterliğe sahip olduğu görülmüştür. Yıldırım-Çayır da (2008) 8. sınıflarla yaptığı çalışmada benzer sonuçlara ulaşmıştır. Öğrencilerin öğretmen rolüne yönelik görüşlerinde cinsiyetler arasında herhangi bir farklılık görülmezken, kızlar matematik ve matematik öğrenme alt boyutunda erkeklerden daha yüksek puan almıştır. Kishlenko da (2009) kızların erkeklere göre daha az kural merkezli olduğunu belirtmiştir.

Bu çalışmanın sonuçları genel olarak 5. sınıf öğrencilerinin matematikle ilgili yararlı inanışlara sahip olduğunu göstermektedir. Sonuçlar öğrencilerin anlamaya ve matematik öğrenmeye hevesli olduğunu ve kendi yeteneklerine güvendiğini ortaya koymaktadır. Yani öğrenciler ortaokula başlarken matematiğe karşı olumlu bir bakış açısıyla gelmektedirler. Diğer yandan öğrenciler büyüdükçe matematiğe yönelik yararlı olmayan inanışları artar (Kislenko 2009; Kloosterman & Caugan, 1994). Bu durumdaki muhtemel en büyük sebep öğrencilerin okulda edindikleri matematik deneyimleridir. Daha önce yapılan çalışmaların sonuçları da öğrencilerin matematikle ilgili deneyimleri arttıkça inanışlarının daha yararlı olmayan inanışlar olduğunu göstermektedir. Benzer şekilde öğrenciler matematik ve matematiğin doğası ile ilgili yararlı inanışlara sahip olmasına rağmen zihinlerindeki öğretmen rolü hala oldukça baskın görünmektedir. Öğrenciler öğretmenin bildiyi aktaran kişi olduğuna inanmaktadır ve bu bakış açısı Türkiye’de uygulanan yapılandırmacı yaklaşıma dayalı öğretim programına göre yararlı bir inanış değildir. Diğer pek çok çalışmada da belirtildiği gibi öğretmenler öğretim yaklaşımlarını programın gerektirdiği şekilde düzenleyememiştir (Avcu, 2014; Enki, 2014; Tortop, 2011). Sınıf içi etkinliklerin doğası ve öğretmen rolü program geliştirenlerin ve öğretmenlerin pek çok açıdan dikkate almaları gereken önemli bir konudur. İlk olarak öğretmenler öğrencilerin inanışlarının oluşmasında en çok etkiye sahip olan kişilerdir (Kislenko, 2009) ve matematik öğretmenleri öğrencilerin yararlı inanışlar geliştirebileceği öğrenme ortamlarının oluşturulması konusunda sorumludurlar. Ayrıca öğretmenler sınıf içindeki öğretim yöntemlerini ve bu yöntemlerin öğretim programı ile ne kadar tutarlı olup olmadığını da göz önünde bulundurmalıdır. Bu nedenle hem öğretmen yetiştirme programları, hem de hizmet içi eğitimler öğretmenlerin etkili matematik eğitim ortamları üzerindeki rolüne odaklanmalıdır.

Son olarak bu çalışmada öğrencilerin öz yeterlikleri cinsiyetler arasında farklılık göstermediği görülmüştür. Aslında matematiğin bir erkek alanı olduğu inanışı öğrenciler büyüdükçe geliştirdikleri bir inanıştır (Brandel & Staberg, 2008). Yani öğrenciler büyüdükçe onların bazı deneyimleri bu şekilde bir inanış geliştirmelerine sebep olmaktadır. Bunun olası sebeplerinden biri öğretmen bakış açısı olabilir. Öğretmenler kız ve erkek öğrencilerle farklı şekilde iletişim kurarak onlara yetenekleri ile ilgili farklı mesajlar veriyor olabilir. Bu durumda öğrencilerde erkek öğrencilerin lehine öz yeterlik inanışlarının gelişmesine sebep olabilir (Hannula, 2011; Keller, 2001). Ayrıca ders kitapları da öğrencilere cinsiyet tabanlı inanışları iletiyor ediyor olabilir. Doğan (2012) 6., 7., ve 8. sınıf matematik ders kitaplarının öğrencilere cinsiyet rolleri ile ilgili bir takım mesajlar verdiğini ortaya çıkarmıştır. Kitaplarda genel olarak matematik yeteneği gerektiren işlerde erkeklerin betimlenmesi öğrencilerin cinsiyete yönelik bir takım matematik inanışları geliştirmesine sebep olabilir. Bu nedenle kitap yazarları ve program geliştirenler yaptıkları işin bir takım cinsiyet yargılarına sebep olup olmadığı konusunu göz önünde bulundurmalıdır. Ayrıca öğretmen yetiştirme programları ve hizmet içi eğitimlerde de cinsiyet yargılarına yer verilmelidir.

Gelecek Çalışmalar için Öneriler

Bu çalışmada öğrencilerin matematik hakkındaki inanışları Op't Eynde ve arkadaşlarının (2002) öne sürdüğü teorik çerçeve ile ele alınmıştır. Ancak bu çerçeve çok kapsamlı olduğu için sadece bir takım alt grupları çalışmaya dahil edilmiştir. Gelecekte yapılacak çalışmalarda çerçevenin diğer alt boyutlarına yer verilebilir. Ayrıca bu çalışmada geliştirilen ölçeğin yapı ve kapsam geçerliliği test edilmiş ölçüt geçerliliğine yer verilmemiştir. Gelecekte yapılacak çalışmalarda ölçeğin ölçüt geçerliği incelenebilir.

Bu çalışma tek bir şehirdeki 5. sınıf öğrencileri ile yapılmıştır. Daha farklı ve geniş örneklemlerle çalışma yenilenebilir.

Bu çalışmada öğrencilerin matematik hakkındaki inanışları ve cinsiyet etkisi araştırılmış ancak inanışların diğer değişkenlerle ilişkilerine bakılmamıştır. İleriki çalışmalarda inanışlarla tutum, başarı gibi duyuşsal özelliklerin arasındaki ilişkiler incelenebilir.

Bu çalışmada sadece 5. sınıf öğrencilerinin inanışları incelenmiştir. Öğrencilerin inanışlarının büyüdükçe nasıl değiştiği ile ilgili daha kapsamlı bilgi edinmek için çalışma boylamsal olarak yapılabilir. Ayrıca cinsiyet tabanlı farklılıkların öğrenciler büyüdükçe nasıl ortaya çıktığı öğretmen ve veli etkisi yoluyla araştırılabilir.