EXPLORING THE INFLUENCE OF TEACHING MATHEMATICS IN EARLY CHILDHOOD COURSE ON PRESERVICE EARLY CHILDHOOD TEACHERS' IMAGES AND EMOTIONS OF MATHEMATICS, MATHEMATICS ANXIETY AND MATHEMATICS TEACHING ANXIETY

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ABSTRACT

EXPLORING THE INFLUENCE OF TEACHING MATHEMATICS IN EARLY CHILDHOOD COURSE ON PRESERVICE EARLY CHILDHOOD TEACHERS' IMAGES AND EMOTIONS OF MATHEMATICS, MATHEMATICS ANXIETY AND MATHEMATICS TEACHING ANXIETY

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The aim of this study was to describe 47 preservice early childhood education teachers' mathematics anxiety (MA) and mathematics teaching anxiety (MTA) before taking Teaching Mathematics in Early Childhood (TMEC) course and after completing it through asking their mathematics related images, emotions, mathematics anxiety and mathematics teaching anxiety, and their sources throughout the course. Moreover, the relationship between the prior mathematics anxiety and mathematics teaching anxiety of preservice teachers were explored. Three questionnaires, field reflection reports, drawing activities were used as data collection tools. In addition, interviews were conducted with 20 preservice teachers to get in-depth information regarding their MA, MTA, and specific key course experiences.

Compared to beginning of the course, some changes in participants regarding images, emotions, and levels of MA and MTA were seen at the end of the course. Images including advance formulas and abstract concepts in the beginning of the semester were switched to early years mathematics concepts and many negative emotions were replaced with the positive emotions related to mathematics at the end of the course. The sources of MA were generally related to perceived teacher characteristics, family and previous courses. These sources probably did not change, but preservice teachers developed new images and emotions regarding the mathematics they will teach. At the end of the course, participants referred to the contribution of TMEC course on their MTA in a positive way. Moreover, some candidates showed shifting in MTA and emphasized the importance of TMEC course and its contribution to diminishing their MTA.

Key Words: Mathematics Anxiety, Mathematics Teaching Anxiety, Preservice Early Childhood Education Teachers

ÖZ

OKUL ÖNCESİNDE MATEMATİK ÖĞRETİMİ DERSİNİN OKUL ÖNCESİ ÖĞRETMEN ADAYLARININ MATEMATİK İMGELERİ VE DUYGULARI, MATEMATİK KAYGILARI VE MATEMATİK ÖĞRETİMİ KAYGILARINDAKİ ETKİSİNİN ARAŞTIRILMASI

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Bu çalışmanın amacı, 47 okul öncesi öğretmen adayının, Okul Öncesinde Matematik Öğretimi (OÖMÖ) dersini almadan önce ve aldıktan sonraki matematik kaygılarını (MK) ve matematik öğretimi kaygılarını (MÖK); matematikle ilgili imgeleri, duyguları, matematik kaygıları ve matematik öğretimi kaygıları ile bunların nedenlerini ders süresince inceleyerek betimlemektir. Ayrıca önceki MK ile MÖK arasındaki ilişki incelenmiştir. Veri toplama araçları olarak üç anket, uygulamalarıyla ilgili yansıtıcı düşünceler raporu ve çizim etkinlikleri kullanılmıştır. Bunların yanı sıra, 20 öğretmen adayıyla, MK, MÖK ve özel olarak ders deneyimleri hakkında daha derin bilgi alma amacıyla görüşmeler yapılmıştır.

Dersin başına kıyasla, dersin sonunda öğretmen adaylarının matematikle ilgili imgeleri, duyguları, MK ve MÖK düzeylerinde bazı değişiklikler görülmüştür.

Dersin sonunda, üst düzey formül ve soyut kavramlardan oluşan imgeler okul öncesindeki matematik kavramlarına dönüşmüş ve birçok olumsuz duygular matematikle ilgili olumlu duygularla yer değiştirmiştir. Matematik kaygıları, çoğunlukla öğretmenlerin algılanan özellikleri, aile ve önceden alınan derslerden kaynaklanmıştır. Bu kaynaklar değişmemiş, ancak öğretmen adayları öğretecekleri matematik hakkında olumlu imge ve duygular geliştirmişlerdir. Dersin sonunda, katılımcılar OÖMÖ dersinin matematik öğretimi kaygılarındaki katkılarından olumlu şekilde bahsetmişlerdir. Dahası, bazı öğretmen adayları matematik öğretimi kaygı düzeylerinde kaymalar göstermiş ve bu kaygılarının azalmasında OÖMÖ dersinin katkısını ve önemini vurgulamışlardır.

Anahtar Kelimeler: Matematik Kaygısı, Matematik Öğretimi Kaygısı, Okul Öncesi Öğretmen Adayları

To my dearest: My family, darling and Emre Türkmen

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PST	Preservice Teachers
MoNE	Ministry of National Education
HEC	Higher Education Council
NAEYC	National Association for the Education of Young Children
NRC	National Research Council
OECD	Organisation for Economic Cooperation and Development
TMEC	Teaching Mathematics in Early Childhood
ECE	Early Childhood Education
MA	Mathematics Anxiety
MTA	Mathematics Teaching Anxiety

CHAPTER I

INTRODUCTION

Early childhood mathematics has been a growing concern of research (Aydın, 2009), because gaining the mathematical skills at the beginning of the preschool is essential for children (Polat-Unutkan, 2007). Although teaching mathematics has a considerable value in the field of education (Sutherland, 1992), early childhood teachers might not always be comfortable while teaching mathematics to children (Clements & Sarama, 2007). Many teachers working with children were reported to describe the mathematics with negative words, such as hard, complex, difficult, boring, frightening, or painful, which may influence teachers' practices and harm children's long-term success in mathematics (Pound, 2006). Since teachers have their own negative experiences related to mathematics, many teachers may avoid teaching mathematics (National Research Council [NRC], 2009).

Knowledge, beliefs, experiences, conceptions, and attitudes which preservice teachers already have at the beginning of the teacher education programs may impact their development as a student and as a teacher (Carter & Norwood, 1997). Preservice teachers who have positive educational experiences with mathematics, and related beliefs and anxiety have the power to influence children's attitude, interest, and success in mathematics when they become teachers (Martinez, 1987; Zacharos, Koliopoulos, Dokimaki & Kassoumi, 2007). Considering the importance of teacher education programs in preservice teachers' future teaching and disposition in the classrooms, this study attempted to investigate mathematics anxiety and mathematics teaching anxiety of preservice early childhood education teachers before taking *Teaching Mathematics in Early Childhood* course and after completing it. How their mathematics anxiety might shape their intended teaching decisions was

also explored. Moreover, their mathematics related images and emotions were inspected before and after the course.

1.1 Mathematics Anxiety

Mathematics anxiety is the most widespread problem encountered in the affect domain (Baloglu & Koçak, 2006). Mathematics anxiety can be seen at any age, it does not depend on mathematical ability, and it has a significant effect on the child's whole education life as well as their adulthood (Rossnan, 2006). The anxiety and fear of mathematics in children generally begins with their first experiences with mathematics, prevents children's ability to engage in mathematics in daily life, and continues in later ages (Rossnan, 2006).

Anxiety has been a complicated construct which has several definitions (Fennema & Shermann, 1976). Dreger and Aiken (1957) mentioned mathematics anxiety first as an emotional response syndrome towards mathematics and arithmetic. However, until 1970s mathematics anxiety did not receive much attention of educators (Baloglu, 2001). Tobias (1993) described it as a feeling of sudden death. In order to measure mathematics anxiety, Richardson and Suinn (1972) developed the "Mathematics Anxiety Rating Scale" (MARS), which has been extensively used by many researchers. They defined mathematics anxiety as "feelings of tension and anxiety that interfere with the manipulation of numbers and the solving of mathematical problems in a wide variety of ordinary life and academic situations" (p.551).

Besides psychological aspects, mathematics anxiety was also defined in terms of emotional aspect (Plaisance, 2009). For example, mathematics anxiety was described as "an emotional reaction to mathematics based on a past unpleasant experience which harms future learning" (Freedman, 2014, p.1). In a similar way, mathematics anxiety is "an emotional avoidance reaction to situations requiring numerical or mathematical conceptual tasks" (Hadfield, Martin, & Wooden, 1992, p.171). Zettle and Raines (2000) described mathematics anxiety as feeling displeasure when meeting with the conditions related to mathematics. Individuals with mathematics anxiety may avoid effective learning opportunities as well as careers which are

related to application of mathematics (Organisation for Economic Cooperation and Development [OECD], 2004) and they will lose correctness for speed while dealing with mathematical tasks (Zettle & Raines, 2000).

There are different classifications for sources of mathematics anxiety. Rigid classroom implementations, examinations and grades given more importance by teachers, problem solving activities which are unreal or irrelevant with daily life lead to mathematics anxiety (Harper & Daane, 1998). According to Stuart (2000), inadequate confidence related to working mathematics, family as well as peer pressure cause mathematics anxiety. When children see mathematics as enjoyable, then their anxiety will disappear, and this pleasure is likely to continue throughout their lives (Das & Das, 2013). Therefore, early mathematics should be seen as a vital educational chance (McCray & Chen, 2012) and mathematics should be experienced by young children in the early ages so as to shape their future life (Varol & Farran, 2006).

There have been two kinds of anxiety, namely, *state anxiety* and *trait anxiety* (Spielberger, 1972). Spielberger (1972) defined state anxiety as "the unpleasant emotional state or condition which is characterized by activation or arousal of the autonomic nervous system" (p.482). It was based on time and situation, and was fostered when a person perceived a situation to be dangerous (Spielberger, 1972). On the contrary, trait anxiety was considered as an individual's long-lasting predisposition to feel anxious and was not based on time and situation (Spielberger, 1972). When mathematics anxiety depended on time and situations regarding mathematics, it was considered as state anxiety (Işıksal, Curran, Koç, & Aşkun, 2009). Mathematics anxiety has been described as a kind of worry, fear, and panic which appeared when an individual was asked to involve in mathematical tasks (Ashcraft, 2002; Wood, 1988). People who were anxious might keep away from mathematics courses and the activities related to mathematics. Mathematics anxiety took its source from teachers and their teaching (Vinson, 2001) and affected students' learning (Ma, 1999) and teachers' efficiency in teaching (Işıksal, Curran, Koç, & Aşkun, 2009).

Personality factors, environmental factors, and intellectual factors were found as the causes which led to mathematics anxiety (Trujillo & Hadfield, 1999). *Personality factors* covered being unwillingness when asking question due to feeling of fear of embarrassment, having low self-esteem, and especially for females, considering mathematics as a male dominated (Trujillo & Hadfield, 1999). *Environmental factors* were related to negative experiences in the classrooms, parents' desire, senseless teachers, and employment of traditional teaching methods including memorizing rules and formulas, doing long calculations and struggling with number (İdris, 2006). On the other hand, *intellectual factors* involved unawareness of usefulness of mathematics, students' attitude, inadequate confidence and persistence in mathematics ability, knowing wrongly about learning styles (Trujillo & Hadfield, 1999).

1.2 Mathematics Teaching Anxiety

Peker (2006) described mathematics teaching anxiety as "teachers' feelings of tension and anxiety which occurs during teaching mathematical concepts, theories, and formulas or during problem solving" (p.77). In other words, having mathematics teaching anxiety means feeling anxious about one's mathematics teaching ability. Different from mathematics anxiety, this type of anxiety is seen while teaching mathematics. While mathematics anxiety is more internally concentrated (such as a person's self-evaluation of mathematics capability), mathematics teaching anxiety is more externally centered (such as a person's self-evaluation of own ability to help children learn mathematics in the classroom) (Brown, Westenskow, & Moyer-Packenham, 2011).

Gardner and Leak (1994) described the mathematics teaching anxiety as the anxiety related to teaching process of preparation and application of activities in the classroom. Preparation of teaching mathematics might be a difficult situation especially for the preservice teachers who have no experience. Indeed, mathematics teaching anxiety is a commonly encountered fear among the preservice teachers (Levine, 1993). The difficulty of the topic, insufficient content knowledge, poor interest towards teaching profession, and inappropriate teaching style without

thinking the developmental phase of the students could be causes for mathematics teaching anxiety for the preservice and in-service teachers (Peker, 2009). However, little is known on preservice teachers' mathematics teaching anxiety and its relationship with mathematics anxiety (Haciomeroglu, 2014) and there are fewer studies (Brown, Westenskow, & Moyer-Packenham, 2012; Peker & Ertekin, 2011) inspecting this relationship and its influence on preservice teachers.

1.3 Theoretical Framework

In the literature, there is a lack of a solid theoretical background for mathematics anxiety (Lange, 1992; Hembree, 1990). Many studies (Baloglu, 2001; Jackson & Leffingwell, 1999; Johnson & vanderSandt, 2011; Plaisance, 2009; Rossnan, 2006; Uusimaki & Nason, 2004) mentioned about the definition, description, causes, and symptoms of mathematics anxiety as well as ways to overcome or reduce mathematics anxiety without providing a theoretical base. For the current study, the theoretical framework is based on research on emotion and mathematics anxiety and attribution theory. The causes that the preservice teachers attributed their mathematics anxiety were examined through attribution theory. Apart from the more general construct of mathematics anxiety, the construct of mathematics teaching anxiety has recently been introduced and gained attention and precision (Brown et al., 2011, 2012; Peker, 2009). Therefore, I used the Brown et al.'s (2011) framework related to mathematics anxiety and mathematics teaching anxiety. Detailed information related to this framework was given in the Literature Review Chapter. I extended the framework to show how mathematics teaching anxiety can shift at the end of the *Teaching Mathematics in Early Childhood* course. While Brown et al.'s (2011) framework showed one static point in time showing no change, the extended framework reached at the end of this study was dynamic to show the change.

1.4 Image and Its Importance

Images of mathematics might influence teaching and learning mathematics in a positive and negative way (Belbase, 2013). Most people remember the mathematics in their childhood when they were afraid of mathematics in the class and/or frightened of problem solving (Sterenberg, 2008). As a result of their long struggle

with learning mathematics, different mathematics related images were emerged. However, many of those images were formed as negative (Sterenberg, 2008). This negative image portrays mathematics as "difficult, cold, abstract, theoretical, ultra-rational, but important and largely masculine" (Ernest, 2008, p.5). Besides, the negative images of mathematics are related to anxiety and failure in mathematics for most people (Ernest, 2008). On the other hand, more intense positive image of mathematics is described as "artistic, beautiful, emotional, exciting, full of joy and wonder, awesome, inspiring, fascinating, entrancing, delightful, absorbing, and life enhancing" (Ernest, 2008, p.6).

Ernest (2008) points that mathematics related images and learners' images of mathematics have a considerable role in individuals and society, influencing one's attitudes and beliefs regarding mathematics. Those attitudes and beliefs are effective in problem solving, in learners' participation in higher level mathematics studies and their careers. Therefore, indirectly, development of positive mathematics images is important in terms of improvement of society and learners' benefit (Ernest, 2008).

1.5 Emotion

Defining some terms, such as *affect, feelings, emotions*, and *mood* is difficult since there is no consensus among the researchers regarding their meaning (Forgas, 2000). According to Forgas (2000), affect can be seen as a comprehensive term that includes particular emotions and general moods. He identifies that while mood is low intense, emotions are more short-lived and intense. Contrary to moods, emotions have noticeable cause and clear cognitive content. In other words, individuals may be in good or bad mood, have good and bad feelings. They are not aware of the reason underlying that mood, but the causes underlying emotions are known (Forgas, 2000). For instance, one may fail an examination and therefore, he knows the reason of the emotion at the end of the examination (Forgas, 2000).

There are several taxonomies and definitions of emotions (Pintrinch & Schunk, 2002). In the affect domain of mathematics education, compared to attitudes and beliefs related to mathematics, emotions has received less attention (Hannula, 2011) because emotions are not easy to study and are the least stable components of affect

(Hannula, 2011; Martínez-Sierra & García González, 2014). McLeod (1988) identified emotion as "a more visceral kind of affect, a response that is quite intense but of relatively short duration" (p.135). Another definition of emotions is "rapidly-changing states of feeling experienced consciously or occurring preconsciously or unconsciously during mathematical (or other) activity" (DeBellis & Goldin, 2006, p.135).

Emotions may become rather strong and cause a deeply negative response which is known as mathematics anxiety (Colsman, 2012). Mathematics anxious people indicate that their emotions show change from discomfort to panic when they encounter tasks related to mathematics (Ashcraft, 2002).

1.6 Importance of Mathematics Related Emotions

Earlier research regarding affect in mathematics education focused on the results of surveys conducted on mathematics anxiety or attitude towards mathematics (Zan, Brown, Evans, & Hannula, 2006) and studies on mathematics-related emotions was not much conducted (Hannula, 2012). Generally, mathematics-related emotion studies were conducted mostly in the problem solving context (Hannula, 2012). More specifically, there have been not much theoretical or empirical studies inspecting the emotional relationship of teachers with mathematics (Hodgen & Askew, 2007).

Emotions are crucial part of mathematics learning process and instruction (McLeod, 1992; Zan et al. 2006). They may become quite stable and affect negatively the school performance related to mathematics, and generally can cause phobia regarding mathematics even for adults (Buxton, 1982, as cited in Di Martino & Zan, 2013). Negative perception of mathematics reduces students' capabilities of success in mathematics (Ghee & Khoury, 2008).

1.7 Attribution Theory

How individuals' expectancy beliefs and emotions are shaped is related to attribution theory and the biggest contribution related to attribution theory in achievement

contexts was made by Bernard Weiner (Pintrich & Schunk, 2002). Weiner's theory of attributions (1986) referred here briefly.

Weiner (1986) stated that attribution theory was related to how people interpreted the situations and how they could connect it to their thinking and behaviors. The first assumption of this theory was that people were motivated to comprehend the environment to predict and control future events, which made them to learn and adjust to their environment (Weiner, 1986). The second assumption indicated that besides understanding the environment, people tried to understand the *causal determinants* of their own behavior and the others' behavior (Weiner, 1986). It would be useful for people to see how people might perceive themselves and others. In this way, people could see why things occurred and they attributed causes to behavior (Pintrich & Schunk, 2002). For instance, students in the school might try to comprehend the reasons why they failed or passed a mathematics examination (Pintrich & Schunk, 2002). In other words, this theory was interested in what people believed about why they succeeded or failed at various tasks and the effects on future learning as well as behavior (Pintrich & Schunk, 2002).

Environmental and personal factors had an effect on the perceived causes of an event. *Environmental factors* consisted of specific information, social norms, and information (Weiner, 1986). To illustrate, if the teacher told a student that she/he did poorly on a mathematics test because she/he did not study hard enough, then this was related to specific information (Pintrich & Schunk, 2002). How mathematics was generally perceived in the culture was one of the examples regarding social norms and information (Pintrich & Schunk, 2002). *Personal factors* consisted of different schemas and prior beliefs (Weiner, 1986). Prior beliefs which were held by individuals were related to the test or to themselves. For instance, before taking a new test, some students had perceptions of their mathematics ability based on their past experience. As a result of environmental and personal factors, students might attribute their failure to bad luck, a difficult test, low aptitude, inadequate effort, bad mood, teacher, health and fatigue. However, those attributions are the *perceived causes* of individuals, and may not be the real causes (Weiner, 1986). For example, a student might state that he did not do well on the test because of having inadequate

mathematics aptitude (Pintrich & Schunk, 2002). This perceived attribution resulted in two consequences, namely, psychological (shame) and behavioral (less future effort in mathematics). In fact, actual causes might be that he might not have studied hard and the test was difficult (Pintrich & Schunk, 2002).

According to Weiner's (1986) model, attributions responsible for individual's success or failure could be categorized with three dimensions: Stability (stable versus unstable), locus (external versus internal), and control (controllable versus uncontrollable). Those dimensions had an effect on expectancy for success, self-efficacy beliefs, and affect as well as actual behavior (such as choice, persistence, level of effort, and achievement). The *stability* dimension, which addressed how stable the attribution is over time, was the most closely related to expectancy for success (Weiner, 1986). Pintrich and Schunk (2002) presented the following example related to this situation: A student did not have a good performance on a mathematics examination and attributed his poor performance to a stable cause, which was insufficient mathematics aptitude. Because of stable cause, his insufficient aptitude would remain the same over time. Thus, he should not have a very high expectancy for success for future mathematics tests. On the other hand, if the student performed well in the examination and attributed his success to adequate mathematics aptitude, he should have higher expectations to perform well on the future mathematics examination. Similarly, it was a stable cause.

Weiner (1986) indicated that locus dimension refers to whether a cause is perceived as internal or external to the person. To illustrate, when a student did not do as well as in the past, he/she might attribute her performance to a difficult task (external), and he/she expected to try harder in the future (Pintrich & Schunk, 2002). The last one was *controllability* dimension (Weiner, 1986). For example; calculus has been perceived as difficult because of its abstract structure. It would still be abstract whatever student would do. It was an uncontrollable situation for some students (Tilley, 2009).

The three dimensions mentioned above have a considerable influence on individuals' expectancy for success beliefs (Pintrich & Schunk, 2002). If a person said that "I did

well on the test because I have the aptitude for it", then s/he would expect to succeed in the future because individual's attribution for success would be internal and stable. Similarly, if a person's attribution was unstable (luck, test-specific effort), then s/he would not expect to do well in the future. If one failed an examination and attributed it to lack of effort and inadequate studying, s/he could control this situation for the next examination and expect to do better in the future (Pintrich & Schunk, 2002). For future expectancies for success, a stable, internal, and uncontrollable attribution for failure, such as "I failed because I have no aptitude for mathematics", had the most damaging results. More explicitly, while positive emotions made the individual to pursue a task, try harder and persist longer on the task, negative emotions caused the individual to avoid the task in the future (Pintrich & Schunk, 2002).

The root of preservice teachers' negative mathematics related beliefs and mathematics anxiety could be attributable to prior school experiences, which were related to teachers' prior affect, experiences when they were student, and the effect of teacher education programs (Malinsky, Ross, Pannells, & McJunkin, 2006; Uusimaki & Nason, 2004). Negative experiences and mathematics anxiety of preservice primary school teachers were attributed to their teachers rather than parents, peers, or concepts regarding mathematics (Uusimaki & Nason; 2004). Therefore, in the light of the attribution theory, preservice early childhood education teacher's anxiety will be inspected through their attributions to success or failure in mathematics.

1.8 Significance of the Study

Several researchers (Ernest, 1989; Güven, Öztürk, Karataş, Arslan, & Şahin, 2012; Klibanoff & Levine, 2006; Lerman, 1983; Markovits, 2011; McLeod, 1988; Schoenfeld, 1985; Thompson, 1984) have stated that although subject knowledge determined the success and failure in mathematics, decisions, emotions, and beliefs had a considerable impact on mathematics achievement. Constructivist reform movements entailed changes in teachers and preservice teachers' perception of mathematics, learning, and teachers' role in the classroom (Simon & Schifter, 1991). Since the greatest interest towards mathematics is at the stage of early childhood, it is

required to well-prepare the curriculum to be implemented and train the early childhood teachers (National Association for the Education of Young Children [NAEYC], 2009). In other words, the quality of mathematics instruction in the schools is related to the quality of training of preservice and inservice early childhood teachers and elementary teachers (Battista, 1990).

Student's school experiences are important since students spend a considerable amount of time at schools (Fraser, 2001). Those experiences would affect their preferences of future careers in the long run. Gardner (1985) emphasizes that students' success is based not only cognitive ability but also other abilities such as interpersonal and intrapersonal skills. Intrapersonal skills are related to emotional ability. In detail, this ability involves the abilities of connecting to own feeling, separating them, and using them to lead behavior (Goleman, 1995). Those emotions have important roles in learning. As Md Suhaily and Riah (n.d.) state "When learning becomes a painful experience, emotions can hijack students' mental processes. These can be seen in their expression of their moods and feelings in their classes" (p.1). In learning and teaching mathematics, mathematics anxiety was found as the most important problem (Baloglu, 2001). Indeed, it is not only students' problem, because mathematics-anxious students mostly are taught by mathematics-anxious teachers (Martinez, 1987).

In their study, Trujillo and Hadfield (1999) found that all of the preservice elementary teachers they investigated were exposed to mathematics anxiety. There were common factors that those teachers had, such as negative school experience, inadequate family support, and general text anxiety. Especially, anxiety related to mathematics teaching is very common among the preservice teachers (Peker, 2009). Godbey (1997) emphasized that negative self-talk causes preservice teachers' mathematics teaching anxiety. If the preservice teachers regularly say themselves, 'I can't teach this concept', or 'I have never been good at mathematics teaching', or 'I just can't teach this problem solving', then they may not teach the mathematical concepts effectively in practice, because they are convinced that they cannot do it good (Peker, 2009). Since the mathematics anxiety influences learning (Martinez, 1987), teachers having higher mathematics anxiety may unconsciously transfer those

negative feelings to their students (Tobias, 1998; Vinson, 2001; Wood 1988) and build up the early growth of mathematics anxiety for their student (Vinson, 2001). Students may adopt their teachers' interest and eagerness towards teaching mathematics; however, teachers may not be aware of their insensitive and undesirable behaviors causing mathematics anxiety (Jackson & Leffingwell, 1999). If teachers want to make the lessons exciting for children, first they should handle their fears and negative attitudes, which influence their instruction style (Hadfield & McNeil, 1994). Because, compared to having lower mathematics-anxious elementary school teachers, higher mathematics-anxious teachers spend little time on planning and making mathematics related activities (Swetman, Munday, & Windham, 1993).

Studies on mathematics anxiety were generally conducted with elementary preservice teachers (Işıksal, Curran, Koç, & Aşkun, 2009) and very few studies focused on early childhood education teachers (Ginsburg, Lee, & Boyd, 2008). In their study, Johnson and VanderSand (2011) revealed that among the elementary, early childhood, deaf and hard of hearing, and special education preservice teachers, preservice early childhood teachers had the highest mathematics anxiety at the beginning of the methods course. Likewise, preservice teachers in these fields are found to express negative emotions for mathematics (Clark, Quisenberry, & Mouw, 1982 as cited in Rule & Harrell, 2006). Early childhood teachers had less content knowledge and less positive attitudes toward mathematics when compared to upper elementary teachers (Wilkins, 2008). However, very few studies have been conducted on early childhood teachers' teaching mathematics preparation (Ginsburg, Lee & Boyd, 2008). Furthermore, undergraduate degrees, especially undergraduate degree with early childhood does not provide sufficient knowledge and skills to teach mathematics for early years (Ginsburg, Lee, & Boyd, 2008). Besides not being trained, most of them are not pleased with their own skills related to mathematics (Stipek, 2008). Those teachers hate and fear mathematics, as a result of this, they do not acknowledge mathematics as crucial for involvement in the classroom (Stipek 2008). If learning mathematics is not given enough attention and early childhood teachers are not prepared to be effective mathematics teachers, they will continue avoiding mathematics, perform inefficient practices, and this eventually will result in

poor performance of children (Stipek, 2008). In brief, since the key to be successful in early childhood mathematics is the teachers, the most essential need is improving teacher training and support them (Ginsburg, Lee, & Boyd, 2008).

In their recent research, Bates, Latham, and Kim (2013) studied with preservice early childhood teachers and emphasized that although there were several studies which investigated preservice teachers' mathematics anxiety, there was not much study related specifically to preservice teachers' mathematics anxiety of the future teaching profession. Therefore, there is a need for exploring preservice early childhood education teachers' mathematics anxiety and mathematics teaching anxiety.

Mathematics teaching anxiety is a common fear among preservice teachers and it is related to teaching mathematics (Levine, 1993). It causes some symptoms, such as having intense tension, being unable to focus attention and not hear students, being easily angry, making negative talk with themselves, and having wet palms (Peker, 2009). Therefore, reducing mathematics teaching anxiety before starting to teaching profession is important in order to prepare preservice teachers who are confident and successful in teaching mathematics (Peker, 2006). Recognition of events causing or reducing mathematics teaching anxiety gives opportunity with teacher educators and mentors to organize and construct related practices addressed those events (Brown et al., 2012).

There is little information on what prior mathematics teaching experiences bring about anxiety for preservice teachers (Brown et al., 2011). The origin of mathematics anxiety lies under how individuals are taught mathematics (Downie, Slesnick, Stenmark, & Hall, 1983; Tobias, 1998). It is a crucial issue because teachers have a tendency to teach mathematics the same as they were taught (Furner & Berman, 2005). Mathematics-anxious teachers unconsciously pass their mathematics anxiety on to their students. Mathematics anxiety does not only come from mathematics itself, but also comes from how mathematics presented in school or childhood (Stuart, 2000). Early childhood education teachers generally don't have a firsthand knowledge of mathematics, they have negative attitudes towards mathematics, and they encounter difficulties while teaching mathematical concepts (Zacharos,

Koliopoulos, Dokimaki, & Kassoumi, 2007). Zacharos et al. (2007) have also addressed that the early childhood education teachers were unaware of important mathematical procedures such as reasoning, problem solving, connection with mathematics and children's ability of understanding the concepts. Therefore, there is a need to reinforce knowledge and skills of teaching mathematics to young children during teacher education (Zacharos et al., 2007). Moreover, mathematics method courses might possibly be the last chance to influence preservice teachers' affect towards mathematics (Harper & Daane, 1998; Plaisance, 2009). Method courses should be designed to help in building confidence on mathematics, minimizing mathematics anxiety, and providing effective teaching and learning environments (Harper & Daane, 1998). Method courses might help preservice teachers reflect on their past mathematics experiences and level of their anxiety, which would make them less anxious, become aware of their individual mathematics anxiety levels, and know the factors lead to mathematics anxiety (Harper & Daane, 1998).

1.9 Research Questions of the Study

Considering the importance of preservice early childhood education teachers' mathematics and mathematics teaching anxiety in early childhood settings, the purpose of this study was to describe preservice early childhood education teachers' mathematics anxiety and mathematics teaching anxiety before taking *Teaching Mathematics in Early Childhood* course and after completing it through asking their images, emotions, mathematics anxiety and mathematics teaching anxiety, and their sources throughout the course. Moreover, the relationship between the prior mathematics anxiety and mathematics teaching anxiety of preservice teachers were explored. This study employs *Teaching Mathematics in the Early Childhood* course as the context for investigating the images, emotions and specifically anxiety because it provides an environment in which preservice teachers deal with mathematics and teaching mathematics. It was also assumed that the influence of the course would be reflected on preservice teachers' mathematics and mathematics teaching anxiety specifically at the end of the course. More explicitly, this study aimed to answer the following research questions and subquestions:

1- How does the course influence preservice early childhood education teachers' mathematics related images and associated emotions?

a) What are the images and emotions of preservice early childhood education teachers before the Teaching Mathematics in Early Childhood course?

b) What are the images and emotions of preservice early childhood education teachers after the Teaching Mathematics in Early Childhood course?

2- How does the course influence preservice early childhood education teachers' mathematics anxiety?

a) How does the course influence preservice early childhood education teachers' level of mathematics anxiety?

b) What are the sources of preservice early childhood education teachers' mathematics anxiety?

3- How does the course influence preservice early childhood education teachers' mathematics teaching anxiety?

a) How does the course influence preservice early childhood education teachers' perceived level of mathematics teaching anxiety?

b) How does the course influence preservice early childhood education teachers' sources of mathematics teaching anxiety?

c) What are the key course experiences that influence of preservice early childhood education teachers' mathematics teaching anxiety?

4- How is preservice early childhood education teachers' mathematics anxiety related to their mathematics teaching anxiety?

1.10 Definition of Important Terms

Preservice Early Childhood Education Teacher: Third year Early Childhood Education Program students taking the TMEC course.

Mathematics Anxiety: Tobias (1998) describes mathematics anxiety as an "I can't syndrome, a feeling of uncertainty, of not being able to do well in mathematics or with numbers" (as cited in Gresham, 2007, p.182). For this study, it refers to preservice early childhood education teachers' rather negative feelings while dealing with mathematics operations and mathematical problem solving.

Mathematics Teaching Anxiety: Peker (2006) and Levine (1993) describe mathematics teaching anxiety as feelings of tension and anxiety hold by pre- and in-service teachers while teaching mathematical concepts, theories as well as formulas or during problem solving. In the present study, it refers to preservice teachers' anxiety regarding their ability to teach mathematics in order to make children engage in mathematics activities (Brown et al., 2011) and not to make them afraid of mathematics. It is experienced with respect to teaching process including the preparation and implementation of the activities (Gardner & Leak, 1994).

Emotions: "Emotions belong joy, pride, sadness, frustration, anxiety and other feelings, moods and emotional reactions" (Hannula, 2011, p.44).

Mathematics Related Emotions: It refers to preservice early childhood education teachers' feeling of joy (happiness), pride, sadness, frustration, anxiety, fear, anger, disgust and interest for when dealing with mathematics operations as well as problems.

Mathematics Related Images: Tall and Vinner (1981) described the *concept image* as "Total cognitive structure that is associated with the concept, which includes all the mental pictures and associated properties and processes" (p.152). In this study, mathematics related images refer to the all the mental pictures and related characteristics (concepts and procedures) of mathematics preservice early childhood education teachers held in their mind.

CHAPTER II

LITERATURE REVIEW

This chapter documented the importance of teaching mathematics in the early childhood and the related studies conducted abroad and in Turkey concerning mathematics anxiety, sources of mathematics anxiety, mathematics teaching anxiety, and its sources. Moreover, studies investigated the relationship between mathematics anxiety and mathematics teaching anxiety were presented.

2.1 Mathematics Education and Early Childhood

There has been a considerable increase in attention to mathematics education for children in the preschools since 2000s (Benner & Hatch, 2009). One reason for those interests that many children have started to attend early care as well as education programs, and financial support for prekindergarten programs is provided by several governments (Clements, 2001; Clements, Sarama, & DiBiase, 2004). Another reason is related to greater awareness towards the significance of mathematics (Kilpatrick, Swafford, & Findell, 2001) for individuals' future life. Research indicates that better mathematics education can and should begin in the early ages (Clements et al., 2004). Therefore, more attention has been given to learn mathematics before elementary school (Clements, 2001; Clements et al., 2004). Thus, mathematics education given to early childhood children is crucial. If rich and meaningful mathematical learning environments are provided for children, they will have powerful mathematical understanding in the coming years. Moreover, effective early mathematics experiences may prevent learning difficulties in the elementary school (Fuson, Smith & Lo Cicero, 1997; Güven et al., 2012). Therefore, learning environments are very important for children to encounter rich mathematical

experiences. In this process, early childhood education teachers have major roles (Güven et al., 2012).

Teacher quality is the best predictor of student success (Darling-Hammond, 2000). In addition to teacher quality, the quality of mathematics teaching in the early years is also important (Copple, 2004) for students' success in mathematics. However, early childhood educators view mathematics as a difficult topic to teach and they perceive mathematics as composed only of counting and simple arithmetic (Copley, 2010 as cited in McCray & Chen, 2012). Therefore, early childhood education teachers need a better understanding related to what comprises early childhood education mathematics and how they can construct that knowledge for the children. The significance of early childhood education teachers' need for good content knowledge is generally minimized or disregarded. However, the latest efforts in early years mathematics have formed an awareness emphasizing that teaching mathematics in preschool is critical as well as difficult (McCray & Chen, 2012).

The Ministry of National Education (MoNE, 2013) also placed importance on learning mathematics for the early ages in the recent Turkish Early Childhood Education Curriculum. The curriculum suggests that developing mathematical questioning skills of children with the help of mathematics activities should be aimed (MoNE, 2013). Because, learning mathematics helps in improving children's cognitive development, gaining positive attitude towards mathematics, connecting the prior knowledge children bring to preschool to the new knowledge, and understanding how and why the mathematical concepts are used (MoNE, 2013). In addition, it is aimed to develop mathematical inquiry skills of children with the help of mathematics activities. Objectives are related to the awareness of the patterns which take place in their environment, problem solving, reasoning and communication through using mathematical concepts (MoNE, 2013). Therefore, teachers should use real objects as much as they can in the mathematical activities and then should continue with symbols. They should emphasize the number of objects which are not more than 10. Measurement studies should be done and teachers should provide opportunities for children to use especially unstandardized measurement units, such as foot, pen, book, and toothpick. Establishing

relationships, matching, making pattern, ordering, counting, adding-subtracting, identifying shapes, and making graphs are some of the mathematics activities (MoNE, 2013).

Effective early childhood mathematics is deeper and broader than only practice in counting as well as adding. Children are well-interested in counting, sorting, building shapes, finding patterns, measuring, and estimating in their early childhood years (Clements, 2001). Therefore, mathematics in the preschool years consists of many important mathematics topics, such as graphs, pattern, geometry, matching, classification, numbers, and counting (Umay, 2003). Therefore, teachers are needed to be capable of bringing children meaningful and rich mathematical experiences.

Teachers are not only expected to have an effective knowledge and skills of mathematics, but also positive affect towards mathematics in order to provide students with meaningful learning experiences. Children have various emotions regarding mathematics, such as horror, helplessness, and terror. Emotions bring about weak academic performance on mathematics and avoidance of usage mathematics (Vinson, 2001) and most of the students don't like mathematics not only in school process but also after they graduate (Markovits, 2011). Therefore, it is crucial for teachers to teach mathematics in a positive way so that children can develop positive disposition toward learning mathematics.

2.2 Early Childhood Education Teacher and Mathematics

Phillippou and Christou (1998) found that teachers' opinions related to their self-effectiveness are important factors in terms of continuing a job or encountering a challenge such as teaching mathematics. It was found that while preservice early childhood education teachers are generally afraid of mathematics, they have more self-confidence in teaching language (Copley, 2004). Although mathematics is in everywhere in our lives, several teachers feel that they have restricted mathematics background. Early childhood teachers are found to have poor mathematics training, they are afraid of mathematics, and perceive mathematics as unimportant to teach to children, and teach mathematics ineffectively or not at all (Ginsburg, Lee, & Boyd, 2008). Many preservice and in-service early childhood teachers hate mathematics

and they are afraid of it, and they don't want to teach mathematics (Ginsburg et al., 2008). Generally, social, emotional, and physical activities are given more importance than the intellectual ones, such as teaching mathematics (Lee, 2006). Feeling not prepared or effective in teaching mathematics is reflected in teachers' practices. Layzer and colleagues (1993) observed that 15% of time in class was allocated to teaching mathematics and science whereas 29% of time was allocated to teaching reading and language in early childhood settings (as cited in Ginsburg et al., 2008). One reason might be that several early childhood college programs were unsuccessful in providing sufficient training in teaching early childhood mathematics education (Ginsburg et al., 2008). Therefore, enhancing and supporting preservice training is essential. Furthermore, more courses regarding early childhood mathematics education should be offered since there are not many adequate courses related to teaching mathematics in the early years (Ginsburg et al., 2008).

Teaching is influenced by past experiences of those who teach (Presto, Kevin, & Corey Drake, 2004, as cited in Lake, 2009). Most of the teachers don't have pleasant memories regarding mathematics. Those unpleasant histories make teachers have inadequate confidence and insecurity feelings in their mathematics teaching and they possibly affect their students' learning (Lake, 2009). Therefore, mathematics or science seemed difficult and early childhood teachers were reported not able to teach those subjects because of their fearful reaction towards to mathematics and science (Copley & Padron, 1998). However, children in the early ages coming to preschools approach mathematics in a natural way and they are interested in mathematics. This difference between the children and teachers' approach is a problem since children have a tendency to adopt their teachers' enthusiasm (Jackson & Leffingwell, 1999).

Hachey (2009) indicates that teachers' indifference and unawareness of importance of mathematics may be harmful for children who take their teachers as role-model. Therefore, teachers should recognize mathematics properly, aware of its place in daily life, use it in a correct way and know well what they will teach before introducing the early mathematics to children in a meaningful way (Umay, 2003). During preservice teachers' training process, Johnson and vanderSandt (2011) recommended that special care should be given earlier to identify the level of

mathematics anxiety and to work towards reducing the mathematics anxiety. Moreover, they suggested to use concrete manipulatives and to give importance to conceptual understanding in order to reduce preservice teachers' mathematics anxiety level. Preservice training is important in terms of development of preservice teachers' content knowledge and affect which influence the way mathematics is taught and its effectiveness in different grades (Burton, 2012).

2.3 Mathematics Anxiety

Uusimaki and Nason (2004) indicate that if one wants to understand the mathematics anxiety, first he should learn the complication of this term. However, when the literature is reviewed, there are several mathematics anxiety definitions and there is no common mathematics anxiety definition (Dede & Dursun, 2008). Mathematics anxiety can be defined by various emotions, such as dread, helplessness, frustration, as well as fear, and those feelings can reveal themselves in different ways of avoiding mathematics and implementation, and weaken mathematics performance (Gresham, 2008; Vinson, 2001). Mathematics anxiety was defined as a negative emotional reaction to situations related to mathematics and mathematical reasoning or problem solving (Ashcraft, Krause, & Hopko, 2007). Vinson (2001) states that mathematics anxiety is beyond disliking mathematics. It could be considered as a reaction given to every situation including mathematics which is also a threat to self-esteem (Deniz & Üldaş, 2008).

Mathematics anxiety includes both cognitive and affective components (Ashcraft & Faust, 1994; Bessant, 1995). Compared to people with less mathematics anxiety, high mathematics anxious people take fewer elective courses related to mathematics. Those people get lower scores in the examinations and have negative attitudes as well as perceptions regarding their mathematical ability. Avoidance of mathematics is the most important feature of people with high mathematics anxiety (Ashcraft & Moore, 2009). Beside the probability of being unsuccessful, having high anxiety leads to both emotional and physical discomfort and it also limits the career selection (Hendel, 1980). High mathematics anxious people commonly avoid the professions related to mathematics (Ashcraft, 2002; Meece, Wigfield, & Eccles, 1990).

Generally, ones who have higher levels of mathematics anxiety display more negative attitudes towards and have less self-confidence as well as less enjoyment of mathematics (Ashcraft, Krause, & Hopko, 2007). In brief, mathematics anxiety is a multidimensional construct including cognitive and affective origins (Bursal & Paznokas, 2006).

Bessant (1995) describes mathematics anxiety as a composition of negative attitude towards learning mathematics, fear of failure, lack of self-confidence and pressure of examinations. The mathematics anxiety as a psychological construct (Das & Das, 2013) leads to three symptoms: *Physical symptoms, psychological symptoms*, and *behavioral symptoms* (Plaisance, 2009). Heart rate, sweaty hand, pain in the stomach, and head constitute the *physical symptoms*. *Psychological symptoms* are related to focusing problems, feeling helpless, fear, and shame. Avoiding mathematics, postponing mathematics homework, and working irregularly generate *behavioral symptoms*. Mathematics anxiety is also critical in terms of its effect on students' mathematics performance and achievement. To illustrate, avoiding mathematics, feeling discomfort, blocking conceptual understanding, and having failure in memory process are some main outcomes of mathematics anxiety (Das & Das, 2013).

In their study, Johnson and vanderSandt (2011) mentioned a freshmen student who responded as "math makes me sweat" when asking her feelings about mathematics. Such findings in their study raised their concerns about potential effect of mathematics anxiety of preservice teachers on their prospective classrooms and their students' attitude, as well as performance. Their findings showed that the drawbacks of the current mathematics teacher preparation do not help in minimizing the mathematics anxiety. They addressed that it was worth to investigate how mathematics anxiety level of preservice teachers would be related to their areas of preparation or the courses preservice teachers enrolled in (Johnson & vanderSandt, 2011).

Malinsky, Ross, Pannells, and McJunkin (2006) chose their participants from college students coming from preservice early childhood education teachers, non-science majors taking physical science labs, and preservice middle school teachers. Since

identifying the students with mathematics anxiety is difficult, these researchers believed that the participants they chose would exhibit mathematics anxiety. To determine their level of mathematics anxiety, the Mathematics Anxiety Rating Scale-Revised (MARS-R) was implemented to 481 university students. Then, students were asked to reply as true or false to 12 myths related to mathematics. At the end of the study, a significant difference between the anxiety scores of students whose area was mathematics/science and the students in language arts/social studies was found. Anxiety scores of students in the language arts/social studies were higher than the anxiety scores of students in the mathematics/science. Since mathematics achievement and potential students of the preservice teachers may be influenced from the mathematics anxiety, the authors suggested finding ways to diminish the mathematics anxiety of prospective teachers.

Mitchell (1984) developed a model regarding mathematics anxiety process (as cited in Truttschel, 2002, p. 7). This model is given as in Figure 2.1.

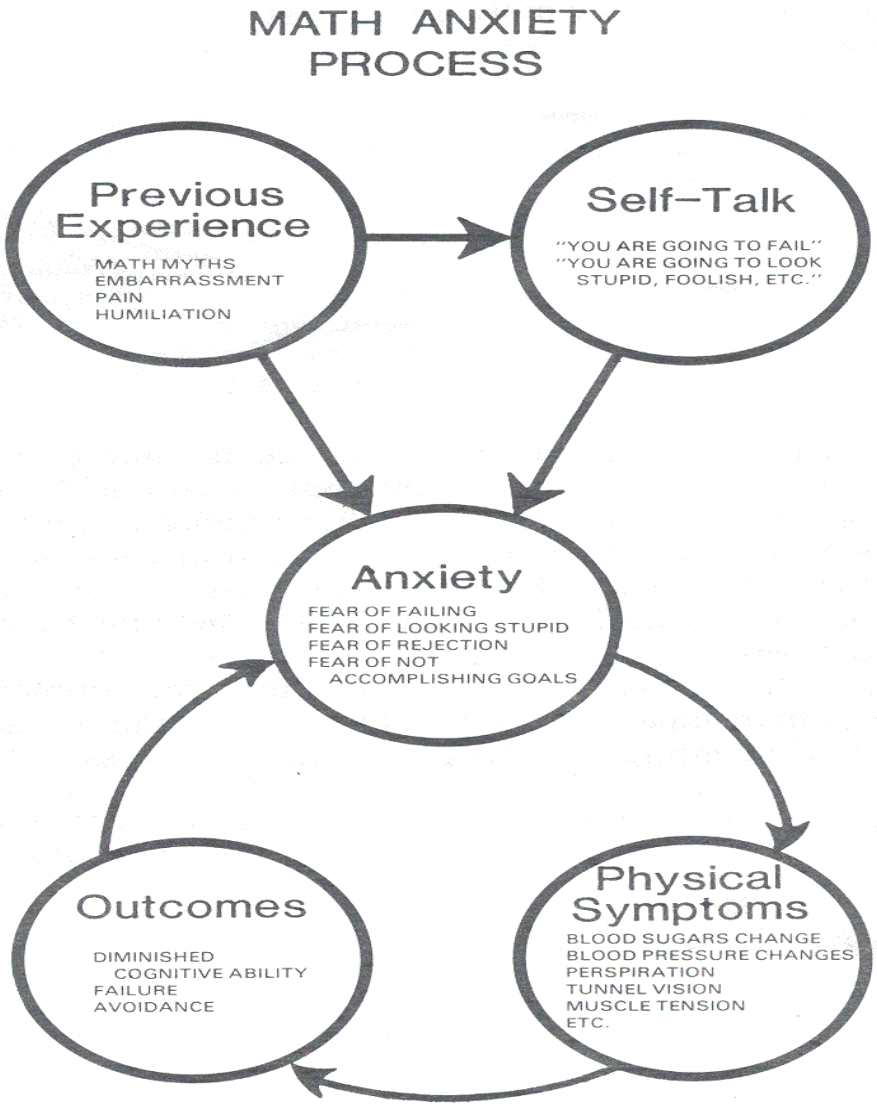


Figure 2.1 Mitchell's (1984) anxiety model. "Mathematics Anxiety at Chippewa Valley Technical College," by W. J. Truttschel, 2002, p. 7.

In this model, the sources of mathematics anxiety, its symptoms as well as outcomes are given in a circle path. Previous experiences directly or indirectly influence anxiety. *Math myths, embarrassment, pain*, and *humiliation* constitute the previous experiences. There is an indirect path coming from previous experiences which forms self- talk stage. This stage comprises negative thoughts that one consider the cases in which anxiety is brought about. In the model, the anxiety stage includes *fear of failing*, *fear of looking stupid, fear of rejection*. and *fear of not accomplishing goals*. However, this stage is not restricted to only those fears (Truttschel, 2002).

Anxiety creates physical symptoms such as *blood sugar changes, blood pressure changes, perspiration, tunnel vision*, and *muscle tension*. The physical symptoms produced the outcomes. In that stage, as a result of physical symptoms, one's cognitive ability are lessened and one encounters failure as well as avoidance. The outcome stage turns back again the anxiety stage which includes different fears. The path of process looks like a circle in which anxious people become a part of never-ending anxiety process.

2.4 Sources of Mathematics Anxiety

Studies related to mathematics anxiety have become widespread as researchers investigated the reasons for why many people avoided mathematics (Das & Das, 2013). There are several classifications related to sources of mathematics anxiety, but the common classification for the underlying reason of mathematics anxiety includes *environmental, intellectual,* and *personality sources* (Hadfield & McNeil, 1994). *Environmental factors* are related to negative experiences lived in the classroom, parent pressure, indifferent teachers, presenting mathematics as inflexible sets of rules, and passive classrooms (Tobias, 1990). *Intellectual factors* involve student attitude, inadequate persistence, low confidence on mathematics ability, being taught in a mismatched learning style, and inadequate perception on usefulness of mathematics (Miller & Mitchell, 1994). Being unwillingness to ask questions because of fear, having low self-esteem and considering mathematics as a male dominated area are indicators of *personality factors* (Levine, 1995; Miller & Mitchell, 1994).

Similarly, Baloglu and Koçak (2006) found three sources lying under the mathematics anxiety in Turkey: *Situational, dispositional*, and *environmental sources*. *Situational sources* are related to the nature of mathematics and teaching mathematics. *Dispositional sources* involve individuals' emotional and physiological features. Individuals' prior perceptions, attitudes, and experiences constitute *environmental sources* (Baloglu, 2001). Yushau, Bokhari, Mji, and Wessels (2004) emphasized that the negative emotions that the teachers hold, transferring those emotions to students and low-qualified teaching bring about mathematics anxiety.

Repeated failure in the past and bad study habits (Ho et al., 2000) are also considered as reasons for mathematics anxiety.

The sources of mathematics anxiety vary depending on the individuals' experiences. While for some individuals, mathematics anxiety take its source from poor teaching, shame and/or scorn; for other individuals, mathematics anxiety is related to teachers who had mathematics anxiety, parents, siblings, peers, or some of them attribute their mathematics anxiety to numbers or merely some operations (Stuart, 2000). Inadequate and negative family support also cause mathematics anxiety and lack of self-confidence for children (Stuart, 2000). On the other perspective, the support which was given by the family who were not good at mathematics in the past years may not be persuasive for the students who know that reality, because the student knows that his mother or her mother was unsuccessful in mathematics, or they had problems related to mathematics in the previous years, and their emotions take automatically similar forms (Alkan, 2010). Families who were afraid of mathematics and did not comprehend the importance of mathematics could not give sufficient support for their children (Zaslavsky, 1994). If parents always state their lack of success in mathematics, then the desire of their children towards learning mathematics and science becomes suppressed (Copley & Padron, 1998). Besides, some students' mathematics anxiety is increased when they are humiliated by peers (Alkan, 2010).

Mathematics anxiety for many students might start in the elementary school (Harper & Daane, 1998). The underlying reason for mathematics anxiety was, most of the time, inadequate teacher subject knowledge (Plaisance, 2009), strict teaching style, and impractical problems or situations in elementary mathematics classrooms (Hilton, 1980). Indeed, teacher behavior was found as a major factor for mathematics anxiety (Jackson & Leffingwell, 1999). Teachers who had mathematics anxiety can consciously or unconsciously transfer their anxiety to their students (Bulmahn & Young, 1982; Lazarus, 1974). One reason for this might be teachers' behaviors consisting "inability to explain concepts, lack of enthusiasm for subject matter, and lack of patience with students" (Plaisance, 2007, p. 110) in the classroom.

Preservice teachers' negative opinions and anxiety regarding mathematics arise from their earlier experiences with mathematics and inadequate procedural and conceptual knowledge they have (Vinson, 2001). The relationship between previous negative experiences with mathematics and mathematics anxiety were revealed in several studies. According to Rossnan (2006), prior negative experiences of students in the classroom or at home cause mathematics anxiety. Those negative experiences are carried over to potential works related to mathematics and result in inadequate mathematics understanding. Furthermore, instructional conditions were also found as another source of mathematics anxiety (Fiore, 1999). Especially, ineffective teaching methods used in past mathematics courses resulted in mathematics anxiety (Tobias, 1978). In his study, Fiore (1999) emphasized that students' mathematics anxiety was caused by their teachers and how they were taught mathematics. Similarly, anxious preservice teachers suffered from the previous mathematical experiences, they felt themselves unsuccessful, did not study mathematics much since they considered mathematics useless, and believed that they had insufficient subject knowledge (Reyes, 1984).

In conclusion, it can be seen that from primary school to university, students and preservice teachers have mathematics anxiety and they dislike mathematics due to various sources. It has been found that both cognitive style and learning style are to some extend related to mathematics anxiety (Hadfield & McNeil, 1994). Investigating the sources of mathematics anxiety is essential in order to inspect emotional and cognitive dimensions of mathematics anxiety (Ashcraft, 2002).

2.5 Mathematics Teaching Anxiety

Mathematics teaching anxiety or teachers' anxiety in teaching mathematics does not appear much in the literature compared to mathematics anxiety. While mathematics anxiety was related to ones' own insufficient content knowledge and confidence, mathematics teaching anxiety displays how individuals measure their ability to have interaction with children and engage them in mathematics (Brown et al., 2011). Recently, studies separating mathematics teaching anxiety from general mathematics anxiety has been receiving more attention (Brown et al., 2012). Yet, it seems that

mathematics teaching anxiety is mostly addressed in studies about mathematics anxiety because mathematics anxiety influences teaching mathematics (Hembree, 1990; Vinson, 2001). Therefore, in this part, studies on mathematics anxiety which also address teaching related anxiety are explained.

Teachers who have high level mathematics anxiety show disposition to implement more traditional methods. Instead of conceptual understanding, they select lecturing method or rote learning, and spend less time on problem-solving, games, and different types of instruction (Hembree, 1990; Vinson, 2001). Similarly, in his study, Bush (1989) found that mathematics anxious teachers had inclination to use traditional teaching. Their students did more seat works and had less time on playing games, doing small group activities, and problem-solving. Students learned less concepts and more skills because of their teachers' rather negative tendency to mathematics (Bush 1989). Since nontraditional activities including playing games, small group instruction, specialized instruction, and problem solving entail more mathematics and management risks, those teachers don't want to take risks due to their mathematics anxiety (Bush, 1989). It can be understood that teachers who have mathematics anxiety use traditional approaches in their teaching, which might indicate high level mathematics teaching anxiety.

Minimizing mathematics teaching anxiety before being a teacher is vital in terms of starting the teaching profession with success and confidence (Peker, 2006). Teachers with mathematics anxiety may account for early anxiety in their children, which is very likely to influence their students' mathematics achievement negatively (Martinez, 1987). Moreover, Schmidt and Buchmann (1983) found that there was a relationship between the emphasis elementary teachers considered should be given mathematics and the time they spared to make mathematics. Their study revealed that if teacher gave much importance to mathematics, they spent more time on it. They also found that if teacher enjoyed teaching a content area much, the time allowed for the content may also be high. The differences in the allocated time depended on the teachers' preferences. If the teachers felt that the content was difficult to teach, they spent less time on it. Specifically, teachers who had mathematics anxiety spent 50% less time on the activities related to mathematics

than the other teachers who liked mathematics (Schmidt & Buchmann, 1983). Similarly, Bulmahn and Young (1982) reported that mathematics was described by the elementary preservice teachers, who hated mathematics, as the worst subject among the all courses which they would have to teach when they graduated. Those studies lead to doubts regarding preservice early childhood education teachers' potential efficiency in teaching mathematics to students of younger ages.

Aktaş Arnas (2009) indicates the importance of early ages when many fundamental mathematical concepts arise. Mathematics in the primary school is affected by the experiences of mathematics in the early childhood years (Henniger, 1987). Kilpatrick, Swafford, and Findell (2001) reported in their studies that preservice early childhood education teachers did not have enough mathematics pedagogical content knowledge in their undergraduate year and they did not show positive beliefs and attitudes toward mathematics. However, early childhood teacher's attitudes toward mathematics is crucial while forming children's positive attitude related to mathematics and not having mathematics anxiety (Aslan, 2013). Because the starting point of mathematics anxiety generally is attributed to negative classroom experiences which are perceived powerful and unforgettable (Tobias, 1978). Those negative experiences with mathematics teachers may enhance the mathematics anxiety.

2.6 A Framework of Mathematics Anxiety and Mathematics Teaching Anxiety

In their study, Brown et al. (2011) examined the assumption that preservice elementary teachers who had prior mathematics anxiety would have mathematics teaching anxiety and preservice elementary teachers who have little or no prior mathematics anxiety would have little or no mathematics teaching anxiety. While some preservice teachers supported the assumption in their study, some did not. The Framework of Mathematics Anxiety (MA) and Mathematics Teaching Anxiety (MTA) in Brown et al.'s (2011) study is given as Table 2.1 below.

Table 2.1

Framework of MA and MTA Results

	NO-MA	**YES-MA**
	No: Prior Mathematics Anxiety (MA)	Yes: Prior Mathematics Anxiety (MA)
NO-MTA		
No: Mathematics Teaching Anxiety (MTA)	Quadrant A: No-MA, No-MTA	Quadrant B: Yes-MA, No-MTA
YES-MTA		
Yes:Mathematics Teaching Anxiety (MTA)	Quadrant C: No-MA, Yes-MTA	Quadrant D: Yes-MA, Yes-MTA

Note. "Elementary Pre-service Teachers: Can They Experience Mathematics Teaching Anxiety without Having Mathematics Anxiety?," by A. B. Brown, A. Westenskow, P. S. Moyer-Packenham, 2011, *Issues in the Undergraduate Mathematics Preparation of School Teachers: The Journal, 5*, p. 6.

Table 2.1 reveals the interaction of MA and MTA for preservice teachers. There are four quadrants showing the existence of MA and/or MTA or absence of MA and/or MTA. In detail, preservice teachers in Quadrant A means that these preservice teachers have little or no MA and no MTA. On the other hand, Quadrant D means that these preservice teachers have both MA and MTA. The preservice teachers classified in Quadrant A and Quadrant D fit assumptions of MA and MTA. The prior assumption is that preservice teachers with prior MA will have MTA and preservice teachers without MA will not have MTA. However, preservice teachers in the Quadrant B and Quadrant C challenge these assumptions. In detail, Quadrant B means that these preservice teachers have MA, but they have little or no MTA and Quadrant C mean that these preservice teachers don't have high MA, but they have MTA. Teachers in Quadrant B and Quadrant C challenge the common assumption that MA causes MTA. These teachers are important for teacher educators because they can teach mathematics effectively regardless of their mathematics anxiety level. Based on the common assumption, mathematics anxiety is considered as a pre-

existing condition and therefore mathematics teaching anxiety which develops in consequence of teaching mathematics is ignored (Brown et al., 2011).

2.7 Sources of Mathematics Teaching Anxiety

Despite the considerable number of studies on mathematics anxiety and its sources, less is known about mathematics teaching anxiety of preservice teachers (Brown et al., 2012). Among the few studies conducted on mathematics teaching anxiety, Brown et al.'s (2012) study investigated the preservice elementary teachers' reflections regarding their teaching mathematics experiences at the end of the field practice for whether their mathematics teaching anxiety was increased or decreased. They categorized the sources of mathematics teaching anxiety as *adapting to established teaching structures, preparing for the mathematics classroom*, and *recognizing personal attributes for mathematics teaching* and among the three categories, 10 key themes appeared from the participants' reflections regarding teaching experiences. Research related to internal-external locus of control (Rotter, 1966) was used while constructing these categories and the categories were described from the most externally focused to the most internally focused. In addition, categories and themes that increased MTA, reduced MTA or sometimes increased and other times reduced were found.

Brown et al. (2012) addressed that *adapting to established teaching structures* included resources, curricular structure, classroom management, and supervision which were related to existing classroom environment where preservice teachers would have no control on them (external locus of control). They stated that *preparing for the mathematics classroom* included observing other teachers, practice and reflection, preparation, and children's understanding. For this category, preservice teachers were sometimes able to have control over their mathematics related teaching experiences in the field practice. *Recognizing personal attributes for mathematics teaching* included emotional impact and previous experiences with mathematics. Preservice teachers felt more internal locus of control in this category (Brown et al., 2012).

2.8 Studies Related to Mathematics Anxiety and Mathematics Teaching Anxiety

Although the studies regarding mathematics anxiety has launched in 1950s in United States, still there is not much study conducted in Turkey (Aydın, Delice, Dilmaç, & Ertekin, 2009). Therefore, there is a need for future research investigating Turkish students' mathematics anxiety levels and the factors influencing that anxiety (Baloglu, 2001).

Several studies (Bursal & Paznokas, 2006; Gresham, 2007; Vinson, 2001) have shown that preservice teachers had high anxiety level in mathematics. To illustrate, in Bates, Latham, and Kim's (2013) study, preservice early childhood teachers had different kinds of fears related to mathematics and there were several reason underlying their mathematics fear. The authors studied with 89 female (48% juniors, 52% seniors) preservice early childhood teachers. The preservice early childhood teachers were asked to determine their specific fears related to mathematics and the reasons underlying the fears were examined through an open-ended survey. Outcomes of the study revealed that preservice early childhood teachers had various fears related to mathematics, such as *mathematics content knowledge fear, mathematics teaching fears, student success fears,* and *fears of personal mathematics experiences.* In fact, participants believed that they were not much afraid of the content, they had accepted a stigma related to fear of the mathematics content since their childhood, which was the main reason of that anxiety. Inadequate experiences in the teacher education program, different teaching methods and wide range age group made participants fear mathematics. Moreover, some participants were afraid of affecting the mathematics success of their students. The common fears were related to inadequate confidence for teaching ability, insufficient knowledge on teaching methods, a lack of ability to engage students, and inadequate mathematics content knowledge. Therefore, Bates et al. (2013) suggested that teacher educators should put effort to understand the reasons caused anxiety and pay attention to those factors while planning courses and teaching methods. Furthermore, they recommended that preservice teachers and teacher educators may make collaboration and teacher preparation programs may supply essential training in order to train the highest quality preservice teachers. Bates et al. (2013) emphasized that since the

early childhood teachers have major effect on the children's learning mathematics, potential early childhood teachers may be informed on the value of mathematics for young children. Moreover, they should learn to believe themselves and be aware of their capabilities regarding mathematics. It was suggested that preservice teachers may have more opportunity in the field practice, which diminish fear on teaching as well as insufficient experience. In other words, putting the preservice early childhood teachers in the class and wanting them to only observe the teaching of mathematics may not be enough for teaching mathematics (Bates et al., 2013). Therefore, what researchers recommended was that teacher education programs should consider both the mathematics goals of early childhood years and mathematics pedagogy courses so as to reveal chances for the new teachers to change their expectations related with the curriculum. This will let preservice teachers have hands-on experiences to construct their effectiveness related to both the subject matter and teaching mathematics (Bates et al., 2013). Further research related to exploring the influence of more mathematics content courses, method courses, and in-depth experiences may enrich understanding of the preservice teachers' mathematics fears (Bates et al., 2013).

Methods of mathematics teaching courses have been effective in diminishing mathematics anxiety (Gresham, 2008; Rule & Harrell, 2006; Tooke & Lindstrom, 1998). Since mathematics anxiety affects mathematics performance, method courses should be well-designed so that the preservice teachers who have mathematics anxiety can find the chance to decrease their anxiety and improve positive attitude toward teaching mathematics (Bursal & Paznokas, 2006). While designing teacher education programs, different mathematics anxiety level of preservice teachers should be considered (Bursal & Paznokas, 20006) and method courses and field experience courses should engage in the improving of preservice teachers' mathematical beliefs and minimizing mathematics anxiety (Haciomeroglu, 2013).

Vinson (2001) investigated the effect of method course on preservice teachers' mathematics anxiety and implemented the Mathematics Anxiety Rating Scale (MARS) to 87 preservice teachers who were taking mathematics methods course at the beginning and at the end of the course. The research was based on the Bruner's

theory which emphasizes developing conceptual understanding and using manipulatives as well as concrete materials. At the end of the study, preservice teachers' overall mathematics anxiety was significantly decreased. During the interviews, preservice teachers claimed that they understood the mathematics topics well because they worked with concrete materials as well as pictorial presentations. However, some candidates' anxiety level was increased because they did not have any experience with manipulatives. While they were learning how to use manipulatives, they were also relearning the mathematics topics. Gresham (2010) studied with 52 special education preservice teachers and inspected their mathematics anxiety before and after method course. Data were collected through MARS, informal discussions, and different interview techniques. Outcomes displayed that the mathematics anxiety of special education preservice teachers was significantly reduced.

Aslan (2013) conducted a study with preservice and in-service early childhood teachers in order to investigate their mathematics anxiety as well as beliefs regarding mathematics for young children in Turkey. Fifty freshmen and 50 senior preservice early childhood education teachers, and 50 in-service early childhood education teachers participated in the study. Beliefs Survey (Platas, 2008) and Math Anxiety Scale (Bai, 2010) were employed to collect data. It was found that compared to preservice teachers, in-service teachers had more mathematics anxiety. In-service teachers' backgrounds were social studies major area and they had less mathematics course in high school, which might have resulted in more mathematics anxiety. Senior preservice early childhood education teachers who had taken the teaching mathematics course had higher beliefs scores than the freshmen preservice teachers. However, preservice teachers had very little experience regarding teaching mathematics. Since teachers' mathematics anxiety leads to their children' mathematics anxiety, Aslan (2013) emphasized the need for minimizing the mathematics anxiety of in-service teachers.

There are different findings for the effect of teachers' mathematics anxiety on students' mathematics anxiety and achievement. Beilock, Gunderson, Ramirez, and Levine (2010) found that female teachers' mathematics anxiety had a considerable

effect on female students' mathematics achievement in the elementary school. However, Aslan, Gürgah Oğul, and Taş (2013)'s findings were not in line with the studies mentioned before. They inspected the influence of early childhood education teachers' mathematics anxiety as well as beliefs on children's mathematics achievement. There were 400 six years old children who participated in the study. Data were collected through Beliefs Survey (Platas, 2008), Math Anxiety Scale-Revised (Bai, 2010), Number and Operation Task (Aktaş Arnas, Deretarla-Gül & Sığırtmaç, 2003), and Geometric Shapes Sorting Task (Aslan & Aktaş Arnas, 2007). Beliefs Survey and Math Anxiety Scale-Revised conducted for teachers and Number and Operation Task, and Geometric Shapes Sorting Task were implemented to children. It was found that while teachers' mathematics anxiety had no significant effect on children's achievement related to number, operation, and geometric shapes, their beliefs had a significant impact on achievement of children.

In his research, Bush (1989) investigated teacher mathematics anxiety and its relation to changes in chosen teaching practices, student mathematics anxiety and achievement, and characteristics of teachers. He studied with 31 fourth, fifth, and sixth grade teachers and 584 students of them. Based on the MARS scores, teachers' mathematics anxiety showed rather large range from 101 to 304. There was a negative relationship between the teachers' mathematics anxiety and the time allocated to whole-class instruction. On the other hand, a negative relationship was found between the teachers' mathematics anxiety and number of questions students asked. Compared to mathematics anxious teachers' students, the students whose teachers were not mathematics anxious asked more than twice questions during the instruction. There was not a significant relationship between teacher's mathematics anxiety and the changes in their students' mathematics anxiety, but in teaching practices, few significant differences were found. For instance, while mathematics anxious teachers gave importance to traditional teaching, such as seatwork, whole instruction, they ignored the nontraditional activities such as problem solving, playing games and small group instruction due to their mathematics anxiety and they did not want to take risk during the instruction.

Trujillo and Hadfield (1999) investigated preservice elementary teachers' mathematics experiences during elementary school, high school, college and in their family. The analysis for the sources of their anxiety revealed five major categories: *Self perceptions related to mathematics anxiety, school experiences related to mathematics, family influences on mathematics attitude, mathematics text anxiety,* and *future plans for teaching mathematics to children.* It seemed that a combination of negative experiences and inadequate family support resulted in negative feelings. They also had test anxiety and fear of teaching mathematics. However, preservice teachers were eager to use constructivist and age-related methods in teaching mathematics in their future teaching profession. The preservice teachers had awareness on their negative feelings towards mathematics and they were cautious not to pass them to the students. It was inferred that the university mathematics methods course had positive influence on these participants' attitude. In conclusion, Trujillo and Hadfield (1999) indicated that it might not be possible to make every teacher like mathematics, but it is possible to help them be aware of their mathematics anxiety level in order to identify and minimize their mathematics anxiety.

Likewise, Uusimaki and Nason (2004) studied with 18 third year preservice primary teachers to explore the sources of their mathematics anxiety and beliefs. Most of the participants attributed their mathematics anxiety to prior school experiences, generally to primary school. Researchers found that if the participants felt themselves under evaluation, such as in a test situation or in the teaching practice, they had the most anxiety. Moreover, some topics such as algebra, space, and number sense were described as the specific mathematics concepts leading to higher mathematics anxiety among the candidates.

In their study, Harper and Daane (1998) investigated the 53 elementary preservice teachers' mathematics anxiety levels before and after taking a mathematics methods course. Interviews were conducted with participants whose score showed the biggest difference between pre- and post-tests and the factors causing mathematics anxiety were asked to participants. *Finding correct answer, solving word problems, being afraid of making mistakes, having timed tests,* and *being insecure* were the common factors causing mathematics anxiety. Those sources have started in elementary

school and classroom teacher was generally seen as the responsible for them (Harper & Daane, 1998).

Jackson and Leffingwell (1999) investigated the role of teachers from kindergarten through college in constructing mathematics anxiety on preservice teachers and aimed to identify the level that the mathematics anxiety first experienced by the students. Researchers asked 157 preservice teachers to describe their worst experience or experiences that made them the most stressed when they were successful in mathematics. Participating students were to teach mathematics and more than one-third of them had baccalaureate degree. It was found that while only 7% (11 students) had positive experiences with mathematics, 146 students had negative mathematics experiences from kindergarten through college. At the elementary level, specifically grades 3 and 4 were the grades that the student first experienced mathematics anxiety although some had it at kindergarten or 1st grade. Jackson and Leffingwell (1999) categorized the sources underlying the mathematics anxiety based on the grade levels. *Complexity of material*, *aggressive behavior of instructors, gender bias, insensitive* and *uncaring view* caused mathematics anxiety for the elementary level. *Instructors' angry behavior, instructors' unrealistic expectation, gender bias*, and *instructors' insensitive and uncaring attitude* were the reasons for mathematics anxiety for the high school level. In addition to this, some students felt ashamed in front of their friends because their instructors forced them to go to board. For college level, *communication and language barriers, instructors' insensitive and uncaring attitude, quality of teaching, students' evaluation type, instructor's displeasure on level of class* as well as *gender bias* caused mathematics anxiety. Sixteen per cent of students indicated that their mathematics anxiety launched first in the elementary grades. While 26% of the candidates experienced mathematics anxiety first at the high school, 27% of them had it at the college level (Jackson & Leffingwell, 1999). The results displayed that the negative background of students is very deep that mathematics anxiety might remain for 20 or more years.

Levine (1993) investigated the mathematics teaching anxiety of preservice elementary teachers through the methods course. A significant decrease in teaching mathematics anxiety was found from the beginning of the methods course to the end

of it. McGlynn-Stewart (2010) designed a new course on learning and teaching mathematics from kindergarten to grade 3 for her preservice students who had fears related to learning and teaching primary mathematics. She gave opportunity to the preservice teachers to practice at the university and primary classrooms. Students were asked to determine their fears and anxieties related to mathematics as well as teaching mathematics. Besides, the researcher supported peer learning and wanted the preservice teachers to practice in the real primary classroom environments. Students' perspectives were considered to design and develop course for the second time. McGlynn-Stewart (2010) found that preservice teachers were afraid of failing the course, not comprehending the mathematics content and the teaching strategies, and they feared of being unsuccessful during the real teaching experience. In order to prepare an activity, students came together and discussed, which developed their positive attitudes and confidence. Moreover, teaching in the real environment as an assignment of method course helped the preservice teachers in improving their attitudes towards learning and teaching mathematics. It was also seen that their anxiety was reduced at the end of the method course. The key experience for preservice teachers about their mathematics teaching anxiety seems to be the methods of teaching mathematics courses.

Research has also investigated the relationship between mathematics anxiety and mathematics teaching anxiety. Brown et al. (2011) investigated the relationship between preservice teachers' prior mathematics anxiety experiences and their mathematics teaching anxiety. Specifically, prior experiences regarding mathematics was the focus of their study. According to prior assumption, preservice teachers with high mathematics anxiety did not enjoy teaching mathematics and on the other hand preservice teachers who did not have prior experiences would show a positive tendency towards teaching mathematics. Cases that fit and challenge the prior assumptions regarding mathematics anxiety and mathematics teaching anxiety were revealed and findings of the study showed that one-third of the elementary preservice teachers with high prior mathematics anxiety stated that they did not have any experience of mathematics teaching anxiety. Brown et al. (2011) found that mathematics anxiety and mathematics teaching anxiety might not always be related.

They suggested that in order to support successful mathematics teaching for preservice teachers, the connections should be known (Brown et al., 2011).

Hadley and Dorward (2011), on the other hand, found a positive relationship ($r = .42$, $p < .001$) between teachers' mathematics anxiety and their mathematics teaching anxiety. More specifically, the findings indicated that if teachers had no mathematics anxiety, they would most likely have no anxiety regarding teaching mathematics. However, if teachers had higher anxiety related to mathematics, there was not a clear cut on mathematics teaching anxiety. While some teachers had moderate or low mathematics teaching anxiety, others had higher teaching mathematics anxiety. Similarly, Gresham (2008) reports that mathematics anxiety is ambiguous since it is related to an anxiety that the preservice teachers met with the prospect of teaching mathematics.

2.9 Summary of the Literature Review

Mathematics education for early years has gained importance since 2000s (Benner & Hatch, 2009). Beside to teacher quality, the quality of mathematics teaching is crucial (Copple, 2004). Early years mathematics cannot be considered as only counting and adding. There are many topics that children are well-interested in counting, sorting, pattern, shape, measurement and estimating (Clements, 2001). Thus, teachers should provide children with meaningful and rich mathematical experiences. Furthermore, teaching in a positive way is also important in terms of students' positive disposition towards learning mathematics. Many preservice and in-service early childhood teachers dislike mathematics and they are afraid of it, and they don't want to teach mathematics (Ginsburg et al., 2008). Their lack of interest and unawareness of importance of mathematics may be harmful for children who take their teachers as role-model (Hachey, 2009).

There are many definitions of mathematics anxiety. It includes both cognitive and affective components (Ashcraft & Faust, 1994; Bessant, 1995). High mathematics anxious individuals take fewer elective courses regarding mathematics and get lower scores in the examinations. Their attitudes and perceptions on their mathematical ability are negative (Ashcraft & Moore, 2009). Moreover, having high anxiety leads

to both emotional and physical discomfort, and restricts the profession selection (Hendel, 1980). Studies conducted from primary school to university displayed that students and preservice teachers have mathematics anxiety and they dislike mathematics due to various sources. There are different classifications for the sources of mathematics anxiety, but the common classification *consists of environmental, intellectual*, and *personality sources* (Hadfield & McNeil, 1994).

It was seen that compared to mathematics anxiety, mathematics teaching anxiety was not mentioned much in the literature. Mathematics teaching anxiety shows how individuals measure their ability to have interaction with children and engage them in mathematics (Brown et al., 2011). Studies related to mathematics anxiety and mathematics teaching anxiety reveled that methods of mathematics teaching courses have been effective in reducing both anxieties. Minimizing mathematics teaching anxiety before being a teacher is crucial in terms of starting the teaching profession with success and confidence (Peker, 2006). Therefore, knowing sources causing mathematics teaching anxiety is important to understand and pay attention to those factors while planning courses and teaching methods (Bates et al., 2013). Brown et al.'s (2012) categorized the sources as *adapting to established teaching structures, preparing for the mathematics classroom*, and *recognizing personal attributes for mathematics teaching*. Moreover, these researchers in their study (2011) investigated the relationship between prior mathematics anxiety and mathematics teaching anxiety of preservice elementary teachers. It was seen that while some participants supported the prior assumption, others challenged it. In detail, one-third of the elementary preservice teachers with high prior mathematics anxiety stated that they did not have any experience of mathematics teaching anxiety. They found that mathematics anxiety and mathematics teaching anxiety might not always be related. In order to support successful mathematics teaching for preservice teachers, the connections should be known (Brown et al., 2011).

CHAPTER III

METHOD

The purpose of this study was to describe preservice early childhood education teachers' mathematics anxiety and mathematics teaching anxiety before taking *Teaching Mathematics in Early Childhood* course and after completing it through asking their images, emotions, mathematics anxiety and mathematics teaching anxiety, and their sources throughout the course. Moreover, the relationship between the prior mathematics anxiety and mathematics teaching anxiety of preservice teachers were explored. In this chapter, first the context of the study is presented. Then, design, participants, and data collection instruments are introduced. This was followed by data collection procedures and data analysis. Last, trustworthiness of the research design was described.

3.1. The Context

3.1.1 Early Childhood Teacher Education Program

The history regarding early childhood education in Turkey dates back to Ottoman era. Unlike today's preschools, religious instruction was frequently given to young children in that era (Kapci & Güler, 1999). Early childhood education teachers were coming from various educational backgrounds and these teachers were not obligated to get a college degree until 1970s. Therefore, there were differences in teachers' training in terms of duration and quality. Generally, Child Development and Education Departments of Vocational High Schools were training these teachers. In 1980, two-year Early Childhood Teacher Education Programs were built and then, in 1991, these programs were transformed into four-year programs (Gürşimşek, Kaptan,

& Erkan, 1997). Then, the Turkish Higher Education Council (HEC) restructured all teacher education programs in 1998 and gave importance to practice, elective courses as well as methodology (HEC, 1998).

The 1998 curriculum lasted eight years and some curricular changes made in 2006. Gelişli and Yazıcı (2012) stated that while in 1994 and 2002 early childhood programs focused on behaviorist approach, the early childhood program in 2006 employed a constructivist approach with consideration of multiple intelligences. However, the 2006 program has also been reviewed because of the feedbacks coming from the national and international studies conducted and views regarding implementations (Ministry of National Education, (MoNE), 2013). Moreover, with the help of the Project on the Improvement of Early Childhood Education, existing needs assessment were taken into consideration and studies related to development of program was done in 2012-2013 years (MoNE, 2013). It was expected that this 2013 program would contribute to the development of children in the early childhood education throughout Turkey, increase of the quality of program, and provide guidance to teachers as well as managers (MoNE, 2013).

Teachers who are well-qualified have a great value on children's learning. Compared to other teachers, those qualified teachers feel more confident and successful in the teaching process (Darling-Hammond, 2000). Therefore, policymakers made some revisions on the national teacher education curricula. Based on the latest curriculum revisions, the current Early Childhood Education (ECE) Program focuses on developmental, holistic, and eclectic nature of the early childhood period. In the undergraduate curriculum, there are several obligatory and elective courses, such as music, science, mathematics, psychology, art, drama, and practicum. ECE programs are four-year programs.

The study was conducted in an ECE program under the Department of Elementary Education at an English-medium public university in Ankara, Turkey. All university programs in Turkey, including teacher education programs, enroll students through the national university entrance examination which is held once a year. Students in the last year of high school or who have already graduated can take the university

entrance examination. The undergraduate curriculum of Early Childhood Teacher Education Program is given in Appendix A. Although the curricula of teacher education programs are determined by the Higher Education Council in Turkey (2007), universities may have certain flexibilities. Preservice early childhood education teachers in this program take *Teaching Mathematics in Early Childhood (TMEC)* course in the Fall semester of the third year of the program. They take *School Experience* course and go to the kindergartens for the first time in the program as preservice teachers in the same semester.

3.1.2 Teaching Mathematics in Early Childhood (TMEC) Course

I was the instructor of the TMEC course. This course aims to help preservice teachers in developing an understanding of mathematics and mathematical development of children, and to form mathematics related positive images and emotions, and to decrease preservice teachers' mathematics teaching anxiety. Since preservice teachers had this opportunity to learn teaching mathematics for the early ages in the program, which might be the only context that they can reach many resources, I dedicated myself to eliminate any misunderstandings and discouragement in the best way I can and not to develop negative dispositions toward teaching mathematics.

The course composed of both lecture and activity presentations. Lectures took place in the first two weeks of the semester for 3 hours and then for one-hour lecture for the next 10 weeks. In these 10 weeks, students formed five groups and these groups presented their activities for two-hours. After the first hour, the four of the groups (pre-determined) presented their activities. The sequence of presentation was based on willingness of group. After each presentation, every group took feedbacks regarding their activity from their classmates, me and another researcher. At the beginning of the course, I warned the participants regarding feedbacks that they were given to improve the activity and not to criticize or humiliate the presenting students. Activities were prepared on the topic examined that week in the lecture hour. An activity template was given and explained to participants at the beginning of the course. All of them prepared their activities based on this template. An example

activity plan related to patterns was given in Appendix B. There was a mid-term examination in the middle of the semester and a final examination including the all topics at the end of the course. I made every document, which would be used thought the semester, ready before the TMEC course and shared them with my supervisor and got her feedback. Besides her feedbacks, I also shared all documents with a doctoral student in the mathematics education. He attended to all TMEC course from the beginning of the course to the end, read the specified text in each week, observed me and activities prepared by the participants, took notes and gave feedbacks. I showed him the videos, songs, and games related to topic and talked about the flow of the lesson before each class. We discussed about the lesson, participants, next week's topic and a to do list after each class. More specific information on TMEC course was addressed below.

At the beginning of the semester, first, I explained the syllabus and my expectations from the preservice teachers. Moreover, their expectations related to TMEC course were asked through a questionnaire (*Mathematics and Me 1*, which was explained in detail in this chapter). The syllabus of the course is given in Appendix C. In the course, we followed the textbook by Smith (2009). I selected this book because the language used was clear and the book was user friendly. Every topic was presented in separate chapters and detailed explanations as well as different examples related to topics were given. In the course, the topics covered how young children learn mathematics (content and process connections), early mathematics concepts, space and shape, pattern, function and early algebra, graphing, developing number sense, addition and subtraction, measurement, multiplication and division, early fraction concepts, and assessment. The students were required to read the specified text in that book each week. Then, based on the week's reading, they had to prepare an activity as a group. In the first hour of the class, I presented the related topic and showed some examples and activities from the web, and songs and games regarding the topic. Based on the content, we discussed together about some of the misunderstandings and misconceptions the children may have. Preservice teachers presented their activities in the following second and third hours. Meanwhile, I and the other researcher took notes regarding their activities in order to give feedback.

They also got feedback from their peers. We had 10 minutes discussion after every presentation in order to improve their activities. Based on the discussion and feedbacks, they reviewed their activities and uploaded them through the University's digital class platform. In ten week time, they observed and made a total of 50 activity presentations and prepared a total of 100 activity plans.

Preservice teachers taking the TMEC course were required to make a *Learning Center Project* as an assignment. Therefore, in the middle of the semester, we arranged the kindergarten in the University campus and preservice teachers conducted their learning center activities in the real environment with children. Learning centers were placed in different rooms of the kindergarten and children attending the kindergarten visited these centers in groups. I and the other researcher observed preservice teachers and children during the learning center implementations. The activities were the activities which the preservice teachers presented and revised in groups in the class hour. During the implementation, some preservice teachers used their own hand-made manipulatives and attracted children's attention. Furthermore, the administrator and mentor teachers admired the activities and wanted me to send the activity plans of the activities. I got the permission from the preservice teachers and shared the plans with the administrator.

Participants were taking *School Experience* course for the first time at the same semester and had opportunities to make several activities in their field practice within the *School Experience* course. After getting feedback related to mathematics activities, they sometimes implemented their activities in the kindergartens they attended for field practice. Generally, they were making integrated activities and tried to integrate mathematics with music and literature. When we discussed the activities in the class hour, some participants mentioned about the experiences they encountered in the field practice. I tried to ask several questions and learn about preservice teachers' views, and then discuss it together. At the end of the semester, they had to put all activities in their portfolio. In order to get a visual documentation of all the activities and to let them have the opportunity to watch themselves while presenting, I took video-record of every activity each week.

School Experience course provided many contributions to participants and they had chance to implement theoretical knowledge they gained in TMEC course in the real settings. Moreover, university course hours in the School Experience course might help the preservice teachers' improvement toward teaching mathematics. Detailed information related to *School Experience* course was given below.

During the semester, I implemented several instruments (such as *Mathematics* and *Me 2, Me before the Learning Center, Me after the Learning Center)*. These instruments were used in order to understand preservice teachers' progress in the course. They were not used for research purposes. In the instruments used for research, preservice teachers referred to their experiences while preparing and implementing *Learning Center Project*, although it was not a part of the research. Therefore, in order to provide a complete picture of the course, *Learning Center Project* is described here.

3.1.2.1 Learning Center Project

Learning center was composed of learning stations and was implemented at a kindergarten to 4-5 years old children. There were 10 stations which covered different learning areas in early mathematics concepts, such as patterns and measurement. The preservice teachers conducted the same activities they implemented at the class hours of TMEC course. The activities for children were generally used as follow-up and improvement on a topic. Moreover, preservice teachers made children engage in activities.

As an assignment, preservice teachers had to write a detailed report based on certain criteria regarding activities (such as objectives, target age group, instructions for teachers, description of the design, and list of materials), implementation (purpose of the activity, students' reaction, difficulties of students, and reasons for students' difficulties), and discussion. In that part, preservice teachers were asked to write about difficulties they had during the implementation, ways they tried to overcome difficulties, how they would implement if they had a chance to implement the activities to the same group, and their mathematics teaching anxiety during the learning center activity. Participants were asked to compare and contrast the

mathematics teaching anxiety level during their real experience and the presentation of activity in the TMEC course. They wrote similarities or differences between these two experiences with the reasons. Moreover, the ways that they reduced their mathematics teaching anxiety and observation related to teaching and students' learning during the real experience were written by the whole group members for the assignment. *Learning Center Project* is given in Appendix D.

3.1.3 School Experience Course

School Experience course is offered in the program for the first time at the Fall semester of the 3rd year. The general aim of this course was to prepare preservice teachers, give information regarding MoNE policy and gain experience toward teaching profession. In this course, preservice teachers had to make a 12 weeks of teaching practice in the predetermined preschools. The course also met for 2 hours per week at the university where they had preschool curriculum discussions and discussed on what happened in their implementations. Full attendance was required both for teaching practice in the preschools and meetings at the university. Moreover, preservice teachers had to complete several assignments including school observation report, monthly plan, activity plans, daily educational schedule, child observation form, child development report and portfolio. In the school observation assignment, they mentioned about the general information about the school (number of classes, number of teachers, number of students in total and per classroom, school staff list, short information on the history of school (public or private), daily schedule of the classroom, classroom map, physical environment of the school and classroom (measurement of the area of the school, classroom and the playground, colors used, wall decorations, carpeting, furniture, shelves, safety and security precautions, material storage and organization, lighting, corners and etc.), checklist for materials inventory, outdoor map, and their evaluations related to physical environment of the classroom. Briefly, preservice teachers gained ideas about school culture by this report.

At the beginning of November and December, they had to prepare a monthly plan based on the National Early Childhood Education Curriculum. In addition, they

prepared monthly concept chart and monthly objective-indicators chart. Furthermore, preservice teachers had to prepare two activity plans for each week after they completed four weeks in the school through observing the school policies, getting used to their class teachers and the children in the class. While they were preparing those activities, they paid attention to integration of different disciplines. In daily educational schedule, they mentioned about each part of the day and daily assessment. In child observation form, preservice teachers were asked to choose a child from the preschool and observe him/her development throughout the semester and at the end of the semester they had to write an overall report regarding this child via child development report. After all, they had to prepare a portfolio which included information related to institution, all documents that preservice teachers prepared during the semester, an overall reflection paper regarding meetings at the university, performance assessment forms filled by the mentor teacher, and attendance forms signed by administrator or teacher.

Briefly, during the course, they had many opportunities, such as class observation, adaptation to classroom atmosphere, recognizing children and their development process. Besides, they gained experience related to planning and preparation for teaching in the preschools. Totally, candidates were expected to prepare and implement 20 activity plans based on the activity plan criteria recommended by MoNE. Preservice teachers were supported when they prepared forms which they would complete in the future as a teacher. In addition to being familiar with MoNE Early Childhood Education Curriculum and having teaching experiences in the field, they were learning how to prepare developmentally appropriate activity plans and materials for the early ages.

3.2 Research Design

In this study, *phenomenology* was used since this design served to explore lived mathematical experiences of preservice teachers as reflected in their mathematics related anxiety as well as emotions and images. Generally, this design addresses deep human experiences, such as, love and anger (Merriam, 2009). Participants' mathematics anxiety and mathematics teaching anxiety, and mathematics as a school

subject were the experienced phenomena (Patton, 2002). *Phenomenology* is also interested in people's "everyday life and social action" (Schram, 2003, p.71). Therefore, this design works effectively when studying affective, emotional as well as intense human experiences (Merriam, 2009) such as emotions and anxiety related to mathematics and mathematics teaching.

Qualitative generalization is used in a limited way because the aim of the qualitative research is not to generalize findings to other individuals as well as settings (Creswell, 2009). *Phenomenology* suits the nature of qualitative research and certain and generalizable findings do not occur (Yıldırım & Şimşek, 2011). Thus, the findings of the current study cannot be generalized.

Findings of phenomenology research are embedded in examples, explanations and experiences which contribute to understanding and identifying a phenomenon better (Yıldırım & Şimşek, 2011). Therefore, this research might provide important contributions to both literature and implementations (Yıldırım & Şimşek, 2011).

3.3 Participants

All the 3rd year preservice early childhood education teachers (43 female and 4 male preservice teachers) in the Early Childhood Teacher Education program at the mentioned public university in the academic year of 2013-2014 were the initial participants of the present study. They attended both TMEC course and the *School Experience Course* which were offered in the Fall semester of the 3rd year in the Early Childhood Education program. *School Experience* course worths mentioning because it provided an important context where participants were able to conduct mathematics activities and this helped in understanding their mathematics teaching anxiety. Participants have completed *Child Development and Psychology, Play in Early Childhood, Curriculum in Early Childhood Education* courses until the third year in the program. They entered the program with their scores in the national university entrance examination which is held once a year. Most of them were graduates of Anatolian Teacher Training High Schools.

Interview participants were selected based on the *Mathematics and Me 1* questionnaire and their *Field Reflection Reports*. At the beginning of the semester, participants were implemented *Mathematics and Me 1* questionnaire which asked them to rate their mathematics anxiety (MA) level and mathematics teaching anxiety (MTA) level from 1 to 10, where 1 showed the least anxiety and 10 the most. Being moderately anxious would be described by a scale of 5. Participants who rated their MA from 1 to 4 were considered as having lower MA and who rated their MA from 6 to 10 were considered as having higher MA. Participants who rated their MA as 5 were considered as having moderate level of MA. Similarly, this rating was also valid for MTA levels. Participants were selected based on the *Mathematics and Me 1* questionnaire to better see the difference or change. Moreover, preservice teachers were given a *Field Reflection Report* assignment to prepare a mathematics activity in their teaching practice in the preschool and write a reflection paper based on their experiences to see whether a relationship existed between preservice teachers' prior MA and MTA. In this assignment, participants wrote the sources of their anxiety and mentioned the connection or disconnection of their MA and MTA. Based on their reflection paper, participants who reported higher anxiety with mathematics or teaching mathematics were selected for the interviews.

3.4 Data Collection Instruments

Data of the study were collected through *Preservice Early Childhood Education Teachers' Mathematics View Questionnaire (ECEMVQ), Mathematics and Me 1, Drawing Activity 1, Field Reflection Report, Mathematics and Me 3, Drawing Activity 2, and Interview Protocols A/B/C/D*. These instruments were described in detail below. Data analysis procedures were described in the following sections in this chapter.

3.4.1 Preservice Early Childhood Education Teachers' Mathematics View Questionnaire (ECEMVQ)

ECEMVQ aimed to gather information about preservice teachers' views about mathematics, learning and teaching mathematics, and it included eight open-ended

questions prepared based on the literature about teachers' beliefs and their mathematics related beliefs (see Pajares, 1992; Thompson, 1992). For content validity of *ECEMVQ*, the questionnaire was reviewed by two mathematics education researchers whose research area was affective domain in mathematics education and two early childhood education researchers. They reviewed the items of *ECEMVQ* for both content and face validity and they indicated that the *ECEMVQ* questions were adequate for capturing participants' immediate mathematics related views. *ECEMVQ* was administered as a pre-study at the end of the spring semester to 41 preservice early childhood education teachers in their 2nd year. In other words, the questionnaire was implemented to potential participants before they took TMEC course. The questionnaire was used to describe the immediate image in their minds related to mathematics before they come to the TMEC course. The implementation lasted for 15 minutes. The *ECEMVQ* is given in Appendix E.

3.4.2 Mathematics and Me 1

Mathematics and Me 1, including five open-ended questions, was prepared based on the anxiety literature (Ashcraft & Moore, 2009; Gresham, 2007). The first and second questions asked an initial snapshot of the level of mathematics anxiety and mathematics teaching anxiety of preservice teachers. Moreover, their expectations about TMEC course, and their readiness towards teaching mathematics in the early years were asked through the questionnaire. The questionnaire was reviewed by two mathematics education researchers whose research area was affective domain and two early childhood education researchers. They inspected the questionnaire in terms of the clarity of questions and content validity and did not suggest any changes. *Mathematics and Me 1* was implemented to 47 preservice teachers in the beginning of the Fall semester in 15 minutes. *Mathematics and Me 1* was used to describe the participants' MA and MTA at the beginning of the course. Sources underlying the MA and MTA were inspected at the beginning of TMEC course. The implementation lasted for 15 minutes. *Mathematics and Me 1* is given in Appendix F.

3.4.3 Drawing Activity 1 and Drawing Activity 2

Drawing can help exploring the ideas and minimizing cognitive appeals. Compared to writing, drawing is advantageous because of its structure (Caldwell & Moore, 1991). It was developed first as a symbol system and a comparatively flexible and solid method of representation (Caldwell & Moore, 1991). In other words, drawing includes concrete things and instead of describing, it portrays the real objects as well as actions. If drawing is done with confidence, comfort, and pleasure, creative ideas are flourished. Since language generally slowdowns creativity, drawing images can develop creative answers (Caldwell & Moore, 1991). Conscious and unconscious thoughts, experiences as well as emotions are discovered through drawing (Burton, 2012). Tendencies, behaviors, and thoughts regarding a subject area are reflected by the preservice teachers through drawings in a nonthreatening environment (Rule & Harrell, 2006). Moreover, preservice teachers become aware of their emotions, experiences and thoughts which affect their actions regarding the subject via drawings (Burton, 2012). This vehicle is powerful in terms of making discussion with students about their perceptions and emotions (Burton, 2012).

Drawings have been used to explore the meanings elementary preservice teachers assigned to mathematics previously (Burton, 2012). Similarly, in the current study, drawings were used to inspect mathematics related images and emotions of preservice teachers. Similar to Burton's study (2012), a total of 47 participants were asked to draw a picture to answer "What is Math?" at the beginning and at the end of the TMEC course. They wrote descriptive statements under their drawings in order to make their drawings clear. The *Drawing Activity 1* is given in Appendix G and *Drawing Activity 2* is given in Appendix H.

3.4.4 Field Reflection Report

Preservice early childhood education teachers were given a *Field Reflection Report* assignment to prepare a mathematics activity in their teaching practice in the preschool and write a reflection paper based on their experiences. In order to see whether a relationship between the prior mathematics anxiety and mathematics

teaching anxiety existed, first they wrote their prior mathematics anxiety as a life history related to mathematics. After mentioning the prior mathematics anxiety, such as previous teachers, family effect, shyness, and previous class experiences, they focused on the real classroom experiences while teaching mathematics and described their teaching process, feelings, and challenges. At the end of the assignment, they were asked to write if there was a relationship between the mathematics anxiety and mathematics teaching anxiety. The *Field Reflection Report* assignment was written out of the class and the due date for the assignment was given to students. *Field Reflection Report* assignment is given in Appendix I.

3.4.5 Mathematics and Me 3

Mathematics and Me 3 covered 15 open-ended questions. While three questions were taken from the *Mathematics and Me 1*, four questions were taken from *ECEMVQ*, and the rest of the questions were prepared by me according to four aspects: General mathematics and mathematics teaching anxiety, mathematics teaching anxiety for the teaching profession, children's mathematics anxiety, and questions on TMEC course. The seven questions from the previous questionnaires were asked in order to see the influence of course experiences. The questionnaire was reviewed by two mathematics education researchers whose research area was affective domain and two early childhood education researchers for face and content validity. Order of some questions were changed and the similar questions were categorized consecutively. After the revisions, it was implemented to 47 preservice early childhood education teachers at the end of the semester in 25 minutes. *Mathematics and Me 3* was used to describe participants' MA and MTA at the end of the course. Sources underlying the MTA were inspected at the end of TMEC course. *Mathematics and Me 3* is given in Appendix J.

3.4.6 Interview Protocols

Four types of *Interview Protocols* were prepared by me depending on the mathematics anxiety level and mathematics teaching anxiety level of the selected participants. These interviews were conducted to explore deeply the MA and MTA

of participants and key course experiences. The questions were given to the four researchers mentioned earlier for content and face validity. Some revisions related to grammar of some questions were made. Then, *Interview Questions* (A and B) were piloted with two third year preservice early childhood education teachers with similar characteristics and no changes were made. Therefore, these participants were included in the actual study. Interviews were conducted with 20 participants at the end of the semester. These preservice teachers were selected based on their *Field Reflection Report* and *Mathematics and Me 1* questionnaire, in order to better see the difference or change. Interview findings were used to exemplify the MTA sources and key course experiences which contributed specifically to the lower MTA. Interview participants were asked a question referring to their responses to *Mathematics and Me 1* implemented at the beginning of the course. They were reminded of their responses of rating their MTA and asked if they could identify sources for such a response. Their responses generally addressed both the beginning and the end of the course MTA. The interviews lasted approximately 20 minutes. *Interview Protocols* are given in Appendix K.

3.5 Procedures

The ethical permission from Ethical Committee of Middle East Technical University was taken to administer the instruments and interviews before conducting the present study (See Appendix L). First, *Preservice Early Childhood Education Teachers' Mathematics View Questionnaire (ECEMVQ)* was implemented to learn preservice teachers' images related to mathematics at the end of the second year in the teacher education program. Then, *Mathematics and Me 1* questionnaire and *Drawing Activity 1* of "What is math?" were given respectively at the beginning of the TMEC course. Later, the participants were asked to develop learning centers which included the 3-4 activities implemented in the class before and they were given the *Learning Center Project* as an assignment. Then, a *Field Reflection Report* was required from the preservice teachers to see whether a relationship existed between their prior mathematics anxiety and mathematics teaching anxiety. Specifically, the reflection was based on their mathematics history and their real classroom experiences while teaching mathematics. Finally, in the last day of the course, *Mathematics and Me 3*

questionnaire and *Drawing Activity 2* of "What is math?" was given respectively. After one week, based on their *Field Reflection Reports* and *Mathematics and Me 1,* 20 participants were selected for the interview. Each preservice teacher was interviewed depending on their mathematics anxiety level and their mathematics teaching anxiety level through *Interview Protocols A/B/C/D*. Table 3.1 presents the data collection timeline with the purpose part. It summarizes the procedure mentioned above.

Table 3.1

Timeline of Data Collection

Week	Date	Data Collection Activity	Purpose
14	2013 May	*ECEMVQ*	To describe the immediate image in their minds related to mathematics before they come to the TMEC course.
1	September, 27th, 2013	*a)Mathematics and Me 1*	a) To describe the participants' MA and MTA at the beginning of the course. Sources underlying the MA and MTA were inspected at the beginning of TMEC course.
		b)Drawing Activity 1	b) To describe the participants' mathematics related images and emotions at the beginning of the course.
14	January, 3rd, 2014	*Field Reflection Report*	To see whether a relationship existed between preservice teachers' prior MA and MTA
15	January, 10th, 2014	*a)Mathematics and Me 3*	a) To describe participants' MA and MTA at the end of the course. Sources underlying the MTA were inspected at the end of TMEC course.
		b)Drawing Activity 2	b) To describe participants' mathematics related images and emotions at the end of the course.
16-17	January 13-25th, 2014	*Interview Protocols*	To explore deeply the MA and MTA of 20 participants and key course experiences

ECEMVQ and *Drawing Activity 1* used to describe the immediate image in PSTs' minds related to mathematics before they come to the TMEC course. At the end of the course, *Drawing Activity 2* were implemented to describe participants' mathematics related images and emotions at the end of the course. To describe participants' MA and MTA levels in the beginning and at the end of TMEC course, *Mathematics and Me 1* questionnaire and *Mathematics and Me 3* questionnaire were used. Sources underlying the MA were inspected via *Mathematics and Me 1* questionnaire and *Field Reflection Report* assignment. On the other hand, sources

underlying the MTA were inspected through *Mathematics and Me 1* questionnaire, *Mathematics and Me 3* questionnaire and *Interviews*. Key course experiences were explored through *Mathematics and Me 3* questionnaire, *Field Reflection Report* assignment, and *Interviews*. Finally, *Field Reflection Report* assignment was used to see whether a relationship existed between preservice teachers' prior MA and MTA.

3.6 Data Analysis

According to Creswell (2005), in qualitative research "researcher relies on the views of participants, asks broad, general questions, collects data consisting largely of words (or text) from participants, describes and analyzes these words for themes, and conducts the inquiry in a subjective, biased manner" (p.46). Data in this study were analyzed based on the Creswell's (2009) step and the match between data from each source and the codes were also inspected by researchers from the fields of science, mathematics, and early childhood education. I had three types of data, such as drawings, responses to open-ended questions in several instruments and interviews. First, I organized and prepared the data for the analysis. For the drawings, participants' first and last drawings as well as written statements were analyzed through open coding, focusing on their images and emotions. Since drawings clearly displayed the negative or positive emotions, its categorization was relatively straightforward. I reexamined all drawings and asked second coder to check the categories. For the open-ended questions, I sorted the responses of participants, respectively, based on the research questions. For the interviews, I transcribed the all interviews conducted with 20 preservice teachers. As a second step, I read the 47 participants' responses three times and took marginal notes them. After taking notes, I again read all data to gain a general sense (Creswell, 2009) related to participants' images, sources of MA, MTA, key course experiences, and relationship between MA and MTA.

Data were analyzed based on the participants' answers and were categorized in themes depending on the similarities and the relationships of the answers participants provided to the research questions. During the coding process, related literature, tendency of responses, and my own experiences were used while coding. Then,

codes were reexamined and presented to my supervisor. She monitored the findings and gave feedback related to the name of themes, clarity of quotations, and harmony between the quotations and categories. I took her feedbacks into consideration and reduced the number of quotations. Moreover, a name of theme (environmental source) was replaced with more appropriate one (contextual source). Then, data, the categories, and the quotations were presented to three research assistants from science, mathematics, and early childhood education fields. They examined and inspected them for whether they were adequately analyzed and data analyses were finalized.

Merriam (2009) stated that all qualitative data analysis is content analysis since what is analyzed in interviews, field notes, and documents is *content*. Moreover, Merriam (2009) indicated that "the process involves the simultaneous coding of raw data and the construction of categories that capture relevant characteristics of the document's content" (p.205). As explained above, data analysis of the current study was based on content analysis. Each categories and codes were described below according to the sequence of research questions. A detail account of the data sources used for answering each research question and how data were analyzed is given below for each research question.

3.6.1 Research Question 1

Table 3.2 presents the first research question, its purpose and the data collection instruments implemented in order to respond to the first research question.

Table 3.2

A Detailed Account of the First Research Question and Related Data Collection.

Research Question	**Data Collection Instrument**	**Purpose**
1) How does the course influence preservice early childhood education teachers' mathematics related images and associated emotions?		**a)** To describe the immediate image in their minds related to mathematics before they come to the TMEC course & To describe the participants' mathematics related images and emotions at the beginning of the course. **b)** To describe participants' mathematics related images and emotions at the end of the course
a) What are the images and emotions of preservice early childhood education teachers before the Teaching Mathematics in Early Childhood course?	**a)** *ECEMVQ & Drawing Activity 1*	
b) What are the images and emotions of preservice early childhood education teachers after the Teaching Mathematics in Early Childhood course?	**b)** *Drawing Activity 2*	

For the first research question, I examined the data, then categorized the sets of data and classified the sets into similar groups. The categories and codes of "What is mathematics?" were formed and named. The analysis displayed that preservice teachers used two dimensions (*nature of mathematics and connections with daily life and other disciplines)* to describe what images came to their mind first related to mathematics. Moreover, participants were asked to draw a picture to answer "What is Math?" through *Drawing Activity 1* in the beginning of the Fall semester of the 3rd year. For the data analysis, first I organized data and broke them into similar units. Then, I found a pattern within the pictures participants drew and focused on their emotions through open coding. A researcher from early childhood education field inspected the data in terms of appropriateness of the themes and categories. Their mathematics related emotions were also inspected and *Drawing Activity 1* results

indicated that drawings of preservice teachers could be categorized into two dimensions (*emotional expressions* and *contextual expressions*). In the last day of the TMEC course, participants were asked to draw their final impressions and images of "mathematics". *Drawing Activity 2* results indicated that drawings of participants could be categorized into two dimensions (*emotional expressions* and *contextual expressions*).

3.6.2 Research Question 2

Table 3.3 presents the second research question, its purpose and the data collection instruments implemented in order to respond to the second research question.

Table 3.3

A Detailed Account of the Second Research Question and Related Data Collection.

Research Question	**Data Collection Instrument**	**Purpose**
2) How does the course influence preservice early childhood education teachers' mathematics anxiety?		
a) How does the course influence preservice early childhood education teachers' level of mathematics anxiety?	**a)***Mathematics and Me 1 & Mathematics and Me 3*	**a)** To describe the participants' MA at the beginning of the course. & To describe participants' MA at the end of the course.
b) What are the sources of preservice early childhood education teachers' mathematics anxiety?	**b)***Mathematics and Me 1 & Field Reflection Report*	**b)** Sources underlying the MA were inspected at the beginning of TMEC course

For the second research question, at the beginning of the semester, participants were implemented *Mathematics and Me 1* questionnaire which asked them to rate their mathematics anxiety (MA) level from 1 to 10, where 1 showed the least anxiety and 10 the most. Being moderately anxious would be described by a scale of 5. Similarly, at the end of the course, participants were asked to rate their mathematics anxiety

level in *Mathematics and Me 3* questionnaire in order to determine their final anxiety level. Each preservice teacher was grouped based on their MA level and the change in MA scores of preservice teachers before and after the TMEC course was described. Participants who rated their MA from 1 to 4 were considered as having lower MA and who rated their MA from 6 to 10 were considered as having higher MA. Participants who rated their MA as 5 were considered as having moderate level MA. Moreover, the sources causing higher mathematics anxiety and lower mathematics anxiety of preservice teachers were obtained via *Mathematics and Me 1* and *Field Reflection Report* where preservice teachers wrote their prior mathematics anxiety as a life history. Two main sources of MA were found: *Contextual* and *intellectual*. The sources were categorized as themes depending on the similarities and the relationships of the responses.

3.6.3 Research Question 3

Table 3.4 presents the third research question, its purpose and the data collection instruments implemented in order to respond to the third research question.

Table 3.4

A Detailed Account of the Third Research Question and Related Data Collection.

Research Question	**Data Collection Instrument**	**Purpose**
3) How does the course influence preservice early childhood education teachers' mathematics teaching anxiety?		
a) How does the course influence preservice early childhood education teachers' perceived level of mathematics teaching anxiety?	**a)** *Mathematics and Me 1 & Mathematics and Me 3*	**a)** To describe the participants' MTA at the beginning of the course. & To describe participants' MTA at the end of the course.
b) How does the course influence preservice early childhood education teachers' sources of mathematics teaching anxiety?	**b)** *Mathematics and Me 1 & Mathematics and Me 3 & Interviews*	**b)** Sources underlying the MTA were inspected at the beginning of TMEC course & Sources underlying the MTA were inspected at the end of TMEC course
c) What are the key course experiences that influence of preservice early childhood education teachers' mathematics teaching anxiety?	**c)** *Mathematics and Me 3 & Field Reflection Report & Interview*	**c)** To explore the key course experiences which contributed to the lower MTA.

For the third question, participants were asked to rate their MTA level from 1 to 10, where 1 showed the least anxiety and 10 the most in the *Mathematics and Me 1* questionnaire. Being moderately anxious would be described by 5. Similarly, at the end of the course, participants were asked to rate their MTA in the *Mathematics and Me 3* questionnaire in order to understand their MTA level at the end of the course. Each preservice teacher was grouped based on their MTA level and the change in MTA scores of preservice teachers before and after the TMEC course was described. Participants who rated their MTA from 1 to 4 were considered as having lower MTA and who rated their MTA from 6 to 10 were considered as having higher MA. Participants who rated their MTA as 5 were considered as having moderate level.

Besides, the sources causing higher MTA and lower MTA of preservice teachers were obtained via *Mathematics and Me 1*, *Mathematics and Me 3* and *Interviews* where 20 preservice teachers talked about their MTA in detail. For the *Part C,* some possible key course experiences as sources for lower and/or higher MTA were analyzed in detail.

For the analysis, first, *Interviews* were transcribed and organized. Based on the MTA sources which were identified before, related quotations were given to describe the phenomenon well and the meanings hidden under the anxiety ratings were deducted. On the other hand, for the key course experiences, common ideas shared in *Mathematics and Me 3*, *Field Reflection Report* and *Interviews* were determined and codes emerged. Based on the codes, the key experiences were addressed by giving quotations of preservice teachers' interviews. The similar responses were taken into the same category and three categories emerged as *general influence of the course, specific tasks in the course,* and *interaction of the course and school experience.*

3.6.4 Research Question 4

Table 3.5 presents the fourth research question, its purpose and the data collection instruments implemented in order to respond to the fourth research question.

Table 3.5

A Detailed Account of the Fourth Research Question and Related Data Collection.

Research Question	**Data Collection Instrument**	**Purpose**
4)How is preservice early childhood education teachers' mathematics anxiety related to their pre and post mathematics teaching anxiety?	*Field Reflection Report*	To see whether a relationship existed between preservice teachers' prior MA and MTA

For the fourth research question, each preservice teacher's *Field Reflection Reports* were analyzed one by one. Their reflections were explored into two as *Prior Mathematics Anxiety* (MA) and *Mathematics Teaching Anxiety* (MTA). Three

researchers inspected the categories and reached an agreement on the areas and what they represented. Field reflection of 47 preservice early childhood education teachers were coded depending on the Framework of Mathematics Anxiety and Mathematics Teaching Anxiety in Brown et al.'s (2011) study.

Brown et al. (2011) examined the assumption that preservice elementary teachers who had prior mathematics anxiety would have mathematics teaching anxiety and preservice elementary teachers who had little or no prior mathematics anxiety would have little or no mathematics teaching anxiety. While some preservice teachers supported the assumption in their study, some did not. The Framework of Mathematics Anxiety (MA) and Mathematics Teaching Anxiety (MTA) in Brown et al.'s (2011) study presented below in Table 3.6.

Table 3.6

Framework of MA and MTA Results

	NO-MA	**YES-MA**
	No: Prior Mathematics Anxiety (MA)	Yes: Prior Mathematics Anxiety (MA)
NO-MTA		
No: Mathematics Teaching Anxiety (MTA)	Quadrant A: No-MA, No-MTA	Quadrant B: Yes-MA, No-MTA
YES-MTA		
Yes:Mathematics Teaching Anxiety (MTA)	Quadrant C: No-MA, Yes-MTA	Quadrant D: Yes-MA, Yes-MTA

Note. "Elementary Pre-service Teachers: Can They Experience Mathematics Teaching Anxiety without Having Mathematics Anxiety?," by A. B. Brown, A. Westenskow, P. S. Moyer-Packenham, 2011, *Issues in the Undergraduate Mathematics Preparation of School Teachers: The Journal, 5*, p. 6.

Table 3.6 reveals the interaction of MA and MTA for preservice teachers. Those quadrants were showing the existence of MA and/or MTA or absence of MA and/or

MTA. The detailed explanation of the framework is presented in the Literature Review Chapter.

Different from Brown et al.'s study regarding MA and MTA (2011), in the current study, shifting part was identified as another category. A great shifting was seen in mathematics teaching anxiety and as one of the experts who developed the MA and MTA framework, Moyer-Packenham agreed on the shifting part (personal communication). Therefore, I extended the framework to reveal the possible change in MTA a result of the course. Instead of quadrant, I categorized them as "Area". At the end of the course, the shifting in MTA was seen as in the following table 3.7. Table 3.7 also represents how data were coded at the end of the study based on the framework. The interaction of mathematics anxiety and mathematics teaching anxiety for 47 preservice teachers was described and the number and percentage of preservice teachers classified in each of the area was calculated.

Table 3.7

Shifting MTA Anxiety

	NO-MA No: Prior Mathematics Anxiety (MA)	**YES-MA** Yes: Prior Mathematics Anxiety (MA)
Yes MTA to NO-MTA	**Area E'** No-MA, Yes-MTA to NO-MTA Preservice teachers who stated NO prior mathematics anxiety and showed shifts in thinking related to MTA: (+ to -) At the beginning of the course, they had MTA, but they reported that they had NO MTA at the end of the course.	**Area E** Yes-MA, Yes-MTA to NO-MTA Preservice teachers who stated prior mathematics anxiety and showed shifts in thinking related to MTA: (+ to -) At the beginning of the course, they had MTA, but they reported that they had NO MTA at the end of the course.

The shifting process can be seen in Figure 3.1.

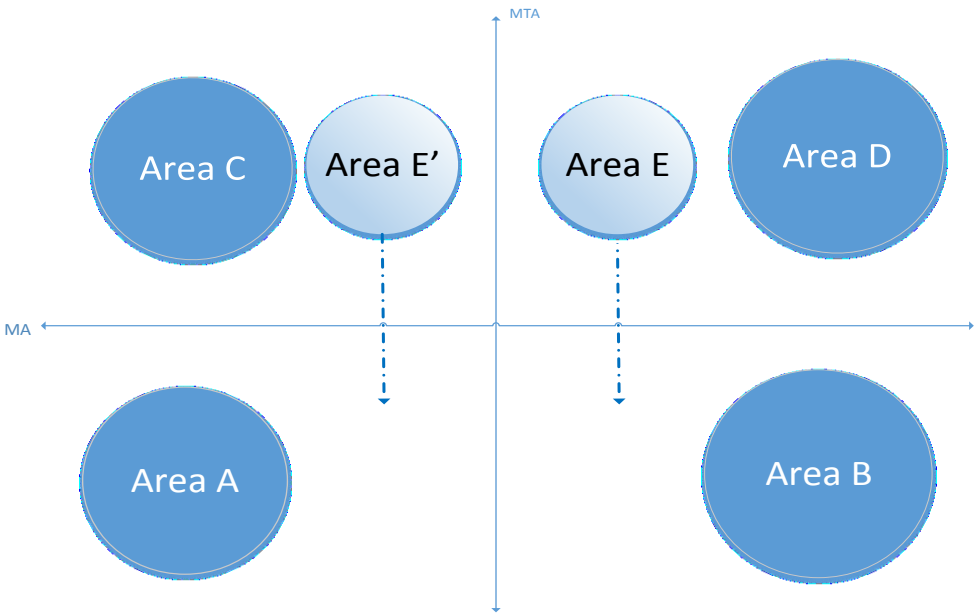


Figure 3.1 Shifting in MTA

3.7 Trustworthiness of the Research Design

3.7.1 Credibility

Researcher's position, adequate engagement in data collection, triangulation, member checks, and peer examination were the five strategies to handle the problems related to credibility (Merriam, 2009). In this study, researcher's position, peer examination, and triangulation were utilized to ensure credibility.

3.7.1.1 Researcher's Position

Researcher in the qualitative study has the major role to collect and analyze the data (Merriam, 1998). As a researcher, I was the instructor of the TMEC course and assumed the participant-observer role. Therefore, I had the opportunity to observe the preservice teachers in several perspectives. While sometimes I was a member of the class (pretending to be a child in the presentation of the activities in the class hour), I was a teacher or researcher at other times. These different points of views helped me in observing them with several perspectives.

The study was not an experimental study although it investigated the influence of a course on a group of students. One of my goals for the course was to help preservice

teachers develop rather positive mathematics related emotions to support their learning in the course and teaching in the future. Therefore, I deliberately spent effort for positive emotions. However, my effort alone would not simply result in positive emotions. My major goal was to understand the course activities which influenced their emotions the most and I carefully prepared my activities based on the successful implementations mentioned in the literature and the collective knowledge in the Department that I worked about the student feedbacks for meaningful course experiences. I also tried to be as welcoming as possible for the questions, concerns, and criticisms about the course activities and the content, and reflected these on the course as much as possible.

During the class, I gave more importance to activity time and try to make all students engage in the activity. I observed that preparing learning activities and engaging in discussions made preservice teachers active during the classes. Generally, there was a positive environment in the classroom and the preservice teachers prepared more effective activities as the class progressed. I collected some of the data before or after my presentation. While distributing the instruments, I emphasized that it would not affect their grades and wanted them to feel free while reflecting their views. Moreover, as an assignment, they were asked to develop learning centers which included 3-4 activities they prepared for the class before. I attended the implementation of learning centers and observed them. I did not interfere in their activities. While observing, I paid attention to their usage of mathematics concepts as well as their answers towards the children's question. At the end of the class, I interviewed some participants based on their mathematics anxiety and mathematics teaching anxiety level. I tried to make them feel comfortable by stating that their responses would not be graded.

The positive environment in the class was a result of a collective effort. While I tried to help preservice teachers with their learning of the meanings of early childhood mathematics concepts and how to help children learn them, I used a positive tone and tried to engage them in the discussions. I believe that this motivated them to contribute to the positive environment and they tried to do their best for the course activities. Since many of them might develop mathematics teaching anxiety in this

course (because they would engage in teaching mathematics to young children for the first time), I was careful in my assignments and in class activities to support their learning of teaching.

3.7.1.2 Peer Examination

Peer examination helps in having a critical perspective of findings through colleagues (Merriam, 1998). After I reexamined the outcomes, my supervisor monitored the outcomes and gave feedback regarding the name of themes, clarity of quotations, and harmony between the quotations and categories. All feedbacks were taken into consideration, then, three research assistants from science, mathematics, and early childhood education fields examined data, the categories, and the quotations and inspected them for whether they were adequately analyzed.

3.7.1.3 Triangulation

Triangulation means crosschecking of the data via multiple data sources or procedures (Fraenkel & Wallen, 2006). In this study, data were collected from 47 preservice early childhood education teachers by conducting various open-ended tasks and interviews. Moreover, their responses were collected through drawing activities which reflected their mathematics related images and emotions. With the help of multiple data sources, the same questions were asked and compared at the beginning and at the end of the course. Interviews were also conducted with 20 participants in order to clarify their mathematics related anxiety, emotions, and images. Those different sources helped in confirming the data and increasing the credibility.

3.7.2 Reliability or Dependability

Researcher's position, peer examination, triangulation, and audit trail are seen as the techniques to increase dependability of results (Merriam, 2009). Besides increasing internal validity, researcher's position, peer examination, and triangulation mentioned above also increased the dependability.

3.7.3 Transferability

Merriam (2009) states that "In qualitative research, a single case or small, nonrandom, purposeful sample is selected precisely because the researcher wishes to understand the particular in depth, not to find out what is generally true of the many" (p.224). Therefore, since my aim was not to generalize the findings to other settings, I gave detailed information related to the context of the study, multiple data sources I used, data collection procedures as well as data analysis so that any researcher who has similar settings can transfer the findings of the study.

CHAPTER IV

FINDINGS

Findings are presented in the order of the research questions in this chapter. Participants who were quoted were identified as PST (preservice teacher) with a number such as PST21.

4.1. Images and Emotions

4.1.1 Preservice Teachers' Mathematics Related Images before the Course

Preservice early childhood education teachers' images of mathematics they brought to the *Teaching Mathematics in Early Childhood* (TMEC) course were sought by the analysis of the *ECEMVQ* questions which asked participants to write about how they viewed mathematics, what they thought about its relationship to daily life, and how they would consider the nature of mathematics. The questionnaire was administered to 41 preservice teachers at the end of their 2nd year before they took TMEC course in the Fall semester of 3rd year in the program. Only six students were absent on the implementation day. In addition, 47 preservice teachers were asked to draw a picture to answer "What is Math?" through *Drawing Activity 1* in the beginning of the Fall semester of the 3rd year. Their images of mathematics were also presented here.

ECEMVQ findings indicated that participants had two broad dimensions of images in their minds related to mathematics: (i) nature of mathematics, and (ii) connections with daily life and other disciplines.

4.1.1.1. Nature of Mathematics

Participants' images of nature of mathematics were numbers/operations/calculations, memorization, problem/puzzle, and abstract concepts, as well as the static versus dynamic nature of mathematics. Many participants (28 of 41) indicated that mathematics were based on numbers, operations, and calculations and they considered these elements as the fundamentals of mathematics.

> *Numbers and calculations. Because, I think, they form the foundation of the mathematics.* (PST12)

> *It seems to me the entertainment with numbers because during my life I like playing with numbers and I think mathematics means numbers fit into any shape.* (PST45)

> *Numbers come to my mind since we firstly started mathematics with numbers.* (PST14)

> *Calculation. I think aim of the mathematics is to make calculation and it focuses on calculation.* (PST22)

Four of the participants emphasized that mathematics reminded them the problems they solved in the mathematics course or a puzzle which raised curiosity. For example, PST46 and PST30 said that:

> *Problems. Because we solve problems in the lesson.* (PST46)

> *Mathematics is like a puzzle for me. We can reach the final step by step. With the help of the arrow, you can find the target. I see mathematics as a puzzle which gives pleasure and curiosity.* (PST30)

On the other hand, four participants had an image of mathematics as an abstract concept. Concerning this issue, PST5 expressed that:

> *Mathematics is an abstract concepts system which is based on numbers and thanks to these concepts we can calculate all possibilities related to life.* (PST5)

Three participants considered mathematics as formulas or multiplication table to be memorized as expressed below:

> *Formulas to be memorized come to my mind first. I am thinking in this way as I had to memorize a lot of formulas because of our education system.* (PST44)

The pile of formulas that you don't know which type of questions to apply on. (PST11)

In *ECEMVQ*, a question related to views on nature of mathematical knowledge was asked to preservice teachers. Twenty-six preservice teachers agreed that the mathematical knowledge was mostly unchanged and not affected by the social events, and considered mathematics as a static entity. Thirteen of the preservice teachers thought that mathematical knowledge was constantly renewed and social events had an effect on it addressing a dynamic entity. Two preservice teachers disagreed with any of the views and they indicated that:

I could not make connection between mathematics and social events. (PST32)

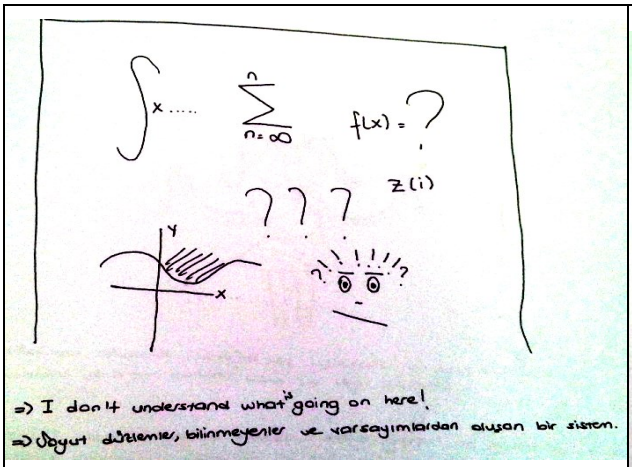
[I don't have an idea] Because I am not in the mathematics discipline… (PST39)

Preservice teachers' images of mathematics were reflected on their drawings in the beginning of the course. Twenty-three participants mentioned about the advanced formulas and abstract concepts, such as equations, algebraic expressions, calculus concepts, functions and trigonometric functions, to describe the mathematics. PST31, PST15, PST23, PST32, PST21, and PST39 drew the following to address mathematics rather as a collection of higher level and confusing concepts as presented in Table 4.1.

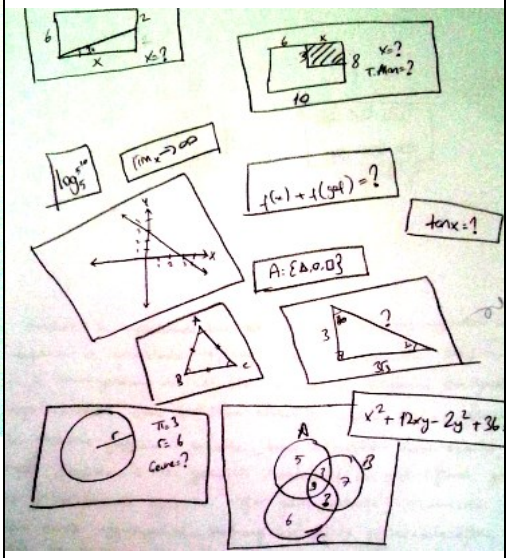
These findings addressed that preservice teachers' images of mathematics were mostly a collection of higher level topics or arithmetic, numbers, and memorization of certain facts. Although they seemed to consider mathematics as an abstract field, this abstraction seemed to be dependent on the difficulty or confusion associated with concepts. Image of mathematics as problem solving was not found in their drawings. When they were asked in *ECEMVQ* if they agreed with any of the two statements addressing mathematics implicitly as either dynamic or static entity, or did not agree with any of them, most preservice teachers agreed that mathematics knowledge would not change. Their drawings also presented several formulas and mathematical expressions as what they thought of mathematics, instead of a tool that was used in daily life and an expanding body of knowledge.

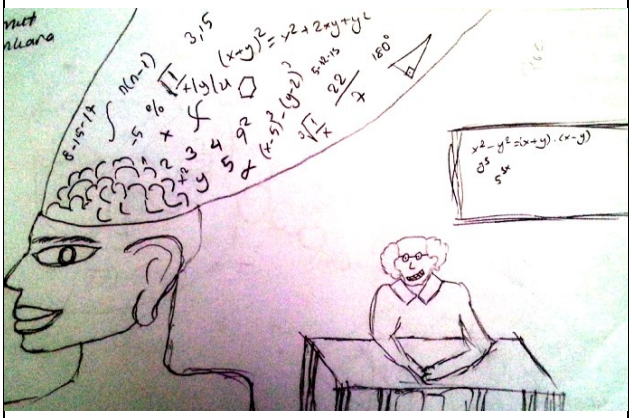
Table 4.1

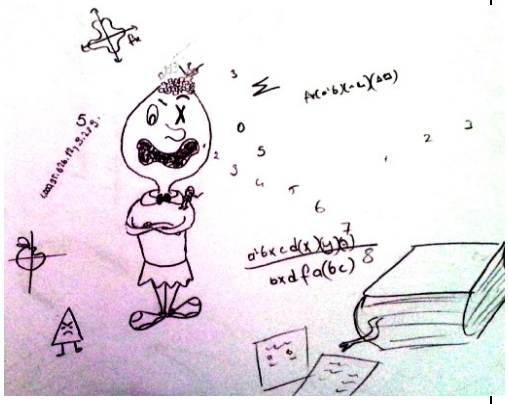
Participants' Images of Mathematics as a Set of Confusing Concepts.

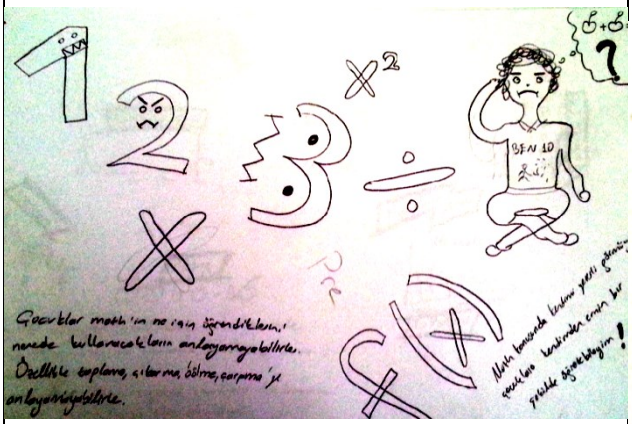


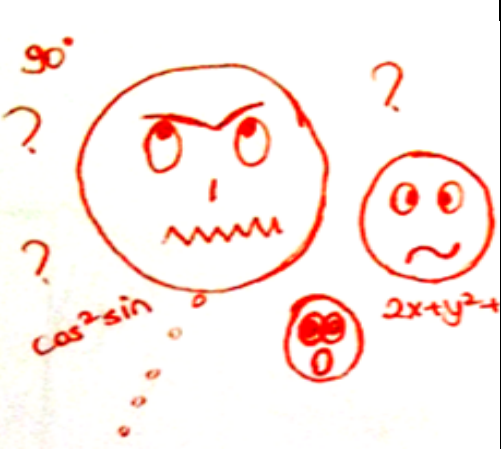
(I don't understand what is going on. It is a system that consists of abstract planes, unknowns and hypothesis.









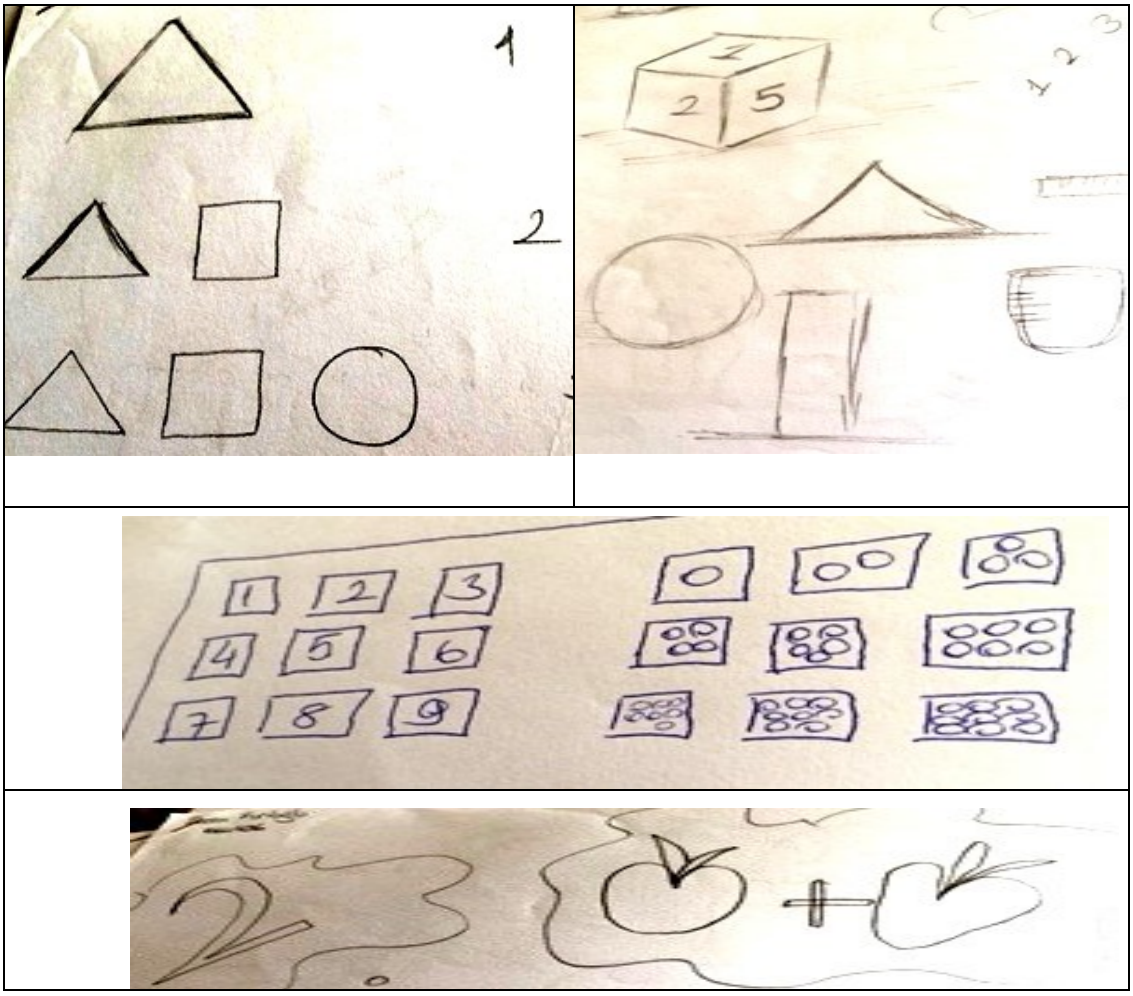


(I don't feel sufficient in mathematics so how can I confidently teach it to children!)

Fourteen participants used basic concepts, such as numbers, shapes, addition and matching. PST6, PST2, PST5, and PST17 drew the following as Table 4.2.

Table 4.2

Participants' Images of Mathematics as a Set of Basic Concepts.



4.1.1.2. Connections with Daily Life and Other Disciplines

Besides the nature of mathematics, while defining the mathematics, four of the participants directly mentioned some connections of mathematics to *daily life* and *other disciplines as follows*:

> *Life. Mathematics is life.* (PST10)

> *Mathematics seems to be the sub-dimension of science. It is a kind of common language in order to understand nature. I think it is an important keystone not only in science but also in literature and art.* (PST39)

> *It is possible to encounter traces of mathematics in music, our way of thinking style, electronic devices, and even in nature.* (PST16)

> *Mathematics is life. If a student connects the mathematics with his life, his confidence, reasoning, and logic can develop.* (PST2)

Among the 24 participants who indicated a daily life connection, three participants indirectly mentioned the relationship between a profession and the daily life. They addressed that some professions might include a relationship between mathematics and daily life. For instance, PST17 stated the following:

> *I was not thinking that mathematics had a relationship with daily life before; however, I now think that it [mathematics] has a relationship based on the profession of people.* (PST17)

Participants' views about the relationship between mathematics and daily life were revealed more when they were asked to indicate if they considered the relationship before starting the university. While 24 participants stated that the mathematics was related to daily life, 17 indicated either a clear expression of lack of relationship or did not indicate any relationship between mathematics and daily life. Among 17 participants who indicated no relationship, five participants indicated directly that mathematics had no relationship with daily life. For instance, PST43, PST14, and PST12 indicated the following:

> *It is obvious that we don't use mathematics in daily life as much as we saw it in mathematics lessons. Maybe, we use it for small calculations, but I think that the mathematics that we saw during our education cannot be fully integrated into daily life.* (PST43)

> *Mathematics has been taught [to me] without establishing relationship with daily life throughout my education life. Therefore, I don't think anything [about the relationship]*. (PST14)

> *I was thinking that the information I learnt would not be useful for daily life and still I think like that.* (PST12)

Twelve of seventeen participants gave indirect responses on the relationships. For instance, PST41 and PST18 stated that only arithmetic were useful for daily life. Other mathematics subjects were simply not useful at all:

> *I think, apart from the four-operations, mathematics has no place in daily life. (*PST41)
>
> *When I came to university, my opinions did not change. We use only four-operations in daily life. I still don't know how other subjects that I learned would be useful for me.* (PST18)

In some indirect responses, mathematics was mostly seen as a necessity in order to enter the university and had nothing to do with daily life. To illustrate:

> *The more correct mathematics answer I have, the more point I get [in the national examination]. Now, it has not much effect. Now, there is no effect.* (PST7)
>
> *Before the university, it [mathematics] was just something that I had to do for ÖSS [University Entrance Examination]...* (PST6)
>
> *It was a necessity to enter a university. Now, I don't think anything [about mathematics].* (PST46)

In brief, participants' views of mathematics in daily life were mixed. While some of them had a view of mathematics as connected to the daily life, others simply considered it as a distant concept. The daily life connection, however, did not go beyond arithmetic and possible job connections. Analysis of participants' drawings did not yield any real life or other discipline connection.

In conclusion, participants came to university with the mathematics image that mathematical knowledge was mostly unchanged and social events had no effect on it. Their images related to mathematics generally covered memorization of formulas as well as abstract concepts. This situation was also reflected on their drawings which included advanced formulas, equations, algebraic expressions, derivative, integral, factorial, trigonometric functions, numbers, arithmetic and complex numbers. When it comes to connections with mathematics and daily life, only 24 participants indicated the relationship between mathematics and daily life. Yet, rather a weak connection was addressed. Mathematics was seen distinct from the daily life by others.

4.1.2 Preservice Teachers' Emotions before the Course

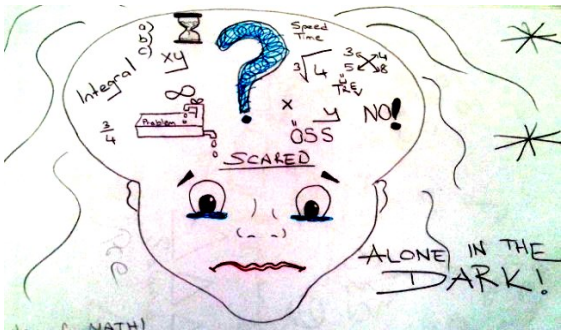
Participants drew their emotions related to mathematics in two ways. They expressed how they felt about emotions and they also drew the contexts these emotions took place or developed. These contexts provided a base for understanding how they felt about mathematics. Therefore, the findings are presented in two sections as emotional expressions and contextual expressions.

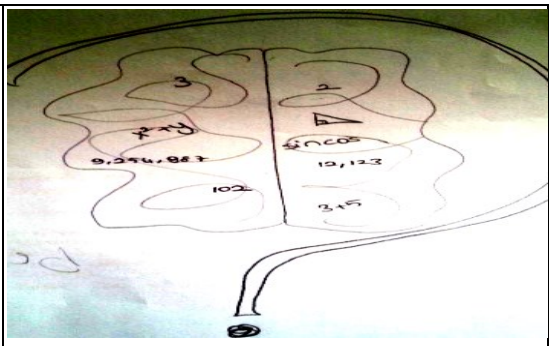
4.1.2.1 Emotional Expressions at the Beginning

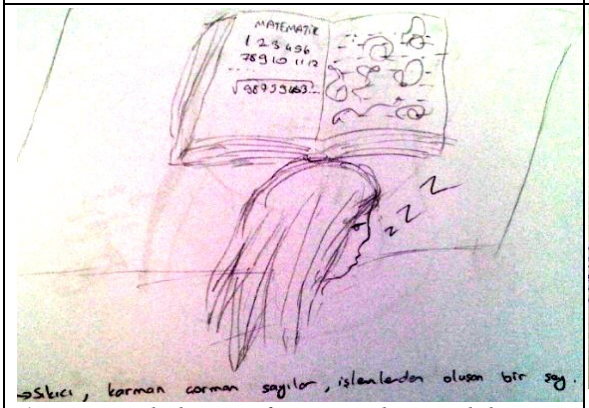
At the beginning of the course, emotional expressions were categorized into three, such as *positive, negative, and neutral emotions*. While 11 participants showed positive emotions, 30 participants had negative emotions and 6 participants had rather neutral emotions related to mathematics. Few participants referred to their feelings about teaching mathematics instead of mathematics. Negative emotions were pictured as faces with tears, puzzled faces, previous teachers who made them lose their desire towards mathematics, and question marks about teaching mathematics in the early years. Mathematics was not enjoyable, rather it gave the feeling of discomfort, sadness, and anxiety as reflected in PST3, PST39, PST18, PST34, PST1 and PST28's images and explanations in Table 4.3.

Table 4.3

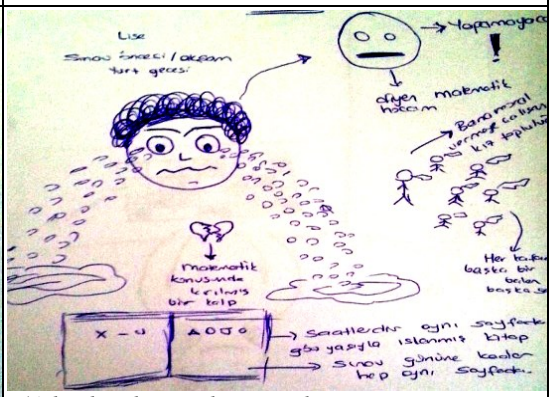
Participants' Drawings Addressing Mathematics with Negative Emotions.







(Boring, including confusing numbers and thing that composed of operations)



(A broken heart about mathematics..
A group of girl relieving my mind..
A book with my tears on the same page for hours
The same page until the exam day.)

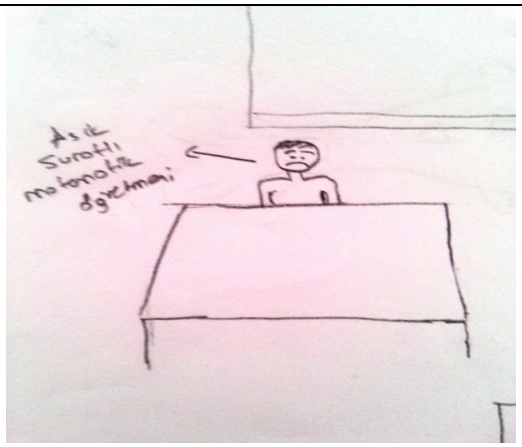
(Statistics, Mat2,University Entrance Examination , Middle School, Exams Private tutorin institutions…Aaaa…Hypothesis, Theorem, Integral, Derivation..)

(A small pond in front the child referred mathematics and I tried to picturize a child exaggerating the mathematics in his eyes.)

Sometimes participants referred to previous teachers when they thought about mathematics. For instance, PST34 and PST44 pictured their previous teachers at the high school and associated negative memories as in Table 4.4.

Table 4.4

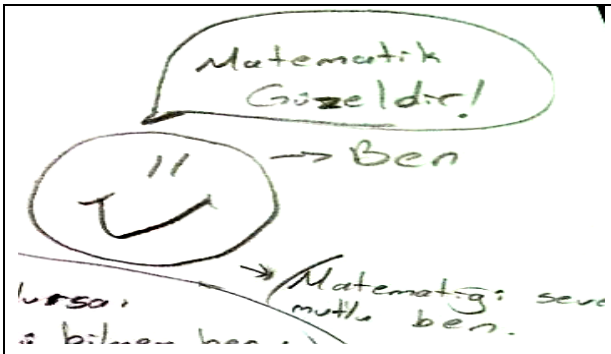
Participants' Drawings Addressing Previous Mathematics Teachers with Negative Emotions.

 *(My mathematics teacher saying "You can't do that!")*	 *(My not smiling, angry mathematics teacher)*

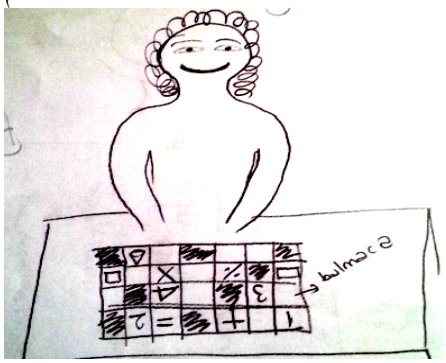
Positive emotion drawings referred to drawings such as smiling faces expressing their love for mathematics and enjoying mathematics as if enjoying a puzzle. PST20, PST27 and PST35 drew as in Table 4.5.

Table 4.5

Participants' Drawings Addressing Mathematics with Positive Emotions.



(Mathematics is nice. Happy me who loves mathematics.)

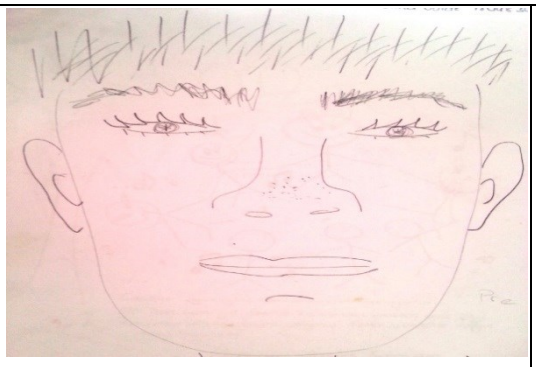


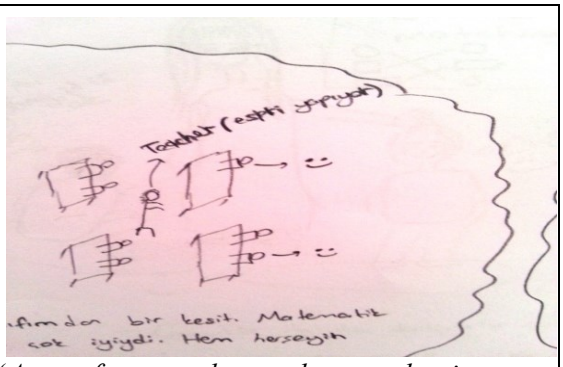
(Puzzle)

Participants with positive emotions also referred to previous teachers when they thought about mathematics considerably with positive feelings. For instance, PST46 and PST47 remembered the previous teachers in a positive memory as reflected in drawings in Table 4.6.

Table 4.6

Participants' Drawings Addressing Previous Mathematics Teachers with Positive Emotions.

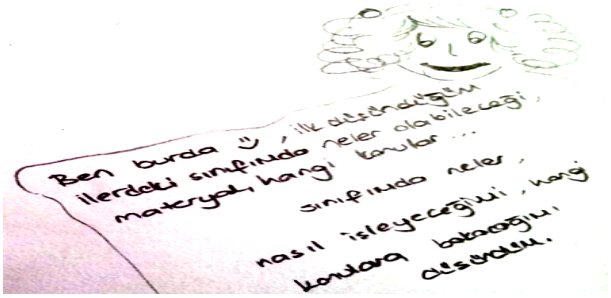




(*A case from my class and my teacher is making joke.)*

PST46 drew her teacher (on the left above), Teacher Ali, when drawing what mathematics was for her. She explained that Teacher Ali influenced mathematics thinking style, view point of mathematics, and increased her self-confidence in mathematics. She stated that when she heard mathematics, Teacher Ali came to her mind first.

Apart from the negative and positive emotions, neutral emotions arose from the drawings. Drawings which did not particularly address negative or positive feelings were coded as neutral. Participants generally drew and wrote on their drawings a curiosity about how they would be teaching mathematics to young children. For example, PST2 drew a curious face, showing willingness to learn about her future teaching profession and how to teach mathematics as in Figure 4.1.



(First, I thought my future class, materials, and which topics I will teach.)

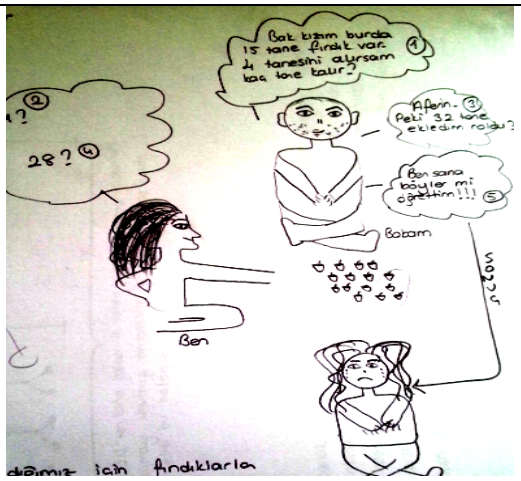
Figure 4.1 PST2's drawing addressing curiosity of teaching mathematics.

4.1.2.2 Contextual Expressions at the Beginning

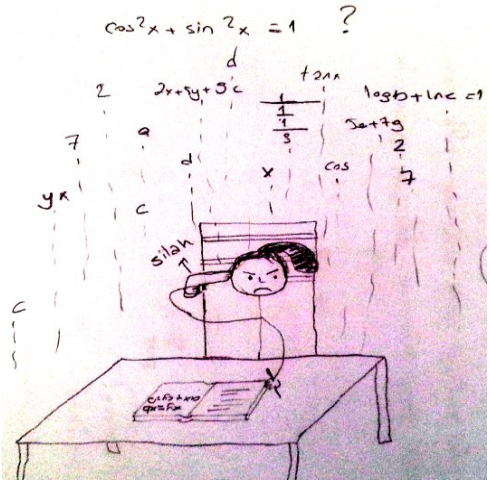
At the beginning of the course, preservice teachers described the learning environment as a *traditional learning environment*. The social context for the emotions were pictured often where an adult, such as a parent or teacher, teaching mathematics to a confused child. For example, PST10 drew her father teaching her subtraction, saying "*Is this the way that I taught you!!*" Participants often pictured the context of learning mathematics and described their emotions in these contexts. The physical context was sometimes the classroom organized as students' desks facing the board and teacher was on his desk. PST10, PST38, PST36, PST44 and PST12 drew as in Table 4.7.

Table 4.7

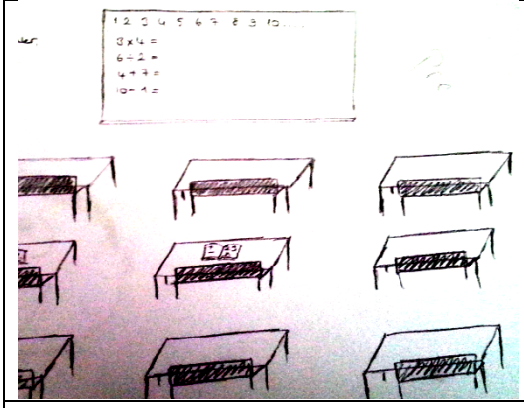
Participants' Drawings of Context of Learning Mathematics.

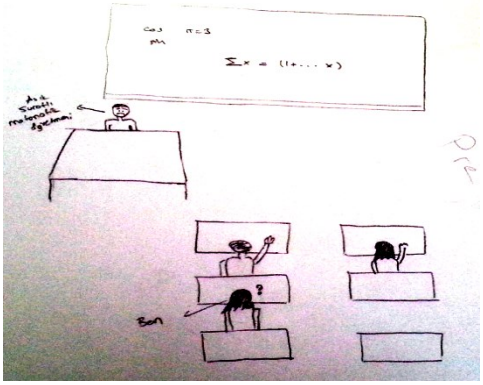


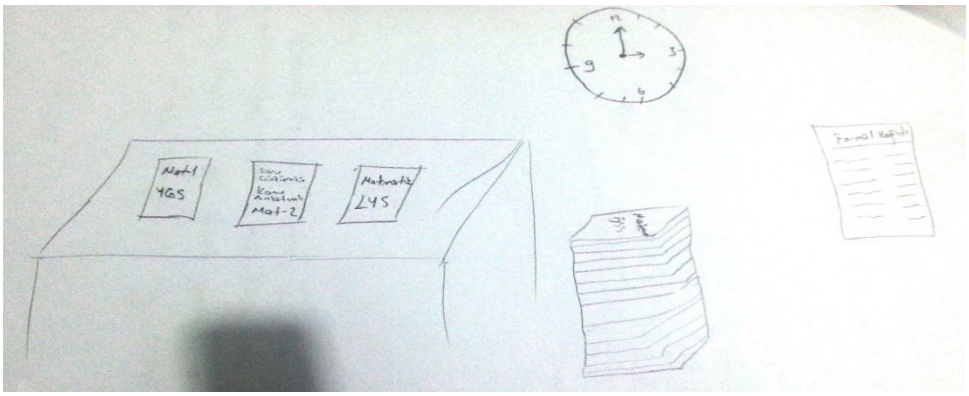
(His father saying "*Is this the way that I taught you!!*".)



(*A gun)*







(Books for Math1-YGS, Math2, Math LYS, Math ÖSS, a paper including formulas)

Drawings indicated that participants came to the teacher education program with traditional learning context ideas. In detail, most of them drew the teacher writing

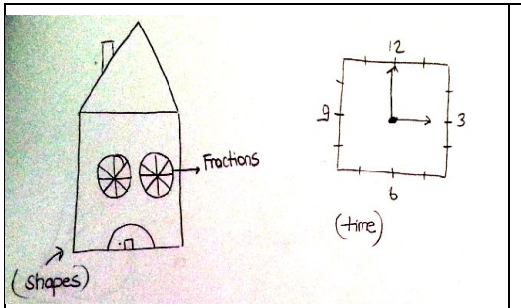
questions on the blackboard and students looking at the teacher in their desks, text books titled "YGS" (University Entrance Examination), papers full of formulas, a clock, and the lesson taken at the high school.

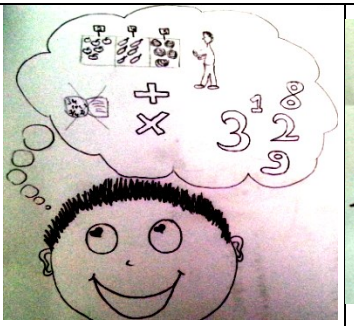
4.1.3 Preservice Teachers' Mathematics Related Images after the Course

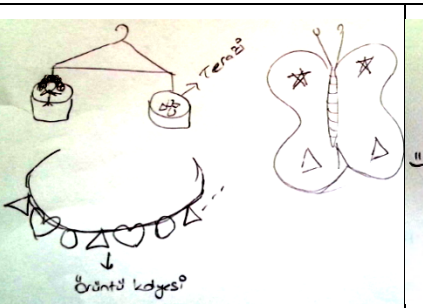
At the end of the course, drawing activity was conducted with the preservice teachers once more. Mathematics symbols in their drawings were categorized as *fundamental mathematics concepts* and *real-life connections*. The *advanced formulas and abstract concepts,* which appeared in the beginning of the course in participants' drawings, disappeared at the end of the course. Forty-two of the participants drew fundamental mathematics concepts, which were the concepts used in the mathematics in the early ages, such as *matching, patterns, measurement, and graphing.*

Among the 42 participants who drew fundamental concepts, 29 of them also made connections between the concepts and real-life. In total, 32 participants used real-life connections which referred to the drawings with daily life examples attached to mathematics. In other words, participants pictured the usage of mathematics in the real life. For example, they drew a quilt formed from patterns, some vegetables with the prices for shopping, the pattern necklace, and the windows, doors, and roof of house made from shapes, such as triangle, square, and rectangle as exemplified in Table 4.8.

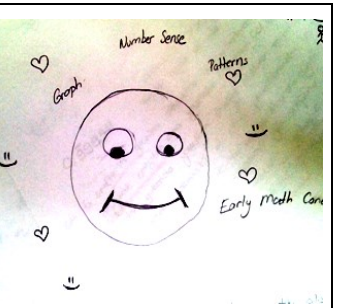
Table 4.8 Participants Drawings Addressing the Connections between Mathematics and Real Life.

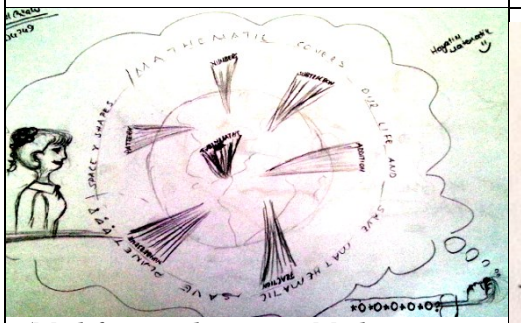




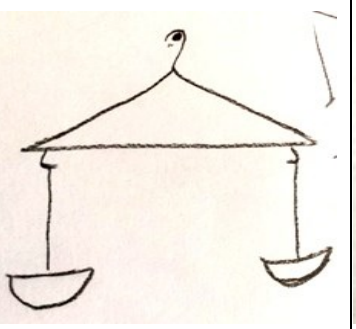


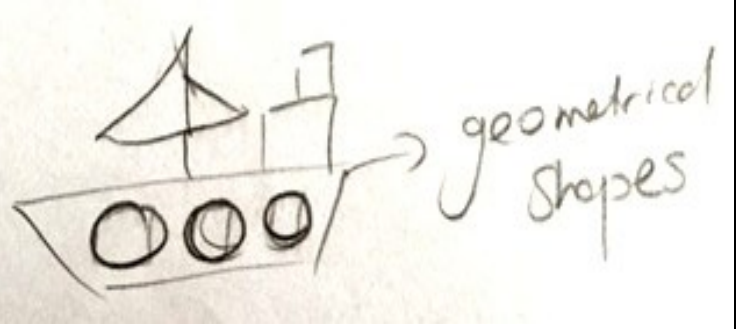
(Pattern Necklace)



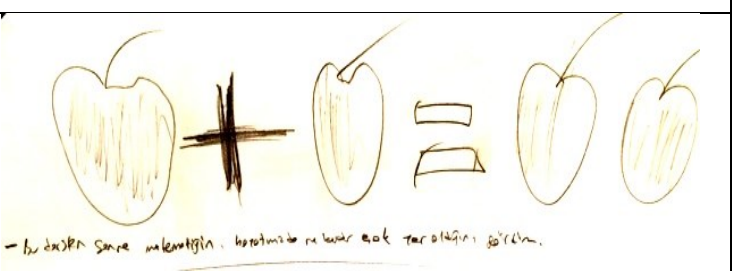


(My life is mathematics..Mathematics covers our life and save mathematics. Save planet!)





(Children are learning mathematics while playing game)



(After this course, I have learnt that in how many places of our life mathematics takes place.)

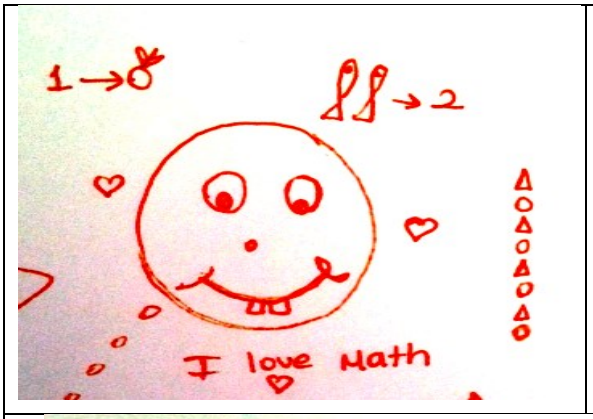
4.1.4 Preservice Teachers' Emotions after the Course

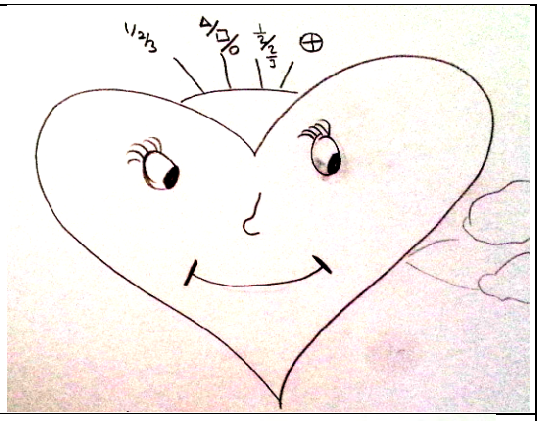
4.1.4.1 Emotional Expressions at the End

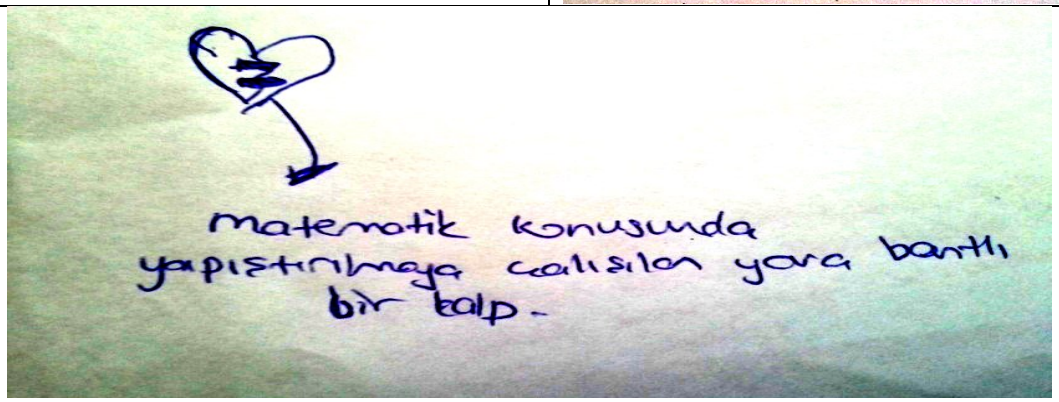
At the end of the course, emotional expressions were categorized as *positive and negative emotions*. Forty of 47 participants drew images of rather positive emotions. These emotions mostly described loving mathematics and being happy to be busy with mathematics. PST39, PST28, and PST34's drawings which illustrated positive emotions regarding mathematics are given in Table 4.9 to illustrate:

Table 4.9

Participants' Drawings Addressing Mathematics with Positive Emotions At the End.







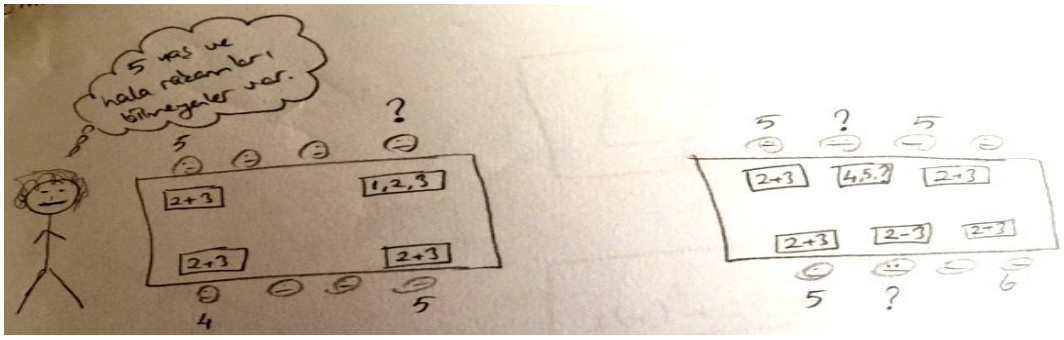
(A heart with adhesive plaster on mathematics issue)

On the other hand, two participants pictured the child crying in their teaching practice illustrating the negative experience that they had in the kindergarten during

their practice teaching. The little child PST14 encountered was crying and had difficulty in mathematics as pictured in the following drawing in Figure 4.2.

Figure 4.2 PST14's drawing addressing a crying child who has difficulty in mathematics.

PST15 drew her field practice class and mentioned about the 5 years old children who still did not know the numbers as in Figure 4.3.



(They are 5 years old and still they don't know the numbers)

Figure 4.3 PST15's drawing addressing a class of 5-year-old children.

The rest of the participants indicated no emotional expressions.

4.1.4.2 Contextual Expressions at the End

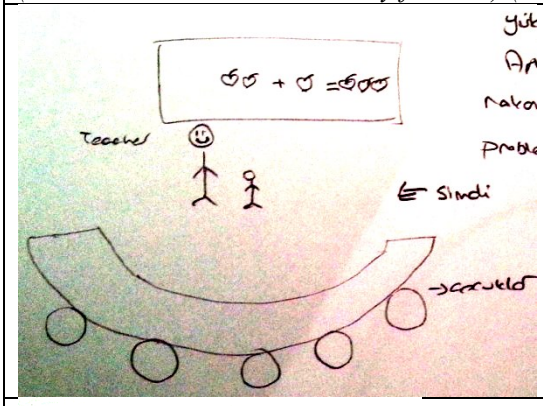
At the end of the course, preservice teachers described the mathematics learning environment as *developmentally appropriate teaching and learning environments* such as children sitting in a circle and studying as a whole group. They were playing games to learn mathematics, and enthusiastically involved in activities. The textbooks were scribbled and instead of them, there were music notes, story books, balls, and ropes form of numbers. The teacher was placed in the middle of the students. The mathematical context switched to the mathematics participants would be teaching and the classroom context became the classroom context they would be teaching. Desks and traditional classroom arrangements disappeared and

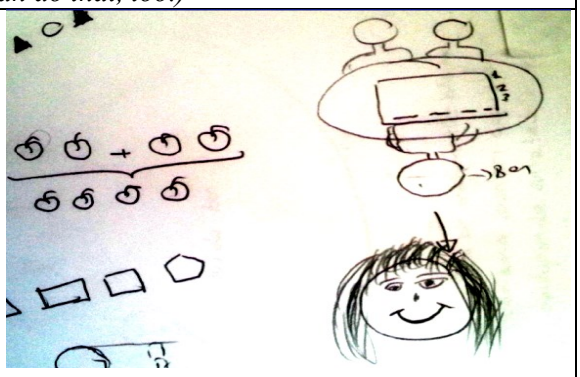
kindergarten contexts and arrangements appeared instead. They also drew children in these classes who were enthusiastic about learning mathematics. Below are drawings by PST47, PST38, PST29, PST31, and PST3 illustrating the context at the end of the course in Table 4.10.

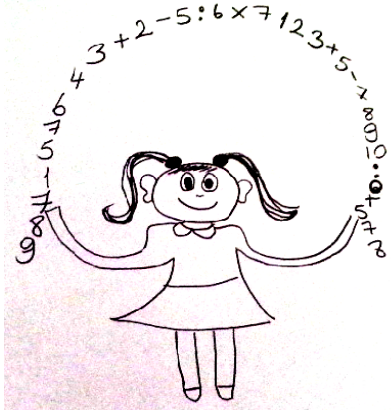
Table 4.10

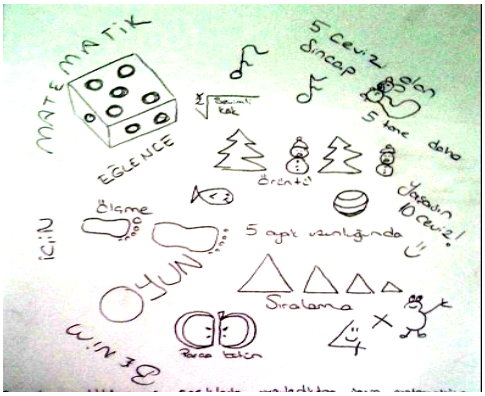
Participants' Drawings of Classroom Context At the End of the Course.

(If Ali makes it wrong, the teacher was not angry. Then, I can try it. If I make it wrong, it is ok.)
(Yes, I can do it. I can. It is easy for me.) (I can do that, too.)









(Mathematics is a game and entertainment for me.)

4.1.5 Summary of Findings for the Influence of the Course on Images and Emotions

The findings from participants' pre drawings showed that negative emotions were contextualized in often high school classrooms as portrayed with more advanced concepts and formulas. These classrooms reflected rather traditional learning contexts with an adult teaching mathematics. Participants illustrated negative emotions, confusion and sometimes fear in these contexts. These negative emotions might be due to participants' lack of accurate knowledge of mathematics they would engage in the course and the images they had and brought to the course.

At the end of the course, participants illustrated expressions of positive emotions of mathematics and classrooms of early childhood contexts. While participants did not draw any emotion or context related to teaching mathematics in the beginning of the course, they pictured ECE contexts and ECE teachers at the end of the course. It appeared that they pictured themselves as teachers of mathematics in ECE contexts and children as learners of mathematics in these contexts. The findings of both pre and post drawings are presented in Table 4.11.

Table 4.11

Results of Drawing 1 and Drawing 2

	Mathematics Related Images	**Emotions**	
		Emotional Expressions	***Contextual Expressions***
At the beginning	Advanced formulas and abstract concepts- *23 PST* Basic mathematics concepts- *14 PST*	Positive-*11 PST* Neutral- *6 PST* Negative-*30 PST*	Traditional learning contexts- *18 PST*
At the end	Fundamental mathematics concepts- *42 PST* Real-life connections-*32 PST* Both of them-*29 PST*	Positive -*40 PST* Negative-*2 PST*	Developmentally appropriate teaching and learning contexts-*44 PST*
Change	*From abstract to concrete*	*From negative emotions to positive emotions*	*From traditional settings to constructivist settings*

Participants' negative emotions for more abstract mathematical concepts in the form of fear, sadness and anxiety they pictured in their pre-drawings probably did not change. However, they seemed to have a different perspective of mathematics and how mathematics teaching and learning might take place which they did not have before the course. The new images were stronger at the end of the course and participants focused more on these images rather than their pre-existing images with negative emotions.

4.2 Influence of the Course on Preservice Teachers' Mathematics Anxiety

Participants were implemented, at the beginning of the semester, *Mathematics and Me 1* questionnaire which asked them to rate their mathematics anxiety (MA) level from 1 to 10, where 1 showed the least anxiety and 10 the most. Being moderately anxious would be described by a scale of 5. Similarly, at the end of the course, participants were asked to rate their MA level in *Mathematics and Me 3* questionnaire in order to determine their final anxiety level. They were also asked questions about MA and mathematics teaching in *Mathematics and Me 1* and additionally about how they viewed children's mathematics anxiety in *Mathematics and Me 3.*

4.2.1 Preservice Teachers' Level of MA in the Beginning and at the End of the Course

Participants who rated their MA from 1 to 4 were considered as having lower MA and who rated their MA from 6 to 10 were considered as having higher MA. Participants who rated their MA as 5 were considered as having moderate level MA. Since the preservice teachers addressed different sources for their MA, any statistical analysis could not be employed in the study. The Table 4.12 shows the change in MA scores of preservice teachers before and after the course as following:

Table 4.12

Change in MA Scores Before and After the Course.

	Before TMEC	After TMEC	Change
Higher MA	13 PST	14 PST	8 participants – no change 5 participants from higher to lower
Moderate MA	3 PST	2 PST	1 participant – no change 2 participants from moderate to higher
Lower MA	31 PST	31 PST	26 participants – no change 4 participants from lower to higher 1 participant from lower to moderate

Although the table shows that the number of participants with higher, moderate and lower MA did not change much, the participants who responded in both implementations in the same level were different to some extent. Yet, eight of the participants with higher MA and 26 of the participants with lower MA maintained their level of anxiety generally within two scores of their initial anxiety level. Twelve participants, on the other hand, expressed different levels of anxiety at the end of the course. Four participants' MA levels were increased from lower to higher MA, five participants' MA levels were decreased from higher to lower MA. In summary, a total of 35 participants had the same level of MA at the end of the course.

There were changes in participants' expressions of the sources of their MA at the end of the course. Eighteen participants expressed different sources for their MA at the end of the course, while the source for 11 of them was high school mathematics classes in the beginning of the course. Eleven of the 18 participants maintained their lower MA even though they expressed different sources. Four participants whose MA level changed from higher to lower also expressed a different source for their MA at the end of the course. These four participants thought about their high school mathematics class in the beginning of the course when they expressed their higher MA. At the end of the course, they expressed rather earlier school periods for their lower MA.

These findings showed that the course did not have much influence on participants' MA levels, most probably because their MA were initiated by sources before their enrollment in the ECE program. The changes in MA levels at the end of the semester

were somehow related to the change in the sources they thought about while expressing their level of MA. The course might have helped participants to reflect more on the sources of their MA and they might have remembered different sources that affected their MA at the end of the course. This might have resulted in changes in the MA levels.

4.2.2 Sources of MA

In *Mathematics and Me 1*, the sources that caused MA were also asked to preservice teachers in order to have a better understanding of their MA in the beginning of the course. In addition to *Mathematics and Me 1*, the sources of MA were also obtained via *Field Reflection Reports* where preservice teachers wrote their prior MA as a life history related to mathematics at the end of the course. Findings are presented in terms of the sources causing higher MA and lower MA of preservice teachers.

4.2.2.1 Sources of Higher MA

According to Hadfield and McNeil (1994), the causes of MA can be traced back to *environmental, intellectual,* and *personality factors*. *Environmental factors* include negative experiences in the classroom, parental pressure, insensitive teachers, mathematics presented as rigid sets of rules, and nonparticipatory classrooms (Dossel, 1993; Tobias, 1990). *Intellectual factors* include being taught with mismatched learning styles, student attitude and lack of persistence, self-doubt, lack of confidence in mathematical ability, and lack of perceived usefulness of mathematics (Cemen, 1987; Miller & Mitchell, 1994). *Personality factors* include reluctance to ask questions due to shyness, low self-esteem, and viewing mathematics as a male domain (Cemen, 1987; Gutbezahl, 1995; Levine, 1995; Miller et al., 1994).

In the present study, there were 13 participants who had higher MA at the beginning of the course. Analysis of data regarding sources causing higher MA revealed two major sources of anxiety in this study: *Contextual* and *intellectual*. These sources mostly reflected the categories of sources mentioned in the literature with some modifications. Contextual sources included *influences of perceived negative teacher*

characteristics, previous courses, classmates, and *family*. Intellectual sources included *perceived difficulty of mathematical knowledge, perceived lack of confidence in mathematical ability, influence of perceived student negative attitude*, and *perceived inadequate subject matter knowledge* taught in classroom. There were three participants with moderate level of MA who expressed rather negative experiences for their MA. Therefore, findings for both higher and moderate MA participants are presented for each source below.

4.2.2.1.1 Contextual Sources

Five participants attributed their high MA to contextual sources. The participants had negative experiences of mathematics at one or more levels of pre-college education and they mostly attributed these experiences to teachers. Families, classmates and the general public understanding that mathematics was a difficult subject were sometimes mentioned in addition to the ineffective teachers. The following excerpts exemplified these experiences:

> *In the primary school, I always had difficulty with problems and I was extremely disturbed by this situation. Those [difficulties] continued during middle school. My teacher told me that I shouldn't have been in TM [Turkish and Mathematics track] and I was not able to do mathematics. […] I think, all of these are due to the teacher.* (PST34)

> *The problems I had were because of my high school teacher's wrong attitude about this subject. Because, although he should have told us that mathematics was easy [to learn], he approved the common understanding and told us that mathematics were difficult and we would not be able to do it. When we gave wrong answers, his reaction was very bad.* (PST28)

In addition to these excerpts above, PST17 and PST35 explained the contextual sources in their reflection papers. In fact, those participants reported moderate MA in *Mathematics and Me 1*, but they reflected their sources underlying their moderate MA in the *Field Reflection Report* assignment in detailed as follows:

> *[My] teacher's unpleasant behavior towards students made me hate this course and be unsuccessful, and almost ended [my] relationship with mathematics.* (PST17)

> *My mother always repeated 'Our family is bad at mathematics. No one understands mathematics in our family. We are mathematically*

> *handicapped.' Apart from my mom, other family members also mentioned that mathematics was so difficult and so complex. I think that those things much affected my subconscious. […] After that, mathematics courses during the 6 year went on "copy the text in the book to the notebook". When this situation combined with my family's attitude, it led to being alienation, going away, and being afraid of mathematics.* (PST35)

In brief, many participants had negative experiences in mathematics during their pre-college education. They mostly attributed these negative experiences to their teachers who were not effective in teaching mathematics and/or not helping students develop positive attitudes. Negative experiences with mathematics resulted in MA for participants. When these experiences were blended with family or society pressure to be successful in mathematics, the MA seemed to get stronger for the participants.

4.2.2.1.2 Intellectual Sources

Eight participants attributed their high MA to intellectual sources. The perceived difficulty of mathematics topics at the pre-college education resulted in higher MA for the participants. Some participants emphasized the difficulty of higher level mathematics while they were at high school. This mathematics was called *Mathematics 2* course at the time of their high school studies and it involved the abstract and complex concepts which led to higher MA.

> *The number of subjects and their difficulty level are increasing as the school level is increasing. If the subject is easy, the [mathematics] anxiety is less, but if the subject is more difficult, it leads to higher anxiety.* (PST18)

> *Because there are a lot of abstract mathematics topics. Because I was I afraid of not understanding the topics and taking bad grades, it was worrisome.* (PST29)

> *Compared to four operations, abstract mathematics makes me more anxious. I can't understand and can't perceive it. I began not to understand some subjects and place them accurately in my mind. In high school, too, it was unfavorable, I was not able to understand at the high school and I was taking low grades.* (PST33)

> *At the end of the high school, integral and derivative appeared and my life changed. I was alienated from mathematics and hated it. Because I did not understand and I did not know what I should do, how I would solve and how I would be successful in mathematics.* (PST40)

Although PST23 and PST39 enjoyed mathematics at some part of their pre-college education, their lack of success or lack of sufficient mathematical knowledge led them towards being more anxious and less interested in mathematics as illustrated below:

> *I liked mathematics very much until I met Mathematics 2.* (PST23)

> *I am very anxious. […] After the 8th grade, we had no [mathematics] teacher in our school and I began to experience lack of [mathematics] background. In middle school, although I liked mathematics, I had a difficulty understanding the topics and a growing mathematics fear has begun because we did not have a mathematics teacher. Even though I managed to do mathematics in the high school, severe stress and crying episodes started before the school examinations. "Dislike" is a false word, [but] "fear" exactly explains the situation.* (PST39)

To sum up, perceived difficulty of mathematical knowledge especially at high school resulted in the higher MA. Especially, topics of Mathematics 2 course made the participants lose their positive feelings for mathematics. Since they felt that they had to memorize all formulas in mathematics, the mathematics lessons turned to an unpleasant experience. They became alienated from mathematics and developed prejudices regarding their ability on mathematics. Moreover, their inadequate success or perceived insufficient mathematics knowledge resulted in less interest towards mathematics. These sources resulted in higher MA for participants.

4.2.2.2 Sources of Lower MA

Mathematics and Me 1 findings also indicated the sources regarding lower MA of preservice teachers. These sources can be categorized into two parts*, contextual* and *intellectual,* as presented below. Although these participants rated their MA in lower levels, some of them still had rather negative experiences which resulted in some anxiety in lower levels. Therefore, although this section presents sources for lower MA, there are findings also presented here for participants with negative past mathematics-related experiences but with lower MA.

4.2.2.2.1 Contextual Sources

Participants with lower MA referred to contextual sources when they expressed the reasons for their low anxiety. These sources included *influences of perceived positive teacher characteristics, previous courses,* and *family*. Having qualified teachers influenced participants positively and they did not develop a high MA. They often referred to their previous mathematics teachers and how these teachers affected their affect and success in mathematics:

> *Because I had good mathematics teachers, I have no mathematics anxiety.* (PST14)
>
> *I love mathematics. Since my primary school teacher taught really well, I love mathematics very much.* (PST37)
>
> *I could say that I had good teachers in primary school to teach me mathematics concepts and establish the basis of mathematics. They were all supportive and well qualified. That's why I never had an anxiety in those years. […] I believe that, the attitude of the teachers affects students' success in that lesson so much.* (PST8)
>
> *I think that the first relationship with mathematics and the role of teacher in this relationship is very important. My teachers were generally successful, had classroom management and higher skills. They did not make me memorize mathematics, they taught me mathematics*! (PST16)

Some of the preservice teachers attributed their lower MA to both teachers and families. Often, having a sister or brother who liked mathematics helped them in having positive feelings while learning mathematics:

> *My father's support for my primary school homework has an undeniable importance to enhance my love towards mathematics course. Endless efforts of my teachers and their faith in me [helped me love mathematics]*. (PST10)
>
> *Even though our teacher taught mathematics course in all free times, I was fond of playing numbers. The most important reason for this was that my sister also liked mathematics and because my sister was my role model in everything.* (PST13)
>
> *I had no difficulty in mathematics and loved it. Because I loved my class teacher and he made us love mathematics. In fact, another reason for loving mathematics was my brother. When I had difficulty in any mathematics homework, my brother explained me quite well and as soon as he explained, I had no problem.* (PST37)

In conclusion, lower mathematics anxious participants had positive experiences in mathematics during their pre-college education. They mostly attributed these positive experiences to their teachers who were effective in teaching mathematics and/or helping students develop positive attitudes. Positive experiences with mathematics resulted in lower MA for participants. Moreover, family had a positive effect on learning mathematics. Participants' siblings who were good at mathematics lowered their MA and contributed to having positive feelings towards mathematics. On the other hand, five participants attributed their MA to their teachers' ignorance about the other lessons, such as, physical education, art and music courses, and mentioned this in the *Field Reflection Report* assignment. For instance, PST36 and PST12 were lower anxious participants, but their reflections revealed that when teachers focused only on mathematics and ignored students' needs and interests in other subjects, mathematics became an anxiety issue:

> *I remembered that one day [in primary school], we were prepared for physical education class by wearing our sport clothes, and we waited for our teacher. Then, something happened and she got angry to us and we did math lesson with our sport clothes in the classroom. That day, I hated math.* (PST36)

> *I hated math when I was in elementary school because my teacher always wanted to study math in almost every class such as physical education, art, and speaking and writing classes.* (PST12).

4.2.2.2.2 Intellectual Sources

Intellectual sources which led to lower MA included *perceived competence in the perceived nature of mathematics, perceived usefulness of mathematics influence,* and *perceived high confidence in mathematical ability influence.* Participants with lower MA perceived mathematics either as a logical set of knowledge or a set of formulas, and considered this nature as enjoyable or not leading anxiety.

> *...I had no mathematics anxiety at [content of one of the high school mathematics course] Mathematics 1, [because] it was based on logic.* (PST5)

> *Because mathematics is a lesson of formulas. If you study enough and make practice there is no need to have anxiety. Mathematics has never been a course that I was afraid of.* (PST43)

Perceived usefulness of mathematics also helped some of the participants in developing lower MA:

> *I am not anxious in general because mathematics is the basic step and it is very useful for human brain.* (PST16)
>
> *I am not much anxious. I think mathematics is enjoyable and useful.* (PST8)

Some participants with lower MA had considerable confidence in mathematics. However, how these participants considered mathematics and viewed themselves confident was not mentioned much. Perceived indicators of success also led them to have lower MA:

> *I think if I spend a little time on mathematics, I will be more successful [in mathematics] than I do in other areas.* (PST42)
>
> *…I don't feel anxiety [because] I believe that I can do mathematics and I am successful.* (PST30)
>
> *I am not anxious because I trust my mathematics background. I think that I had a quality [mathematics] education. Mathematics is the course that I have been the most successful in my whole life. I have studied for TÜBİTAK Mathematics Olympiads for two years. Mathematics was like a love.* (PST15)

Lower mathematics anxious participants approached the nature of mathematics rather as a set of formulas or logical set. Since they felt pleasure while dealing with mathematics, their MA was low. Furthermore, they had the thought that mathematics was useful, which led them towards being less anxious and more interested in mathematics. They believed in their talents on mathematics and as a result of this they had high confidence in mathematics. Briefly, Table 4.13 summarizes the sources of participants' MA.

Table 4.13

*Sources of MA**

Categories	Contextual	Intellectual
Sources of Higher MA	Perceived teacher characteristics influence (-) (N=4)	Perceived difficulty of mathematical knowledge influence (N=5)
	Perceieved previous course influence (-) (N=1)	Perceived lack of confidence in mathematical ability (N=3)
	Perceieved classmates influence (-) (N=1)	Perceived student negative attitude influence (N=3)
	Perceived family influence (-) (N=1)	Perceived inadequate subject matter knowledge influence (N=3)
Categories	**Contextual**	**Intellectual**
Sources of Lower MA	Perceived teacher characteristics influence (+) (N=12)	Perceived competence in the perceived nature of mathematics (N=9)
	Perceieved previous course influence (+) (N=2)	Perceived usefulness of mathematics influence (N=2)
	Perceived family influence (+) (N=4)	Perceived high confidence in mathematical ability influence (N=8)

Note. * (-) represents negative influence and (+) represents positive influence.

Table 4.13. shows that school and family contexts influenced participants' MA either in a positive or negative way. Teachers with positive attitudes helped participants enjoy mathematics and not develop MA. Families also supported the participants' mathematics learning with a positive attitude. On the other hand, teachers with negative attitudes and unsupportive family environment resulted in higher MA for the participants. When these contextual factors were combined with inadequate subject knowledge and participants' lack of confidence, they had higher MA. Participants with higher confidence and sense of competence in mathematics had lower MA.

4.3 Influence of the Course on Preservice Teachers' Mathematics Teaching Anxiety

Participants were asked to rate their mathematics teaching anxiety (MTA) level from 1 to 10, where 1 showed the least anxiety and 10 the most in the *Mathematics and Me 1* questionnaire. Being moderately anxious would be described by 5. Similarly, at the end of the course, participants were asked rate their MTA in the *Mathematics and Me 3* questionnaire in order to understand their MTA level at the end of the course.

In addition, the sources that caused MTA were asked to preservice teachers in the beginning and at the end of the course. The sources of MTA were also obtained via *Interviews* where 20 preservice teachers talked about their MTA in detail. The findings from *Mathematics and Me 1*, *Mathematics and Me* 3, and *Interviews* were given respectively.

4.3.1 Preservice Teachers' Level of MTA in the Beginning and at the End of the Course

Participants who rated their MTA from 1 to 4 were considered as having lower MTA and who rated their MTA from 6 to 10 were considered as having higher MTA. Participants who rated their MTA as 5 were considered as having moderate level MTA. The Table 4.14 shows the change in MTA scores of preservice teachers before and after the course as following:

Table 4.14

Change in MTA Scores before and after the Course.

	Before TMEC	After TMEC	Change
Higher MTA	15 PST	2 PST	1 participants – no change 11 participants from higher to lower 3 participants from higher to moderate
Moderate MTA	6 PST	4 PST	6 participants from moderate to lower
Lower MTA	26 PST	41 PST	24 participants – no change 1 participants from lower to higher 1 participant from lower to moderate

While 15 participants rated higher level of MTA, 26 participants rated lower level MTA in *Mathematics and Me 1*. One of the participants with higher MTA and 24 of the participants with lower MTA maintained their level of MTA. Twenty-two participants, on the other hand, expressed different levels of MTA at the end of the course. One participant's MTA levels were increased from lower to higher MTA, 11 participants' MTA levels were decreased from higher to lower MTA. In summary, a total of 25 participants had the same level of MTA at the end of the course.

In *Mathematics and Me 3*, the sources that caused MTA were asked to preservice teachers in order to have a better understanding of their MTA at the end of the course. In addition, the sources of MTA were also obtained via interviews where 20 preservice teachers talked about their MTA in detail. While two participants had higher level of MTA, 41 participants had lower level of MTA at the end of the course. Besides, MTA levels of four participants were 5, indicating a moderate level.

There were changes in participants' expressions of the sources of their MTA at the end of the course. They stated the contributions of TMEC course they took. These findings revealed that the course had influence on participants' MTA levels.

4.3.2 Sources of MTA

In *Mathematics and Me 1*, the sources that caused MTA were asked to preservice teachers in order to have a better understanding of their MTA in the beginning of the course. Results are presented in terms of the sources causing higher MTA and lower MTA of preservice teachers.

According to Brown et al. (2012), the sources of MTA of preservice elementary teachers can be categorized as *adapting to established teaching structures*, *preparing for the mathematics classroom*, and *recognizing personal attributes for mathematics teaching*. They constructed these categories based on using research related to internal-external locus of control (Rotter, 1966) and the categories were explained from the most externally focused to the most internally focused. *Adapting to established teaching structures* included resources, curricular structure, classroom management, and supervision which were related to existing classroom environment where preservice teachers would have no control on them (external locus of control). *Preparing for the mathematics classroom* included observing other teachers, practice and reflection, preparation, and children's understanding. For this category, preservice teachers were sometimes able to have control over their mathematics related teaching experiences in the field practice. *Recognizing personal attributes for mathematics teaching* included emotional impact (such as strong feelings participants experience) and previous experiences with mathematics. Preservice teachers felt more internal locus of control in this category. Figure 4.4 displays the categories and

themes of preservice teachers' mathematics teaching anxieties. The sources of higher and lower MTA were analyzed through these categories. Moreover, for the current study, the analysis for the sources of MTA revealed other categories for lower MTA. In detail, these categories were *expectations from the course and contributions of TMEC*.

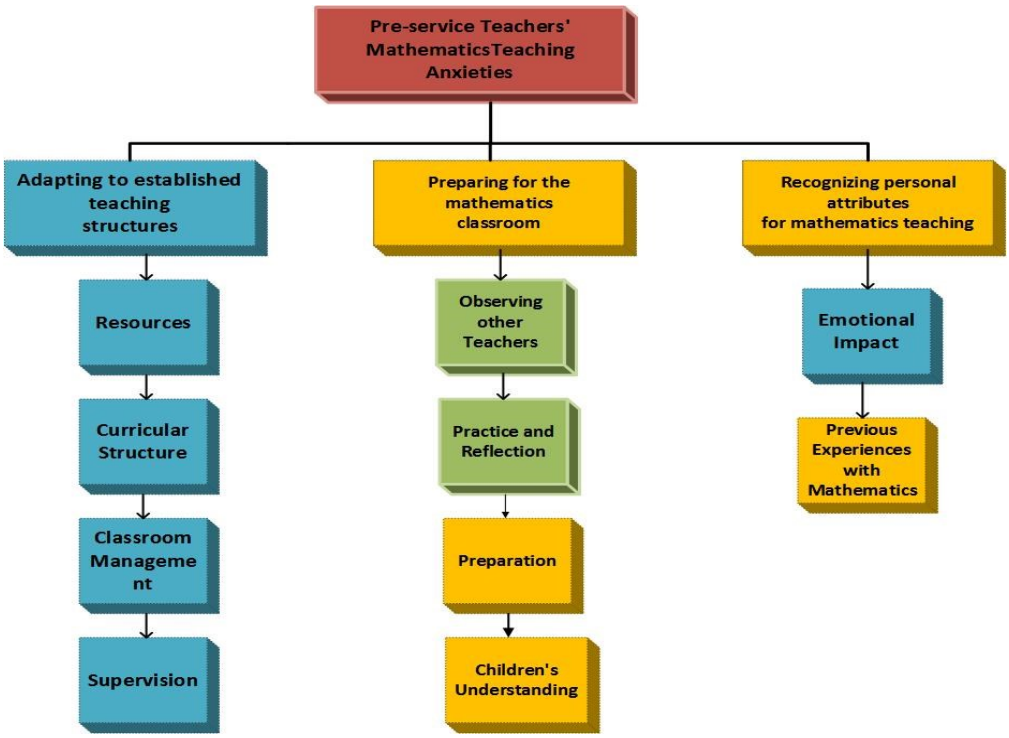


Figure 4.4 Categories and themes of pre-service teachers' MTA. "Teaching Anxieties Revealed: Pre-service Elementary Teachers' Reflections on Their Mathematics Teaching Experiences," by A. B. Brown, A. Westenskow, and P. S. Moyer-Pakenham., *Teaching Education*, 2012, p. 372.

In Figure 4.4., while blue background displays the categories and themes that increased anxieties; green background shows themes that reduced anxieties. On the other hand, yellow background refers the categories and themes that sometimes increased and other times reduced anxieties.

4.3.2.1 Sources of Higher MTA at the Beginning of the Course

Fifteen participants rated their MTA in higher levels in the beginning of the course. Analysis of data regarding sources causing higher MTA revealed two major sources of anxiety in this study: *Preparing for the mathematical activities*, and *recognizing personal attributes for mathematics teaching*. These sources reflected the categories

of sources revealed in Brown et al.'s (2012) study, except for *adapting to established teaching structures.* Since preservice teachers haven't been to field practice until the 3rd year, *adapting to established teaching structures* was not encountered at the beginning of the course. Preparing for the mathematical activities included *children's understanding* and *practice. Recognizing personal attributes for mathematics teaching* included *previous experiences with mathematics*. Findings are presented for each source.

4.3.2.1.1 Preparing for the mathematical activities

Among the 15 higher anxious participants, twelve of them (12 of 15) stated that children's understanding and practices had a great importance on preparing for the mathematical activities. Therefore, the participants were afraid of different levels of children coming to preschools. Since they considered mathematics as abstract for children, they had higher MTA level. The following excerpts exemplified these experiences:

> *Regarding teaching mathematics, I have high [teaching] mathematics anxiety especially for the early childhood children. Because they have different backgrounds and it will be difficult to arrange the educational level.* (PST15)
>
> *It may be difficult to make mathematics easy to teach to children and make it enjoyable for them to like it.* (PST1)
>
> *The reason that I have mathematics teaching anxiety is my thought that I would be unsuccessful in transferring rather abstract concepts to children.* (PST38)

PST17 gave detailed information regarding children's understanding during the interview as following:

> *[….] Not every child is the same. While some of them do their best, others not and no matter how much you try, you may not be successful. This is one of the situations that increase [my mathematics teaching anxiety].* (PST17)

Four participants of twelve attributed their MTA to their lack of practices regarding teaching mathematics. They did not have a teaching mathematics experience with children before and had not known any methods related to teaching mathematics:

> *Not in learning mathematics, but I have more anxiety in teaching mathematics because I don't know any methods of teaching.* (PST4)
>
> *I don't know whether I will be successful or not because I had no experience related to teaching mathematics before. Therefore, I am somewhat anxious about teaching mathematics.* (PST8)
>
> *I think that my basic mathematics knowledge can be sufficient for the young children, but I am anxious about how I can teach it.* (PST12).

Having no experiences and not knowing any methods of teaching mathematics resulted in higher MTA. In brief, 12 participants had higher MTA level at the beginning of the course because of difficulties in handling children's understanding and having no teaching mathematics practices.

4.3.2.1.2 Recognizing personal attributes for mathematics teaching

Three of participants (3 of 15) attributed their higher MTA to their high MA due to previous experiences with mathematics. They thought that their MA and lack of mathematical knowledge would result in not being able to teach mathematics effectively to the early ages.

> *I have had mathematics anxiety for years and it causes to decrease my confidence, more specifically my confidence in teaching and learning mathematics.* (PST39)
>
> *If I know [mathematics] myself, I can teach it, but first I need to reduce my own mathematics anxiety.* (PST34)
>
> *I don't know mathematics very well and I am anxious about teaching what I don't know.* (PST18)

Although participants did not have any memory or experience regarding teaching mathematics to children, they had thoughts related to future teaching mathematics experiences because of their existing higher MA. These sources caused higher MTA for participants.

4.3.2.2 Sources of Lower MTA at the Beginning of the Course

Mathematics and Me 1 findings also indicated the sources regarding lower MTA of participants. Twenty-six preservice teachers rated their MTA in lower levels in the beginning of the course. These sources of their lower MTA can be categorized into

three parts*: Preparing for the mathematical activities*, *recognizing personal attributes for mathematics teaching,* and *expectations from the course* as presented below.

4.3.2.2.1 Preparing for the mathematical activities

Similar to higher level MTA, participants with lower MTA also referred to factors related to preparing for the mathematical activities. Eighteen participants (18 of 26) had lower anxiety level regarding preparing for the mathematical activities category. These factors included *children's understanding* (N=14) and *practices* (N=4). It was stated that knowing the level of children was important in terms of transferring knowledge. If they knew children's ages, it would influence participants positively and they would not develop a higher MTA. Moreover, they considered mathematics as concrete and they believed in their abilities to make it simple for children. Thus, children could enjoy and understand the basic mathematics.

> *I think that I can give the right level of education if I have the information related to the learning level of the children.* (PST6)
>
> *I may be anxious about adjusting the age level that I teach, but I don't think it is something that I cannot achieve.* (PST16)
>
> *Mathematics can be made more enjoyable for children by making it concrete. Therefore, I am less anxious.* (PST10)
>
> *I am less anxious. Because, I think mathematics is a concept that can easily be made concrete for children. I can teach it easily.* (PST45)

Lower mathematics anxious participants approached the nature of mathematics as concrete and thought that they could teach it easily. On the other hand, four preservice teachers interestingly attributed their lower MTA to having no experience in the field. They stated that they had lower MTA and this anxiety was because they had no experience as following:

> *I am not much anxious. My existing anxiety is probably due to not having such an experience before.* (PST30)

Having no experiences with mathematics resulted in lower MTA participants. They seemed more confident in handling children's understanding. This confidence might be due to their lack of teaching mathematics practices in real contexts. Participants

might have thought that there would not be much problems in the early childhood settings during their mathematics teaching practices in the future.

4.3.2.2.2 Recognizing personal attributes for mathematics teaching

Five participants (5 of 26) had lower MTA level regarding recognizing personal attributes for mathematics teaching category. These factors which led to lower MTA included *emotional impact* and *previous experiences with mathematics.* Emotional impact helped three participants in developing lower MTA:

> *Since I like [mathematics], I think that I can do the same things again and again even if I encounter a problem.* (PST42)
>
> *There are many ways of teaching mathematics. Making (students) memorize or showing the way of obtaining solution. I am teaching mathematics to my sister, when I have the chance. I am showing the shorter ways and I am feeling great pleasure in teaching mathematics.* (PST9)

Two participants (2 of 5) had positive experiences in mathematics during their pre-college education. They attributed these positive experiences to their teachers who were good at teaching mathematics:

> *The reason that I have no anxiety is that my mathematics teachers, until now, have had sufficient knowledge and ability.* (PST23)
>
> *I think that I got better education in (mathematics).* (PST3)

In conclusion, lower mathematics anxious participants approached the mathematics as a practice which they enjoyed and their MTA was low. Furthermore, they thought that their previous teachers were effective in teaching mathematics, and as a result of this, they had lower MTA.

4.3.2.2.3 Expectations from the course

In this study, different from Brown et al.'s study (2012), *expectations from the course* emerged as a source of lower MTA. Three preservice teachers (3 of 26) with lower MTA mentioned their expectations of TMEC course they started to participate:

> *I think that if I learn methods of teaching through this course and make practices in the presentations, I can manage it.* (PST25)
>
> *[…..] I feel relaxed because I will learn the methods (of teaching) in this course.* (PST40)

I have the sufficient mathematical knowledge for the children. Since I will learn how I can teach it in this course, I am not anxious now. (PST11)

Participants' expectations from the course in terms of learning mathematics teaching methods to young children seemed to help in developing lower MTA. Briefly, Table 4.15 summarizes the sources of their MTA at the beginning of the course:

Table 4.15

Sources of MTA (At the Beginning of the Course) *****

Categories	**Preparing for the mathematical activities** ***(N=12)***	**Recognizing personal attributes for mathematics teaching** ***(N=3)***	**Expectations from the course**
Sources of Higher MTA ***(N=15)***	Children's understanding (-) *(N=8)* (Age level of children, Nature of mathematics)	Previous experiences with mathematics (-) *(N=3)*	
	Practice (-) *(N=4)* (No methods, No experience)		
Categories	**Preparing for the mathematical activities** ***(N=18)***	**Recognizing personal attributes for mathematics teaching** ***(N=5)***	**Expectations from the course** ***(N=3)***
Sources of Lower MTA ***(N=26)***	Children's understanding(+)*(N=14)* (Age level of children, Nature of mathematics)	Emotional impact *(N=3)*	Learning teaching methods *(N=3)*
	Practice (+) *(N=4)* (No experience)	Previous experiences with mathematics (+) *(N=2)*	

Note ***** (-) represents negative influence and (+) represents positive influence.

At the beginning of the course, MTA of preservice teachers revealed the sources in Table 4.15. Since their first field practices course and TMEC course were at the same semester, they did not have any experience of practice of teaching mathematics before. Therefore, the sources that the preservice teachers mentioned at the beginning of the course were evaluated as *perceived sources* of their MTA. While preservice teachers' existing MA could be traced back to their past experiences as students, their current mathematics teaching experiences might result in future MTA (Brown et al., 2012). Therefore, considering that participants had gained mathematics

teaching experience during the semester in field practice courses, the sources of MTA were again asked through *Mathematics and Me 3* at the end of the course.

In *Mathematics and Me 3*, the sources that caused MTA were asked to preservice teachers in order to have a better understanding of their MTA at the end of the course. Results are presented in terms of the sources causing higher MTA and lower MTA of preservice teachers.

4.3.2.3 Sources of Higher MTA at the End of the Course

Two participants (2 of 47) rated their MTA in higher levels at the end of the course. Analysis of data regarding sources causing higher MTA revealed one major source of anxiety in this study: *Preparing for the mathematical activities*. This category was found as the only source of higher MTA at the end of the course. Preparing for the mathematical activities included considering *children's understanding.* Findings are presented for this source.

4.3.2.3.1 Preparing for the mathematical activities

Only two participants had higher MTA at the end of the course. In fact, their higher anxiety level was not much. Participants selected the 6 and 7 scores in the 10 point-scale for their MTA. Two participants claimed that children's understanding made them have high anxiety. They were anxious about children's age level characteristics. Participants hesitated to adjust mathematics teaching practices according to children's level based on their experiences. The following excerpts exemplified these experiences:

> *I have much more anxiety in teaching mathematics. I don't have problem in teaching mathematics for elementary school children, but I am very anxious about early childhood (period).* (PST15)

> *Because I think that I know mathematics at a particular level and I have no difficulty in the activities I implemented previously, I am not much anxious. Only teaching the appropriate mathematics to the right age group and the process of preparing an interesting activity makes me feel somewhat anxious.* (PST25)

Twelve participants had higher anxiety level at the beginning of the course because of not handling children's understanding and having no teaching mathematics

practices. However, at the end of the course, only two participants had higher anxiety because of their lack of experiences in preparing mathematical activities for the younger children.

4.3.2.4 Sources of Lower MTA at the End of the Course

Forty-one participants rated their MTA in lower levels at the end of the course. The sources for the lower MTA of preservice teachers were categorized into four as *adapting to established teaching structures*, *preparing for the mathematical activities, recognizing personal attributes for mathematics teaching,* and *contributions of TMEC course* as presented below.

4.3.2.4.1 Adapting to established teaching structures

This category included *classroom management*. This code did not appear in analysis of data gathered in the beginning of the course. During the semester, preservice teachers prepared several mathematical activities and presented them in the classroom. Moreover, they went to field practice and implemented the activities in preschools. Two preservice teachers (2 of 41) stated that their MTA arose from the established teaching structures of the preschools. Although at the beginning of the course participants did not mention about this cause, they were expressing issues of managing classroom discipline:

> *I may have this anxiety only when I don't know the class that I will implement activities and the children in advance.* (PST6)
>
> *I don't think that I will have a problem in teaching. My anxiety is related to managing discipline.* (PST7)

Participants' concerns and experiences of classroom management issues were mostly outside of participants' locus of control and contributed to their MTA.

4.3.2.4.2 Preparing for the mathematical activities

Similar to higher level MTA, participants with lower MTA also referred to factors related to preparing for the mathematical activities. These factors was related to only *practices (N= 10),* not to children's age level. Three participants (3 of 10) who were confident in teaching mathematics to early years stated that they needed more

teaching practices and believed that they would be successful with the help of time and experience:

> *Teaching mathematics in pre-school is like teaching all other things. I think I can teach mathematics, which is abstract in its nature, by making it concrete through using clear and short instructions. I am not without anxiety but I think my level of anxiety will decrease as I get more experience.* (PST4)

> *Because I had a course about mathematics teaching and I think it is helpful to me. I [rated my anxiety level as] 2 because I still do not have enough experience. My anxiety will be over in two years.* (PST32)

Seven participants (7 of 10) stated positive teaching mathematics experiences and they attributed their lower MTA to practices of working with children:

> *I think teaching mathematics to children is easy. Besides, I had wonderful experiences with children in practices and I found myself more efficient in this area in accordance with the feedback I got from them.* (PST5)

> *Now I feel less anxiety. Because I experienced this and I saw that I could achieve something. That made me happy and now I can prepare and teach mathematics activities and I teach now.* (PST19)

> *I don't have that much anxiety. I even do not have any anxiety. I had spent enough time with children during the field practice and I had mathematics in my activities. I didn't have any problem in implementation. Therefore, I believe in myself.* (PST23)

> *I was much more anxious at the beginning of the semester, but as I gained experience with the activities during the semester, I can say that my anxiety has decreased.* (PST24)

Four participants had lower anxiety level at the beginning of the course because of having no teaching mathematics experiences. However, at the end of the course, participants' responses showed that teaching mathematics practices with children helped them to have lower mathematics teaching anxiety at the end of the course. In other words, practices made participants' MTA reduced.

4.3.2.4.3 Recognizing personal attributes for mathematics teaching

Three participants (3 of 41) attributed their low MTA to emotional impact. They felt confident and they enjoyed teaching mathematics. Since they had pleasure while

teaching mathematics, they had little MTA. The following excerpts exemplified the emotional impact:

> *I feel comfortable in explaining and teaching mathematics. It gives me pleasure.* (PST41)
>
> *One gets pleasure in sharing and teaching when it is the subject that she likes. Even if she has incompetence, she develops herself and tries to teach because she gets pleasure. I think I'm less anxious because of that.* (PST9)

Although the other theme in this category, *previous experiences with mathematics,* was expressed by the participants in the beginning of the course, they did not refer to previous experiences at the end of the course as a source for lower MTA.

4.3.2.4.4 Contributions of TMEC

In this study, different from Brown et al.'s study (2012), *contributions of the course* have emerged as a source of lower MTA. Twenty-six (26 of 41) preservice teachers mentioned the contributions of TMEC course they took:

> *I was very anxious before I took this course because I thought mathematics was very abstract and I couldn't teach it. However, with this course I learned how to make mathematics concept concrete and teach them.* (PST1)
>
> *I saw so many mathematics activities and I had the chance to implement them during my field practice. Thanks to this course, I observed 50 activity presentations for 10 weeks and this is the biggest factor for the decrease of my anxiety.* (PST13)
>
> *Because we learned how to teach mathematics in course TMEC and we experienced it in preschools. The more we tried, the more we gained experience and we gradually had more self-confidence.* (PST17)
>
> *We learned the principles of mathematics teaching, how to teach it, and which challenges to include. We carried out activities, wrote plans, and implemented them to children. Therefore, my anxiety level decreased.* (PST28)
>
> *I gained so much in terms of mathematics teaching within the scope of the course TMEC. I learned significant points and how to prepare activities. Then, I had the chance to implement them in my field practice. All these decreased my anxiety.* (PST35)
>
> *"As we constantly prepare activities in this course, it does not make me anxious. I believe I can successfully teach mathematics in the future."* (PST37)

Previously my level of anxiety was greater. However, after I took this course, closely studied on mathematical concepts in early childhood education, and at the same time practiced them with children, I can say that I felt more comfortable. (PST42)

To sum up, at the end of the course, almost half of the participants attributed their lower MTA to the TMEC course. They thought that TMEC course helped them in having lower MTA because they learnt how to teach mathematics young childen and conducted several activities with the help of this course. In addition to reducing MTA, this course also contributed to their confidence towards teaching mathematics to children. Briefly, Table 4.16 summarizes the sources of their MTA at the end of the course.

Table 4.16

Sources of MTA (At the end of the course)

Categories	**Adapting to Established Teaching Structures**	**Preparing for the mathematical activities *(N=2)***	**Recognizing personal attributes for mathematics teaching**	**Contibutions of TMEC course**
Sources of HigherMTA *(N=2)*		Children's understanding *(N=2)* (Age level of children)		
Categories	**Adapting to Established Teaching Structures *(N=2)***	**Preparing for the mathematical activities *(N=10)***	**Recognizing personal attributes for mathematics teaching *(N=3)***	**Contibutions of TMEC course *(N=26)***
Sourcesof Lower MTA *(N=41)*	Classroom Management *(N=2)*	Practice (experience) *(N=10)*	Emotional impact *(N=3)*	Different activities and applications *(N=26)*

At the end of the course, MTA of preservice teachers revealed different categories as represented on Table 4.16. Participants experienced several practices of teaching mathematics throughout the course and they implemented different activities both in classes at the university and in their field practice in the kindergartens.

4.3.3 Elaboration on the Sources of MTA at the End of the Course

In addition to *Mathematics and Me 1* and *Mathematics and Me 3,* in-depth information was gathered through *Interviews* from 20 preservice teachers at the end of the course. Interview participants were asked a question referring to their responses to *Mathematics and Me 1* implemented at the beginning of the course. They were reminded of their response to rate their MTA and asked if they could identify sources of such a response. Their responses generally addressed both the beginning and the end of the course MTA. Therefore, these findings are presented here.

In the *Interview*, there were seven participants who had higher MTA in the beginning of the course. These participants stated the reason lying under their MTA and gave detailed information. For instance, PST12 stated at the beginning of the course that she had sufficient knowledge of basic mathematics but she was "*anxious about how to teach*." She explained the sources of her MTA which was related to children' understanding at the end of the course as follows:

> *The reason for my anxiety is actually due to the fact that I know more complicated information and I need to start from a more basic level. I have anxiety about how to explain them, in the way I think or any other way, how to teach them, how can mathematics turn into a game. Generally, mathematics is an issue that people have problems and it requires so much thinking, practice by thinking on it, therefore, at the beginning I was anxious about how to teach [mathematics to] a child.* (PST12)

Regarding practice, PST8 expressed in the beginning of the course that "*As I don't have any experience in teaching mathematics, I don't know whether I will be successful in this respect or not, therefore, I'm a little anxious about teaching."*At the end of the course, she gave details about her expressions:

> *Once I rated 7 because -it may seem awkward but- I didn't have this course actually. We weren't taught any knowledge of teaching mathematics before. That is, the knowledge of mathematics is different from teaching that knowledge. Therefore, I didn't believe in myself in terms of teaching. Of course, I knew what subjects children needed to be taught, which subjects we had to teach, but I was worried about how to reach their level of understanding. Therefore, I had high level of anxiety at the beginning of the semester and I rated as 7.* (PST8)

Differently, PST44 and PST39 gave explanations related to their previous experiences with mathematics.

> *My bad experiences of the past affected my level of anxiety. As I had difficulty in understanding mathematics concepts, I thought I wouldn't teach it to the children as well. Therefore, while preparing mathematics plans, I prepared in a very detailed way and I tried to make [mathematics] more accessible for them in a more entertaining way. As my mathematics teacher taught in a very boring way, I tried to make the concepts enjoyable things for children.* (PST44)

> *[….]I was anxious about how to teach mathematics in a different way without making children feel stressed and without having them feel in a competition because I know my own experiences. Thus, I thought I needed to be very sensitive and I was very anxious. Now, [at the end of the course] my anxiety has changed. I realized that I can easily teach mathematics as if it is a recreation without putting them in a competition, and through integrated music or reading activities that I can prepare. I felt I could do this. It [my mathematics teaching anxiety] has decreased. I can even say that it may end if I do some activities like this. Now, I feel very comfortable.* (PST39)

Participants who had negative mathematics experiences before their university education paid more attention while teaching mathematics and engaging children. They tried to do their best to prevent children having bad attitude towards mathematics. Therefore, during the semester, they attentively prepared mathematical activities and implemented them. At the end of the course, they had lower MTA.

Participants who had higher and moderate MTA were asked the time that the MTA has emerged and all of them (10 of 10) stated that MTA has appeared at the beginning of the semester. To illustrate,

> *I had this anxiety since the time I started this semester. That is, I have never had such an experience before. I have never tried to teach mathematics to children before. Thus, I had the anxiety.* (PST8)

> *My teaching anxiety started when we made our first activity and prepared our first presentation, when we were preparing through brainstorming as a group and talking about the possible activities. We realized that many things were not and would not be appropriate for children. Therefore, because I would consider each and every step, and I would have to consider everything for all of my educational life, my first teaching anxiety began in that first activity preparation.* (PST24)

> *Until this year, I have never thought about my teaching anxiety, and that I would teach mathematics. More precisely, I have never thought that mathematics had such a special place and its foundations are constructed in these very early ages in this way. I knew it was like that for science and for other areas, but I think I have always disregarded mathematics and I have never given any importance to it. However, when I heard the name of the course, I realized that we were going to teach children mathematics as well.* (PST39)

In conclusion, MTA firstly emerged when participants took TMEC course and also their awareness related to mathematics increased due to the course.

4.3.4 Key Course Experiences for MTA

Participants' responses to several tasks (*Mathematics and Me 3*, *Field Reflection Report* and *Interviews*) revealed the key course experiences which contributed to the lower MTA. Three categories of key experiences emerged: *General influence of the course, specific tasks in the course,* and *interaction of the course and field practice*.

4.3.4.1 General Influence of the Course

The course, in general, was considered as providing important key experiences by the participants. The course hours focused on more theoretical aspects of how young children learn mathematics and how mathematics should be taught, and implementations of teaching-learning activities prepared by the preservice teachers. These experiences helped praticipants develop rather lower MTA and gain a positive perspective of teaching early childhood mathematics as below:

> *Before I took this course, I thought mathematics was too abstract for children, the children wouldn't understand mathematics and they would have difficulties in this respect. However, starting from the first week, I learned how to make mathematics understandable for children. I learned how to make the subjects concrete for them. Especially, the presentations we made every week in the course contributed to me a lot. The way courses were taught was also productive. First, we learned the subjects from our teachers and then, we made presentation or observed implementation of subjects. Receiving instant feedbacks of these presentations was very helpful for us.* (PST11)

> *I learned which subjects would be taught inside the class, what I should pay attention in which subjects. The activities we prepared inside the class provided the opportunity of concretely exemplifying and living the theories we were taught. I used these in many activities, which I prepared in my*

school experience. Besides, I realized during my activities that I could carry out the process easily. Therefore, now I do not have any mathematics teaching anxiety. (PST35)

When mathematics is mentioned, first numbers come before this course; it is okay that we will teach numbers to children but it is not the only thing we will teach children. We learnt patterns, graphs, measurement and so on. Therefore, we recognized what we could teach, in which different ways we could teach mathematics to children and that was not only about numbers. Mathematics is not only composed of numbers so we can have children gain many different experiences. That reduced my anxiety. The course reduced my [mathematics teaching] anxiety. (PST17)

At the beginning of the semester, my mathematics teaching anxiety was higher, but now it is decreased. The activities we implemented in the class provided me experience. Besides, I learned which critical points I should underline and which points I should pay attention during implementations. The activities my friends performed in class also provided me to have different opinions. (PST44)

There were changes (in my mathematics teaching anxiety) because, in the field practice, we had the chance to apply what we learned as theory. Also, we received feedback for our activities and these feedbacks reduced our level of anxiety. Because we had the opportunity to re-organize and perform our activities and to compare the differences between them. Thus, I have a lower level of [mathmatics teaching] anxiety. (PST28)

Participants addressed the theoretical knowledge of teaching and learning mathematics, preparing and implementing mathematics activities considering the theoretical knowledge and gaining feedback for their activities in the class, and implementing these activities with young children as the key experiences of the course in general. They also acknowledged that they learned a different mathematics in this course than they expected to learn. This helped them to have rather lower MTA at the end of the course.

4.3.4.2 Specific Tasks in the Course

This category included all tasks done through the semester, such as presentations, activity plans, learning center project and field assignments. Groups of five preservice teachers prepared one activity each week about the content recently covered in the class in that week. Then, they presented this activity to their classmates. Therefore, they had to read the related texts of the week before coming to

the class. TMEC students prepared a total of 100 activity plans regarding the topics in early years mathematics by the end of the course. Moreover, in the middle of the semester, they went to a preschool to implement their learning center activities in an actual setting with children. At the end of the course, they had to write a *Field Reflection Report* assignment, which helped them in comparing their prior experiences regarding mathematics and actual teaching mathematics experiences by the help of reflecting on their experiences in their implementations. Participants' explanations about these specific tasks are illustrated as below:

> *Thanks to mathematics activities we prepared every week, my anxiety was decreasing day by day. I was very experienced that after other activities I could add immediately a mathematics activity relevant to that activity. It made me very happy.* (PST37)

> *We had a lot of difficulty in our first activity, we thought a lot and reaching to final was hard, but we gradually realized by preparing activities every week that we could succeed and we could think like children. In order to be effective, it requires to think like children when teaching them; we started to think like them. We even began to behave like them. That is an anxiety-lowering factor.* (PST24)

> *For example, we went to University Kindergarten [for Learning Center implementation], I realized that even children at same age had different responses and they differed according to their many different histories. I'm so glad that we made that visit; I recognized both the differences among children and how they differed in activities.* (PST27)

> *For instance, I think my early mathematics experiences will contribute so much to my later mathematics teaching.I think, TMEC course provided me to strenghten that.* (PST26)

Specific tasks in the course helped preservice teachers think about the mathematics concepts, children's possible reactions, and different ways of implementations through the semester. These experiences seemed to have resulted in confidence of designing and implementing learning activities and a decreasing in their MTA.

4.3.4.3 Interaction between the TMEC and School Experience Course Experiences

This category displayed the interaction between the TMEC course and field practice courses. In the Fall semester of the 3rd year, participants took TMEC course and School Experience course. Participants expressed the influence of TMEC course on the field practice as below:

During my field practice, I was trying to implement activity plans that we prepared within the course. The knowledge we gained in the course was becoming permanent that way. Therefore, I implemented three mathematics activities to children in field practice and we had so much fun with children. (PST17)

Of course, my self-confidence increased after this course. In my field practice, I implemented mathematics activities four times. The subjects were shapes, patterns, numbers, and addition. I was very comfortable during the activities and I wasn't anixous. I didn't have any trouble or any problem during the implementation. (PST31)

Owing to the activities and presentations that we prepared in the teaching mathematics course, I didn't have any difficulty. I could have understood earlier what kinds of questions they asked and how their reactions were. (PST38)

There were changes (in my mathematics teaching anxiety). In my field practice where I was closely together with children, I had the chance to perform the things I learned in TMEC course. That was the most effective factor decreasing my anxiety. Moreover, I succeeded in addressing the level of children and gained empathy, which decreased my anxiety. Because I'm like one of them. (PST10)

It can be inferred that these preservice teachers used their mathematical knowledge that they obtained in the TMEC in the field practice and this helped them in diminishing their MTA.

4.4 Prior Mathematics Anxiety versus Mathematics Teaching Anxiety

Participants of the study were asked to prepare a mathematics activity in their teaching practice and to write a field reflection paper through a set of guiding questions after they practiced their mathematics activities in kindergartens. This paper was related to their previous mathematics experiences and their real classroom experiences while teaching mathematics. There was also a question related to the evaluation of their experiences in the TMEC course throughout the semester. Participants were free to write their reflections in a narrative form if they felt more comfortable.

Field Reflection Reports were explored in two categories: Prior Mathematics Anxiety (MA) and Mathematics Teaching Anxiety (MTA). While MA was related to preservice teachers' past mathematics history, MTA was related to their current

mathematics teaching to children. In their study, Brown et al. (2011) examined the prior assumption that preservice elementary teachers who had prior MA would have MTA and preservice elementary teachers who had little or no prior MA would not have MTA. However, their study revealed that the assumptions about the relationship between MA and MTA did not always hold. In other words, the preservice teachers who had higher prior anxiety might not experience MTA. Therefore, the authors explained the outcomes via quadrants of preservice teachers that fit or challenge the prior assumption related to MA and MTA. Since the quadrants provided new insight to the literature regarding MTA (Brown et al., 2011), the prior assumption on MA and MTA was inspected for the situation of preservice early childhood education teachers in the current study. Field reflections of 47 preservice teachers were coded depending on the Framework of MA and MTA results in Brown et al.'s (2011) study presented below in Table 4.17.

Table 4.17

Framework of MA and MTA Results

	NO-MA	**YES-MA**
	No: Prior Mathematics Anxiety (MA)	Yes: Prior Mathematics Anxiety (MA)
NO-MTA		
No: Mathematics Teaching Anxiety (MTA)	Quadrant A: No-MA, No-MTA	Quadrant B: Yes-MA, No-MTA
YES-MTA		
Yes:Mathematics Teaching Anxiety (MTA)	Quadrant C: No-MA, Yes-MTA	Quadrant D: Yes-MA, Yes-MTA

Note. "Elementary Pre-service Teachers: Can They Experience Mathematics Teaching Anxiety without Having Mathematics Anxiety?," by A. B. Brown, A. Westenskow, P. S. Moyer-Packenham, 2011, *Issues in the Undergraduate Mathematics Preparation of School Teachers: The Journal, 5*, p. 6.

Different from Brown et al.'s (2011) study regarding MA and MTA, a shift in categories was identified in the current study. This shift was emphasized as a new

category, *Shifting*, because a great majority of preservice teachers showed a shift in anxiety. This new category has two groups which were not addressed as an area, rather I referred to them as group E and group E'. Participants in group E had prior MA and MTA, but their MTA was diminished at the end of the course. Group E' participants did not have prior MA but they had MTA, which was diminished at the end of the course. The findings of the present study are presented in Table X below. Inside the parenthesis in Table X, the first sign before the semicolon indicates prior MA, and the signs after the semicolon reveal the MTA from the beginning of the class to the end. For example, "C(-;++)" shows area C where participants did not have or have little prior MA (-), but they had MTA both in the beginning (+) and at the end (+) of the class. The responses were categorized into five groups. There were five participants (PST1, PST2, PST20, PST31, PST38) with mixed responses that did not fit any category. They were excluded from Table 4.18.

Table 4.18

Categories, Descriptions, and Examples of MA and MTA

Area	Prior Mathematics Anxiety	Mathematics Teaching Anxiety (Beginning to End)			Description	Example
A (-; --)	No	No	to	No	Preservice teachers who stated NO prior mathematics anxiety and NO anxiety related to MTA.	PST4, PST8, PST10, PST14, PST22, PST26, PST30, PST43, PST45, PST47 (N=10)
D (+; ++)	Yes	Yes	to	Yes	Preservice teachers who stated prior mathematics anxiety and MTA to students.	PST7, PST21 (N=2)
B (+; - -)	Yes	No	to	No	Preservice teachers who stated prior MA but NO MTA.	PST3, PST18, PST27, PST41 (N=4)
C (- ;++)	No	Yes	to	Yes	Preservice teachers who stated NO prior MA but HAVE MTA.	PST9, PST42, PST46 (N=3)
Shifting	Yes	Yes	to	No	Preservice teachers who stated prior MA and showed shifts in MTA: (+ to -) At the beginning of the course, they had MTA, but they reported that they had NO MTA at the end of the course.	PST6, PST11, PST23, PST25, PST28, PST29, PST32, PST34, PST39, PST40, PST44 (N=11)
E(+,+-)		No	to	Yes		X
	No	Yes	to	No	Preservice teachers who stated NO prior MA and showed shifts in MTA: (+ to -) At the beginning of the course, they had MTA, but they reported that they had NO MTA at the end of the course	PST5, PST12, PST13, PST15, PST16, PST17, PST19, PST24, PST33, PST35, PST36, PST37 (N=12)
E'(-,+-)		No	to	Yes		X

4.4.1 Area A (-, - -)

Area A referred to the preservice teachers who stated no prior MA, and no MTA in the beginning and at the end of the class. Among the 47 participants, 10 participants addressed that they had little or no MA and MTA, and connected these two types of anxiety.

> *[…] As I didn't have any anxiety towards mathematics, I didn't have any anxiety regarding how to teach mathematics in any way.* (PST4)

> *I really liked mathematics as a student because I was successful and interested in. I believe that there is a high [degree of] relationship between the prior mathematics anxiety and mathematics teaching anxiety. Our backgrounds and experiences affect our attitudes toward the subject and our anxiety level is connected with those attitudes. If we feel comfortable and well prepared for a topic, our anxiety level is decreased immediately because we feel more self-confident and believe ourselves. I think that I was lucky in general about mathematics and that's why I am enjoying to teach it to the children now and I believe that I will enjoy in the future, too.* (PST8)

Preservice teachers in Area A commonly stated that they were good at mathematics and found mathematics enjoyable in the past. Moreover, in their teaching practice at the preschools, they had positive mathematics experiences with children and did not encounter any problem. All of them reported that positive prior mathematics experiences had a great value on their mathematics teaching experiences to children. They considered that they had positive mathematics teaching experiences in the field practice because of not having prior MA.

4.4.2 Area D (+, + +)

Area D represented the two preservice teachers who stated prior MA, and MTA in the beginning and at the end of the class. They stated:

> *My interest in mathematics decreased because my teacher at high school was not a good teacher and he behaved aggressively when we made a mistake. Thus, I avoided to solve problems and to listen to teacher because I felt stupid if I tried to solve problems.. […] I did not feel myself comfortable in kindergarten while doing activity. In my teaching process, we played a game which included number sense. My purpose was to teach numbers between 1 and 3 and make students enjoy the activity. However, I had some problems in this process. When I tried to teach numbers, I sometimes could not explain*

how to write them. I felt very anxious and I was upset because I thought I could not reach to children. […] I again felt myself not efficient for children. I think this happened because I am afraid of being unsuccessful and I do not want children to feel themselves unsuccessful. (PST7)

When it comes to mathematics, bad things come to people's mind. The reason may be originating from negative experiences related with mathematics. Like many others, I can't see much positive experiences when I consider my past experiences of mathematics. [...] For a long time my mentor teacher wanted me to prepare activities on addition skills in mathematics for children. The first activity I prepared ended as a disaster because almost all of children born in the year 2010 didn't even know numbers. Thus, they couldn't do addition. I felt awful when doing the activity. I wanted time to pass as soon as possible. (PST21)

These two preservice teachers had negative prior experiences related to mathematics and they encountered some difficulties while teaching mathematics to children. They expressed that the difficulties they had in their field practice could be related to their prior MA.

4.4.3 Area B (+, - -)

Area B represented four preservice teachers who stated prior MA but no MTA both in the beginning and at the end of the course. Participants in Area B expressed their anxiety as follows:

[...] My mathematics anxiety was higher because I don't know all subjects in mathematics. I didn't have any mathematics course regarding Mathematics 2. Therefore, I had a high level of anxiety regarding mathematics. I didn't have any anxiety during the activity. I have anxiety about not knowing mathematical subjects and I think this is related with my past mathematics teachers. I think, I don't want to be like those bad example [teachers] I encountered. Thus, I tried to be as careful as possible when preparing this activity. Owing to that I didn't have any anxiety during the activity because I was well-prepared. I really had pleasure in teaching children mathematics and seeing them enjoy while learning. I was happy. (PST18)

My mathematics anxiety started when I was preparing for high school [entrance] examinations. If you were not successful in mathematics, you were seen as an unsuccessful student. [...] Having an oral exam in every class, solving problems on the blackboard, and receiving points from these discouraged me [to study] mathematics. [...] I wasn't much anxious about teaching mathematics and about this course at the beginning of the semester. I wasn't anxious in mathematics activities. I believed I would be successful with clear activities in their level of understanding. I paid attention to always

> *being prepared and having prepared the materials and the context before.* (PST27)

Preservice teachers in the Area B commonly stated that they had mathematics anxiety in the past, but they did not experience mathematics teaching anxiety. Since they had prior negative experiences related to mathematics, they didn't want children to have similar mathematical experiences. Therefore, they gave more importance to the preparation of the activities. While preparing the activities, they considered the development of children.

4.4.4 Area C (-, ++)

Area C represented the three preservice teachers who stated no prior MA but have MTA both in the beginning and at the end of the course. There were three preservice teachers in this category. PST42's expressions illustrated their experiences:

> *I liked mathematics course when I was in primary school and it was a lesson in which I was the most successful. I have never thought I couldn't do, understand and learn mathematics. I knew that if I tried a little I could solve my problems related to mathematics. Therefore, I haven't had much anxiety regarding mathematics. However, I was very uneasy in practice and I haven't felt comfortable during the activity. I became very excited even before starting the activity. I couldn't decide what to say or how to start. I started the activity with a story. However, I encountered many problems even in the story part. The students didn't want to listen and some interrupted and asked questions. This made me demoralized. [...] I felt very bad that moment. I wanted to stop the activity and get out of the classroom. I thought this would always continue like this and I even questioned myself for whether I was at the right place. I'm still very anxious in teaching mathematics and I think there will always be a problem...* (PST42)

Although the preservice teachers had positive prior mathematics experiences of mathematics, they had difficulty in teaching mathematics as well as keeping children engaged in mathematics activities. They felt anxious during the implementation of the activities in the field experience.

4.4.5 Shifting

4.4.5.1. Group E

Twenty-three preservice teachers' MTA shifted from higher MTA to lower MTA at the end of the course as expressed in their *Field Reflection Report* assignment. These preservice teachers were grouped based on the existence of prior MA.

Group E represented the 11 preservice teachers who stated prior MA, and showed shifts in MTA and reported that they did not have MTA at the end. To illustrate:

> *Until the university [entrance] examinations, I hated mathematics and everything related with it. [...] At the beginning of the semester, I rather preferred language and art activities in the field practice because I thought mathematics activities would bore students and I was insufficient in gaining attention. However, owing to our in-class activities and the feedback we had, I had clear view of what to do and what to refrain from and I began to include mathematics activities. I didn't have any problems during mathematics activities such as shapes, measurement and numbers in the field practice. This might be because I believe in my ability to teach mathematics and because I was having fun as much as children did, and I was involved in the [activities]. While I previously included children only in activities that needed to be done, I began to include them in the material preparation process as my anxiety decreased. Despite my bad experiences and bad teacher examples, I deeply believe that I can have my children love mathematics and give them the feeling that they can do it.* (PST25)

> *Although I loved mathematics before, I started to hate it in high school. I think the subjects in mathematics were very difficult for me since they seemed not logical for me. […] The abstract concepts in mathematics made me have a mathematics anxiety. […] Therefore I had mathematics anxiety and did not feel confident in teaching mathematics. I think that since I did not feel confident in teaching mathematics, I was over-prepared for my mathematics activities. I prepared my mathematics activity plans in detail by considering early mathematics concepts. Also, I prepared appropriate materials for my activities. […] I wanted children to feel confident about mathematics. I tried to make mathematics enjoyable for children. At first, I was not very comfortable, but then I started to feel much more comfortable through experience. Now I usually feel very confident when teaching mathematics lessons. Also, I really enjoyed implementing my mathematics activities. [...]My early mathematics anxiety helped me to gain confidence in teaching mathematics since I was prepared for my activities well.* (PST44)

> *[…] The only thing I heard in my first mathematics lesson at high school was: 'If you fail, you will fail in mathematics. Nobody passed from my course'.*

Therefore, this inevitably affected my attitude towards mathematics. There were times when we received negative reactions after we gave wrong answers. Thus, it seemed as if fear was dominant in mathematics classes. In that case, it was impossible to feel safe in teaching mathematics. I experienced much the fear 'Mathematics is complex for even me, how will I teach it to children?' I think, mathematics is such an abstract subject for children. It is an area where so many symbols are included and thus, I was worried about teaching mathematics to children and about understanding of children. We learnt a huge amount of information on how children will learn mathematics in TMEC course we took. It helped us to decrease our level of anxiety. In my first activity, children experienced difficulties in making graphs. However, in the second activity, they were quite successful in making and reading graphs. That considerably increased my self-confidence in teaching mathematics. I was very worried about creating misconceptions because I thought mathematics in children was abstract. However, I saw that the activities I did were successful and children easily received the skills I had been trying to give. (PST28)

[...] Until university, I thought that I would study in any department that is not related with mathematics and be happy. Besides, I thought that mathematics was unimportant and did not have any impact on daily life. Mathematics was, for me, something that cannot be learned and maybe that cannot be transformed. [...]With these ideas, I always thought teaching [mathematics] to people was difficult... While I was preparing this activity, I was also worried about my implementation of this activity. I had some questions such as 'How can I apply this activity in my classroom? Will my steps be clear for children? Can I express myself in an effective way to children?' I felt relaxed while I was implementing this activity to children. I was prepared well and I talked to my practicum teacher before the activity. She [suggested] me some methods and I used them in my activity. With the help of some methods, children participated in my activity. And, I felt successful in this activity. I understand we can change our ideas with the help of good experiences. I realized that if I overcome my prejudices, children can also overcome theirs. [...] While I was desperate and unwilling in terms of mathematics before the implementation, I became a comfortable person after the implementation and believed in my ability. (PST34)

Preservice teachers did not have positive prior mathematics experiences before attending the TMEC course and they had MTA in the beginning of the semester. They had concerns about children's age level, mathematical topics they would cover, and appropriate instructional methods in their field practices before they implemented their activities. At the end of the course, despite their prior experiences, those participants had a shift in their MTA because they had positive mathematics teaching experiences.

4.4.5.2. Group E'

Group E' in the Shifting category represented the 12 preservice teachers who stated no prior MA and showed shifts from having MTA to not having MTA. Their experiences are illustrated below:

> *Mathematics has always been an enjoyable course for me since primary school. Again at high school, my interest in mathematics has gradually continued and I have always been a successful student in my mathematics courses. Despite all these mathematics knowledge and my self-confidence about mathematics, I had worries about teaching mathematics to early ages because I didn't believe it was easy to teach mathematics by simplifying and to integrate mathematics activities with other activities. At the beginning of the semester, I expected that this course would give me theoretical information about children but not help [me in teaching] mathematics subjects. However, with all the activities we did during the semester and knowledge we learnt, I don't have any hesitation in teaching mathematics. Moreover, I see that I can teach many things to children by integrating many activities with mathematics activities.* (PST13)

> *I liked mathematics since the beginning of my student life….I was anxious and worried about teaching mathematics in a kindergarten at first. I was thinking about how I could teach mathematics to young children. It is very abstract so I should make it concrete to be able to teach children as it should be done. On the other hand, children may find it very abstract and may not understand correctly and effectively. […] Before our implementation at kindergarten, I was thinking and worried about the process, gaining their attentions on the activities, and children's questions. However, during all those enjoyable times, I was like a real and experienced teacher because I was enjoying what I was doing. It was easy to gain their attention and start to the activities. During all the processes, I was relaxed and self-confident.* (PST24)

> *In the elementary and high school, I was a successful student in the mathematics lessons. In this year, when we are starting this class, I knew that I can do and understand easily this mathematics class, but I did not know how I can teach and explain mathematics to children. In fact, I was afraid from this teaching part and I did not think that I could integrate this class with my other teaching areas. However, over time, I understood how I can teach mathematics and integrate with other areas. Also, today, I am integrating the mathematics in almost my every activity that are prepared for children. […] After this lesson, I overcame my anxiety of teaching mathematics and I learned how I can integrate mathematics to my activities and teach my knowledge to the children.* (PST36)

The common idea shared by 12 preservice teachers was that at the beginning of the course, they had MTA, but at the end of the course the anxiety disappeared while

teaching mathematics to children. They felt relaxed and overcame this MTA with time. Briefly, the Figure 4.5 bellow describes in detail those mentioned categories:

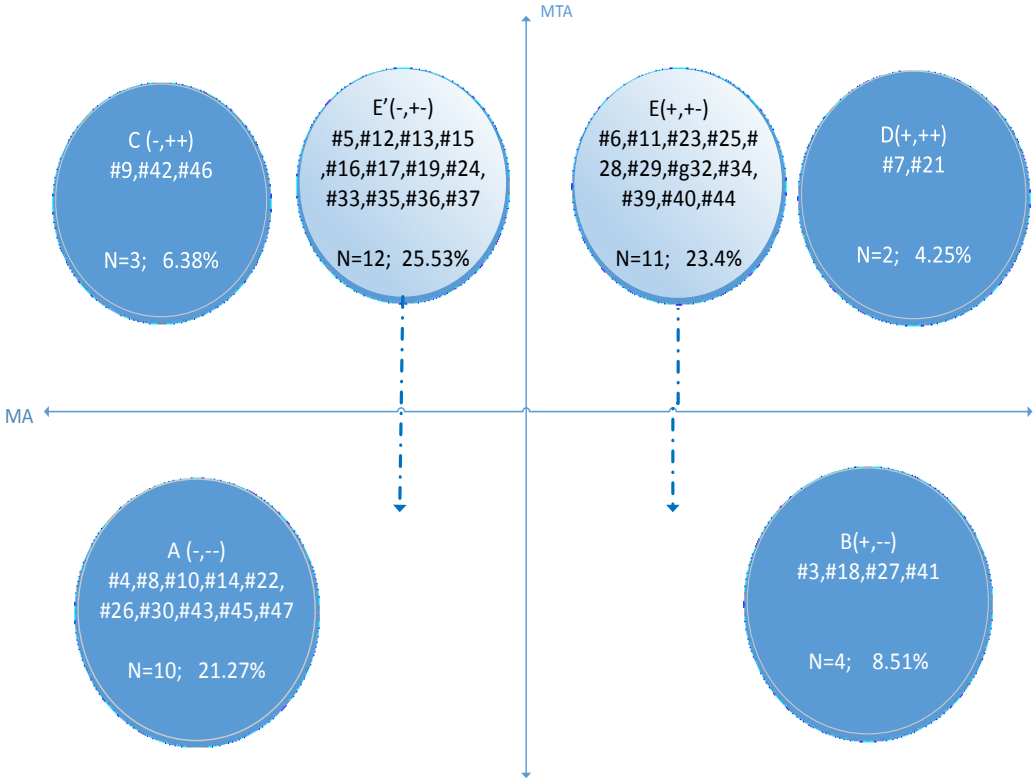


Figure 4.5 Areas of MA and MTA

Findings of this study showed that MA and MTA might not always be related for preservice early childhood teachers. In other words, not all preservice teachers who had higher prior MA experienced MTA. The preservice teachers in the areas A and D supported the assumption that two participants with prior MA had MTA, and 10 participants without prior MA did not have MTA. On the other hand, four preservice teachers in area B and three participants in area C challenged the assumption. While they had bad experiences in the past and had MA, they did not display MTA or while they did not experience MA in the past, they had MTA in the teaching practice.

4.4.6 A Closer Look at Shifting

Different from Brown et al.'s (2011) study, a shift in categories was identified. Reflections of participants helped in recognizing this emerging shifting. This shift displayed the preservice teachers who had MTA at the beginning of the course and

did not have MTA at the end of the course. More specifically, 23 preservice teachers showed a shift in the field reflections as mentioned Groups E and E'. However, when this shifting was compared with the MTA of participants reported for the third research question, the participants who showed shifting displayed differences. More specifically, there were 22 participants who showed shifting based on the ratings of MTA in *Mathematics and Me 1* (at the beginning of the course) and *Mathematics and Me 3* (at the end of the course) questionnaires. However, only 10 participants' data analysis showed shifting in both the questionnaires and *Field Reflection Report* assignment.

When the rest of the participants were inspected, it was seen that the preservice teachers who showed shifting in the *Field Reflection Report* but not the *Mathematics and Me 1* and *3* questionnaires, rated themselves in the same level in both questionnaires. In detail, 12 participants rated themselves with lower levels of MTA and one preservice teacher rated herself with higher level of MTA at the beginning and at the end of the course in the questionnaires. In the surface, these preservice teachers did not have changes because at the beginning of the course they were in the lower level MTA and at the end of the course they were still in the lower level of MTA. However, while they were reflecting on their teaching experiences, they mentioned about their MTA at the beginning and at the end of the course and compared them, which showed shifting. The hidden shift in MTA in questionnaires emerged in the *Field Reflection Reports.*

Similarly, nine preservice teachers showed shifting in *Mathematics and Me 1* and *3*, but not in the *Field Reflection Report*. They focused on the relationship between their prior MA and MTA. In fact, these preservice teachers explained the shifting in detail when they were asked explicitly to compare their MTA at the beginning of the course and the current MTA in *Mathematics and Me 3*. Moreover, they were asked if there was any change or not in MTA and what the cause underlying the change situation was. Among the 47 participants, 44 participants stated that there was a change between their MTA in the beginning and at the end of the course. This question provided a better overview of the shifting. To illustrate, these nine

preservice teachers who showed shifting in MTA ratings in the *Mathematics and Me 1* and *3*, but no shifting in the *Field Reflection Reports* gave detailed information about their pre and post MTA, indicating shifting. For instance, preservice teachers in the Area A (-;--) mentioned the shifting as follows:

> *Of course, there are changes. I was anxious about how to teach when you told us that we will teach those subjects, but I could easily find solutions such as "we will teach this in this way" eventually.* (PST4)

> *There are changes. Because I didn't have much knowledge on mathematics at the beginning of the semester and if they told me to perform a mathematics activity I would become a little confused then. However, now I have prepared many mathematics activities in different environments (field practice, kindergarten, course hours) and I also know what and how to teach.* (PST47)

> *At the beginning of the course, my rating was 7-8. Of course, there were changes. The reason was related to methods and clues we learnt in this course.* (PST43)

Preservice teachers in the Area D (+;++) mentioned the shifting as below:

> *Compared to the beginning of the course, I am more relieved. If the concepts are given in a simple way without making them complex, I believe that children can understand mathematics.* (PST21)

> *There are changes. I didn't know before how I will teach mathematics concepts. Now, I have understood that mathematics can be taught in an enjoyable way with concrete materials and games. It decreased my [mathematics teaching] anxiety.* (PST7)

Preservice teachers in the Area B (+;--) mentioned the shifting as follows:

> *My [mathematics teaching] anxiety is decreased. I found the opportunity to make practice with children and develop my theoretical knowledge. I believe that it will decrease more as I gain experience.* (PST27)

> *At the beginning of the course, my mathematics teaching anxiety was higher because I had no information regarding teaching mathematics. I didn't know what to do and the ways topics can be taught. Now, my anxiety is reduced due to learning these and getting experience.* (PST18)

The above quotes indicated that preservice teachers expressed the changes in their MTA explicitly in the *Mathematics and Me 3* even if they did not express it in the *Field Reflection Report.*

There were two participants who rated a low MTA in the beginning of the semester. One of these participants rated high MTA and the other rated moderate MTA at the end of the semester in the questionnaires, addressing an increase in MTA. However, they also expressed how their MTA was decreased in *Mathematics and Me 3*:

> *Yes, there were changes. I had no idea which topics were related to early years mathematics at the beginning of the semester. As for mathematics, I was a little hesitating because I thought about high school or primary school mathematics subjects as mathematics and about how to teach them to children. However, in this course I learned what subjects are included in early years mathematics and which significant points are to be given to them, and moreover, how to teach them to children. Thus, my [mathematics] teaching anxiety is considerably decreased.* (PST25)

> *When I think about the beginning of the semester, there is a decrease in mathematics teaching anxiety now. I think the reason is the increase in my experiences related to teaching mathematics. The more experience I have, the less teaching anxiety there is.* (PST45)

Finally, two participants rated their MTA at higher scales in the beginning of the semester. One of these participants rated a high MTA and the other rated a moderate MTA at the end of the semester. However, they expressed decrease in their MTA:

> *I think there are major changes. The reason was related to taking TMEC course and going to field practice this semester. Owing to the things that I learned and making implementations, I think that my teaching [mathematics] anxiety was reduced.* (PST8)

> *Especially, my mathematics teaching anxiety related to preschool is decreased. I started to become comfortable as I conducted activities and attended the field practice.* (PST15)

These findings showed that preservice teachers' MTA in their ratings in the *Mathematics and Me 1* and *3* questionnaires and the *Field Reflection Reports* showed differences. Although the ratings for the perceived MTA at the beginning of the course were lower for some participants, they mentioned about the shifting in their MTA from the beginning to the end of the course. Findings have shown that almost all participants experienced a change in their MTA throughout the semester even when they rated the same level of MTA in the beginning and at the end of the semester.

CHAPTER V

DISCUSSION

The study aimed to describe preservice early childhood education teachers' mathematics anxiety and mathematics teaching anxiety before taking *Teaching Mathematics in Early Childhood* (TMEC) course and after completing it through asking 47 preservice early childhood education teachers about their images, emotions, mathematics anxiety and mathematics anxiety, and their sources throughout the course. Moreover, the relationship between the prior mathematics anxiety and mathematics teaching anxiety of preservice teachers were explored. In this chapter, findings of the study were discussed and implications, recommendations and limitations were presented.

5.1. Images and Emotions Before and After the Course

Findings revealed that most of the preservice teachers had complex and confusing images often addressing difficulty regarding mathematics at the beginning of the course. Conscious and unconscious thoughts, experiences as well as emotions are discovered through drawings and become explicit (Burton, 2012; Lusebrink, 2004) and drawings provided a close insight into participants' mathematics related images and emotions. Participants' images were not related with the mathematics they would teach for the early years and were very dominant that the participants reflected negative emotions on mathematics, such as dislike, fear, and anxiety with considerable intensity in their drawings at the beginning of the course. However, at the end of the course, images including advance formulas and abstract concepts switched to early years mathematics concepts and many negative emotions were replaced with the positive emotions related to mathematics. While these participants

did not picture any ECE environments or emotions of teaching mathematics at the beginning of the course, many of them drew a teacher who teaches mathematics to children or children learning ECE concepts in preschool at the end of the course. Therefore, it might be the case that participants developed new images of mathematics contextualized in early childhood settings through their course experiences including the practice in the early childhood settings. However, the initial images consisting of abstract and advance concepts and related emotions probably did not change and were maintained in their minds. They gained a new perspective of mathematics through new experiences at the end of the semester reflecting the mathematics they would teach and those new images might have pushed the previous images which mostly reflected the mathematics they learned in their pre-university education aside.

Outcomes of the study displayed that mathematics related images and emotions at the beginning and the end of the TMEC course were generally parallel to those found in the literature. Most preservice teachers were found to draw rather negative images such as poor grades, unhappiness (crying or sad faces), embarrassment at the blackboard, failure on equations, teachers who are angry, and tutors who are not helpful (Rule & Harrell, 2006) and confusion in the mathematics classroom (Burton, 2012) before the mathematics methods courses. Associated emotions were generally negative and including anxiety, fear, anger, trauma, being confused, shame, insufficiency, and isolation (Rule & Harrell, 2006). Images and interpretations at the end of the methods courses showed that participants had higher engagement, higher understanding towards mathematical activities, and feeling sense of achievement in field practice courses (Rule & Harrell, 2006) and mathematics was enjoyable, meaningful, and made sense for them (Burton, 2012).

Preservice early childhood education teachers seemed to have a different perspective of mathematics (ECE contexts and ECE teachers) and how mathematics teaching and learning might take place which they did not have before the course. Compared to *Drawing Activity 1*, their recent mathematics images and emotions formed after the TMEC course were more powerful and participants made many connections with

real life. While taking course, they might have started to see or been aware of the connections between mathematics and real life and consider mathematics in positive way. The course seemed to have influenced preservice teachers' images and emotions from negative to positive, as reported for preservice teachers in different contexts who took methods course and realized the connection between mathematics and real life (Rule & Harrel, 2006).

5.2 Mathematics Anxiety Before and After the Course

Mathematics anxiety (MA) is not easy to influence because, most of the time, the sources of MA are in the past (Brown et al., 2012) and present experiences do not change these sources (Miller & Mitchell, 1994). However, there were changes in some of the participants' MA, probably because the course provided them a new perspective of mathematics and mathematics teaching. Findings of their MA ratings revealed that TMEC course did not have much influence on participants' MA levels and many participants maintained their MA levels before and after the course. This might be probably related to their past negative sources with mathematics, which had considerable influence on them. Negative school experiences were considered as the main source of MA (Bursal & Paznokas, 2006; Hadfield & McNeil, 1994; Trujillo & Hadfield, 1999). Therefore, they might have focused on the previous mathematics experiences and did not concentrate on the mathematics experiences of the TMEC course. It can be speculated that if their past MA sources, which were mostly related to school mathematics experiences, were not strong enough, this recent mathematics in the TMEC course might have been developed as a source for lower MA. However, since previous school mathematics experiences were longer than the TMEC course experiences, TMEC course did not have a considerable influence on participants' MA. Moreover, one course might not be enough to change their beliefs. For example, in their study, Yılmaz-Tüzün and Topçu (2008) stated that teachers' epistemological beliefs are not shaped in a short period, therefore, preservice teachers' epistemological beliefs are difficult to change during the teacher education program and it requires a more systematic approach including several courses.

Some participants, on the other hand, might have recalled different sources which influenced their MA at the end of the course. TMEC course seemed to push the previous mathematics experiences which were the source for higher MA aside, but did not erase them because those experiences cannot be simply erased. TMEC course seemed to have developed new mathematics experiences, which might also develop as a source for a different anxiety. While coming to the TMEC course, preservice ECE teachers commonly considered mathematics as comprised of complex numbers and set of formulas. Besides their mathematics related images, influences of previous mathematics teachers, courses, classmates, family, and their perceived capability in mathematics, confidence, difficulty in understanding mathematical knowledge, inadequate subject matter knowledge, and perceived usefulness of mathematics led them to have higher or lower mathematics anxiety. These sources were also reported in the previous studies (Baloglu & Kocak, 2006; Bekdemir, 2010; Harper & Daane, 1998; Hembree, 1990; Jackson & Leffingwell, 1999) with the exception of gender bias, university examination issue, and ignorance of art courses.

Bekdemir (2010) indicated that much research on MA is required with Turkish samples in which culture and classroom environment are significantly different. In this study, university entrance examination and the ignorance of art courses were found to be the sources of MA, different than the studies conducted in mostly western contexts. Gender is a personal source of MA and although much research conducted with gender, there was no consistency among findings regarding whether females have higher MA compared to males or not (Baloglu, 2001). Gender bias of teachers was not mentioned as a source of MA by the preservice teachers in the current study. The university entrance examination, especially the part that topics of high school Mathematics 2 course were covered, made participants memorize all formulas and lose their positive feelings toward mathematics most probably because high school mathematics gradually becomes abstract and complex, and students who cannot understand a concept well cannot build the related concepts (Bekdemir, 2010). Therefore, preservice teachers' Mathematics 2 experiences and the importance of mathematics success in the university entrance examination caused higher MA in the present study. Few participants mentioned that some courses such

as, physical education, art, and music courses were ignored and instead of them mathematics courses were done. This tendency in schools to overemphasize mathematics courses at the expense of other courses seemed to have created a negative reaction and resulted in negative emotions for mathematics for the preservice teachers. It might also be the case that preservice teachers with more social science interest would eventually reflect this overemphasis on mathematics as a source for higher MA (Brush, 1980, as cited in Baloglu, 2005) although they did not explicitly state this in the present study.

5.3 Mathematics Teaching Anxiety Before and After the Course

MTA of participants at the beginning and at the end of the course were investigated along with the sources. Preservice teachers' mathematics teaching anxiety (MTA) is most probably developed during the teacher education program and research on MTA (Brown et al., 2012). Therefore, the sources for their MTA are likely to be rather recent, could be identified better and influenced by the course experiences. When investigating the level of MTA, it was seen that while 22 participants expressed different MTA levels after the TMEC course, 25 participants had the same level of MTA at the end of the course. Preservice teachers did not have any experience of practice of teaching mathematics before and they were enrolled in the first field practice course and TMEC course at the same semester. Therefore, considering participants' rather recent mathematics teaching experiences, the level of MTA and sources that the preservice teachers mentioned at the beginning of the course were evaluated as *perceived level* and *perceived sources*. Participants' stable or lower level of MTA might be related to their lack of teaching mathematics practices in real contexts at the beginning of the course. It might also be the case that at first, they perceived early years mathematics easier and might have thought that there would not be much problems in the preschool settings during their mathematics teaching practices in the future. At the end of the course, most of the participants with higher or moderate level of MTA showed shifting to moderate or lower MTA. This shifting might stem from preservice teachers' experiences in the TMEC course as reported for the study investigating the effect of mathematics methods courses on

preservice teachers' MTA (Levine, 1993). Participants referred to the contribution of TMEC course on their teaching anxiety in a positive way at the end of the course.

Several studies (such as Bursal & Paznokas, 2006; Gresham, 2007; Peker, 2009; Uusimaki & Nason, 2004) have focused on preservice teachers' MA and its source. However, there is not much study on MTA of preservice teachers (Brown et al., 2012; Peker, 2006) and little is known about MTA and the relationship between MA and MTA (Haciomeroglu, 2014). Therefore, findings of the present study were compared and contrasted with MTA experiences of preservice elementary teachers in Brown et al.'s (2012) study in which preservice elementary teachers reflected regarding their teaching mathematics experiences at the end of the field practice for whether those practice teaching experiences increased their MTA or decreased.

In the present study, sources of MTA were investigated at the beginning of TMEC course and at the end of TMEC course. At the beginning of the course, different from Brown et al.'s (2012) study, there was no source of MTA regarding *adapting to established teaching structures* theme. This might be due to the lack of field practice experiences until the 3rd year in the teacher education program. Therefore, participants might not know the context of the preschools in terms of teaching mathematics to young children. Moreover, *expectations from the course* was emerged as a new source category. Participants with lower MTA attributed their lower MTA to being enrolled in the TMEC course and the expectations that the course would help in learning mathematics teaching methods to early years.

Since participants' current mathematics teaching experiences might result in future MTA (Brown et al., 2012), the sources of MTA was asked once more to preservice teachers in the study after they gained field practice experiences in the preschools at the end of the course. Compared to at the beginning of the course, *classroom management* under the *adapting to established teaching structures* theme was mentioned by the participants. Similarly, in Brown et al.'s (2012) study, classroom management was considered as one of the factors which increased MTA. *Classroom management* was the outside participants' locus of control (Brown et al., 2012). For example, as PST6 stated in the current study that if she didn't know the class in

which she implemented activities and the children in advance, she thought that she couldn't control them and manage classroom management. Therefore, she might have perceived this issue as beyond her control and external.

For *preparing for the mathematical activities* theme, participants mentioned the sources of MTA as *children's understanding* and *practice.* Participants generally pointed out the different age levels of children and how it influences their MTA. This situation showed parallelism with Brown et al.'s (2012) study, in which they addressed that *children's understanding* could both increase MTA and reduce MTA. If the participants in the present study knew the age level of children before, they were able to arrange activities according to their level, which would decrease their MTA. On the contrary, not knowing children and their ages increased their MTA to some extent. This showed that those participants did not have a grounded knowledge of child development. Future instructors may focus more on ECE mathematics objectives for children. *Practice* was represented as a factor reducing anxieties in the researchers' classification. This finding also aligned with the current study. Teaching mathematics practice made preservice teachers' MTA reduced and they mostly expressed feelings of enjoyment when they conducted mathematics activities.

It would be the case that *previous experiences with mathematics* could be mentioned as a source for higher MTA in this study, considering the negative experiences with mathematics most of the participants had before coming to the teacher education program. However, only three participants mentioned their previous experiences with mathematics as a source for higher MTA. They did not mention their previous mathematics experiences as a source of MTA at the end of the course. This finding might support the idea that they gained a new perspective about mathematics and its teaching. Therefore, the new mathematics might push participants' negative previous experiences with mathematics aside and it seemed that these experiences did not influence their mathematics teaching experiences during the TMEC course and their MTA much. Moreover, participants who mentioned about the negative previous experiences with mathematics might take internal control over their teaching practices and be well-prepared in order not to make any mistake. As a result of well-

preparation for teaching mathematics, they might not encounter any problem during teaching mathematics experiences and not develop MTA.

Different from Brown et al.'s (2012) study, *contribution of TMEC course* was also emerged as a new source of MTA in the present study. Most of the preservice teachers mentioned the contributions of the course for their lower MTA. The key experiences which helped participants develop lower MTA were the *general influence of the course, specific tasks in the course,* and *interaction between the TMEC and School Experience courses*. As general influence of the course, preservice teachers were given theoretical knowledge of teaching and learning mathematics, and preparing and implementing mathematics activities. Moreover, they obtained feedback related to in-class activities from their classmates, the instructor, and another mathematics education researcher. Considering those feedbacks, they implemented activities with early ages. Feedback, which has important role on learning and achievement (Hattie & Timperley, 2007), might have led preservice teachers to pay attention critical points and provided a chance to re-organize them. This helped them to have lower MTA at the end of the TMEC course.

The category of *specific tasks in the course* comprised of all tasks, such as presentations, activity plans, learning center project, and field assignments. It might be the case that preparation of many mathematics activities and recognition of children's possible reactions provided essential experiences for participants which lowered MTA. Preservice teachers met in groups to prepare activities, which might have led to reduce MTA since making collaboration and exchanging ideas diminished their stress (Copley, 2004). Besides, in the field reflection assignment, they thought deeply about past experiences and encountered sources causing their MA, and wrote their mathematics history in detail. As Trujillo and Hadfield (1999) indicated that a deeply look at individual's personal negative prior experiences leads to positive direction for potential encounters. This might be the case that their awareness increased regarding the sources and they might have taken positive action towards teaching mathematics to children.

The last key course experiences for MTA was *interaction between the TMEC and School Experience courses*. Using mathematical knowledge obtained in TMEC course in the field practice and implementing the activities in the real contexts with children might have helped in reducing MTA. This is consistent with findings of McGlynn-Stewart's (2010) study which revealed that teaching in the real environment as an assignment of method course helped the preservice teachers in improving their attitudes towards learning and teaching mathematics as well as in reducing their anxiety. Additionally, preparing activities and receiving feedbacks for these activities in the present study decreased their anxieties.

5.4 The Relationship between MA and MTA

Based on the field reflection responses, there were five categories of change in MTA with respect to the MA. The preservice teachers in Area A and Area D supported the assumption that participants with prior MA had MTA, and participants without prior MA did not have MTA. On the other hand, preservice teachers in the Area B and Area C challenged the assumption. While they had negative mathematics experiences and high MA in the past, they did not display MTA or while they did not experience MA in the past, they had MTA in the teaching practice.

In her study, Haciomeroglu (2014) found a significant relationship between elementary preservice teachers' MA and MTA. Similarly, a significant positive relationship between preservice teachers' MA and MTA was revealed by Peker and Ertekin (2011). These studies supported the existence of preservice teachers in the Area A and D in the current study. It might be the case that participants' past mathematics experiences might be well-built and very strong that they thought they would live the same mathematical experiences in their future teaching to children. However, preservice teachers in the Area B and Area C showed differences, which aligned with the Brown et al.'s (2011) findings. They found that one-third of their participants had high prior MA, but did not have MTA. Preservice primary teachers with negative emotions have also been found to not attend their negative past experiences in order to be good mathematics teachers (Coppola, Di Martino, Mollo, Pacelli, & Sabena, 2013). Some participants in the current study stated that they did

not want to be like their past teachers and they did not want to make children afraid of mathematics. Therefore, preservice teachers with high MA might have the desire to teach mathematics without anxiety in order to be a model for their students.

The findings of the present study explicitly presented a shift in almost half of the participants' MTA at the end of the course which was not much significant in Brown et al.'s (2011) study. This shift, however, was detected in data collected by different instruments and not all participants expressed change in their MTA in all instruments. In fact, when the participants' MTA ratings (Mathematics and Me 1 and 3) were inspected, it can be seen that all preservice teachers showing shift were not the same teachers in both instruments. In other words, although the ratings for the perceived MTA at the beginning of the course were lower for some participants, they mentioned about the shift in their field reflections. Showing different shifts in the different data collection instruments might be due to the dynamic nature of the construct of MTA. Since MTA experiences are formed during field practice experiences (Brown et al., 2012), it might show differences depending on the cases preservice teachers encountered. Exploring shifting with different instruments enabled capturing the rather dynamic nature of MTA and also revealed that MTA could be still under construction for preservice teachers. The timeline of the implementation of the data collection instruments also showed that different responses about MTA were given by the participants during the TMEC course, validating that MTA was still not completely formed. This was somehow expected that TMEC course provided the first experiences of teaching mathematics and even though participants implemented several activities, they were still not fully responsible for designing and implementing mathematics activities as the teacher of their own class. Therefore, the extent of the mathematics teaching experiences were still limited and MTA was still under construction. Another reason for different shifts might be related to the nature of the field reflection assignment, where preservice teachers were able to reorganize their experiences from different perspectives (Munby & Russell, 1990). This reorganization might have provided them to take a close look at their teaching practices and related emotions, such as anxiety, and

evaluate their experiences within their knowledge gained in the TMEC course throughout the semester.

5.5 Implications and Recommendations

Findings of the present study have the potential to contribute to literature on MA and MTA of preservice early childhood education teachers; provide insights, suggestions, and implications for preservice early childhood education teachers, teacher educators as well as teacher education programs.

Preservice teachers should be aware of their anxieties which have considerable effect on their behavior and instruction. If necessary precautions should not be taken into consideration, they might unintentionally pass these feelings to their students and adversely influence them during their teaching. Knowing the sources of their anxiety, especially the teacher-related sources, might provide teachers with strategies to not form these sources. They might prevent their students from having mathematics fear in the long term. Therefore, further research might focus on how teachers deal with mathematics anxiety during the teaching-learning activities and help teachers in this sense. This also have reflections for teacher education that teacher education programs should be designed and implemented to avoid forming anxiety and creating an anxiety cycle which is transferred to next generations (Bekdemir, 2010). Such a design is possible with research focusing on how teachers can avoid conveying their anxieties to students especially in Turkey's educational settings.

Teacher educators and mentor teachers should know well the sources of MTA in order to rearrange field practice experiences. In this way, preservice teachers might gain more positive mathematics teaching experiences in the preschools and their MTA might decrease. Moreover, teacher educators should better design mathematics method courses, activities, and classroom discussions to prepare preservice teachers for teaching mathematics with lower anxiety (Brown et al., 2012). For instance, a short video clip, role-playing scenario or vignettes related to preservice teachers' previous mathematics experiences can be used for discussions in method courses for preservice teachers before going to field practices. These activities have the potential

to make them encounter their negative feelings and see that other preservice teachers also have similar experiences (Trujillo & Hadfield, 1999). Likewise, analyzing a reflection written by preservice teacher with higher MTA or an external locus of control situations can be useful in decreasing the anxiety. Focusing on preservice teachers' future mathematics teaching, developing strategies for several conditions to improve their self-regulation skills, and letting them take more internal locus of control in situations are likely to improve efficient instructional strategies and experiences of teaching mathematics, and probably lower MTA (Brown et al., 2012).

Drawing activities could be a part of the beginning and end of the mathematics method courses in order to identify preservice teachers' mathematics related images and emotions (Rule & Harrell, 2006). In this study, drawing activity made students express their past unconscious images of mathematics in the beginning of the course and provided a useful set of data to understand these images and related emotions for research. At the end of the course, they generally focused on their teaching mathematics experiences in the preschool and this enabled me to see how they developed a new image of mathematics in the context of teaching in preschools. Therefore, it can be said that while drawing provided preservice teachers with a reflection on mathematics and mathematics teaching, it helped my research with the conclusion that the TMEC course resulted in new images of mathematics.

Findings of the study showed that although some preservice teachers had negative mathematics experiences in the past, they wanted to become a better teacher and did not want to make their students have the same negative and unpleasant experiences related to mathematics. They were optimistic about teaching mathematics to children if they were prepared well enough. Therefore, teacher educators have many duties since those preservice teachers might need help about teaching. Teacher educators should be aware of these preservice teachers and should encourage, guide and motivate them until they believe themselves and feel safe for teaching mathematics. In this respect, further study might be conducted on how teachers' MTA influence children's attitude towards and performance in mathematics. Moreover, the possible link between preservice teachers' prior mathematics experiences and their MTA

would be an important research field. Based on the findings of the study, more research is needed to investigate the connection between MA and MTA. On the other hand, some participants in the study indicated that they had higher MA, but in the teaching practice they felt no anxiety and their MTA was lower because they were prepared well enough. Therefore, follow-up studies should be conducted to observe these participants' anxieties after they graduated and confronted realities in the profession.

The shift in the MTA at the end of TMEC course was revealed through three different instruments. Hence, in method courses, preservice teachers should be given opportunities and tasks such as reflection and journal writing to discover themselves and develop their self-awareness of prior experiences, as well as positive emotions of mathematics and its teaching. Further research can be conducted on preservice and in-service teachers' awareness of own MA and MTA and its effect on teaching practice.

Teacher educators should emphasize using hands-on activities, visual aids, technology, and forming cooperative groups while teaching mathematics in multiple ways. When children consider mathematics as enjoyable, the pleasure with mathematics will remain throughout the rest of lives and they will have no anxiety regarding mathematics (Das & Das, 2013). Therefore, the duration of TMEC course should be increased to provide preservice teachers with better opportunities of instruction, implementation, feedback, and support. Moreover, basic mathematics course in which preservice teachers could learn fundamentals of the basic mathematics concepts that they will teach in the future profession could be offered to program developers. In this course, the preservice teachers might design activities and get hands-on experience. They can try to complete the activities on their own before implementing to children, which might reduce their MTA. Findings of the study revealed that more mathematics teaching practice helped preservice teachers realize what they needed in order to conduct better teaching and how this reduced their MTA. Opportunities should be provided to preservice teachers to spend as much time as possible with children. Therefore, more teaching practices with

children in real settings and reflection on teaching could be the key to have early childhood education teachers with lower MTA. An extension of these findings could be investigating the relationship between teachers' MA and MTA, and their students' MA.

Drawing provided a rich set of information for the present study. Further studies can be conducted related to drawing with preservice teachers at the end of field practice course of 4rd year and after being in-service teachers to see how their images change and how sustainable the new positive images and emotions are (Burton, 2012). Moreover, the children they teach in the preschools might be asked to draw mathematics and the relationship between children' drawings and their teachers' drawing could be investigated and compared (Burton, 2012)

Lastly, schools and teacher education programs should make collaborations in order to improve preservice teachers' teaching practices in school settings and provide rich learning environments where they spend a quality time with children while teaching mathematics. Preservice teachers in this study mentioned from time to time that mentor teachers' positive feedback and encouragement reduced their MTA. Therefore, effective collaboration among the mentor teachers, preservice teachers and teacher education program should be established.

5.6 Limitations

Participants of the current study were selected from a single teacher education program in which language of instruction was English and TMEC course was given in this program at the 3rd year of the program. Therefore, participants of the study might not be representative of other preservice early childhood education teachers in Turkey. On the other hand, it should be noted that generalization was not a concern of the study.

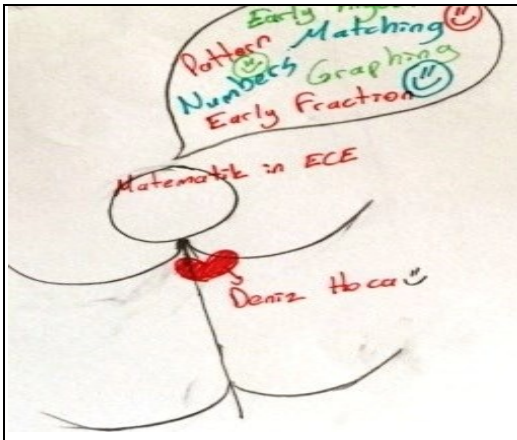
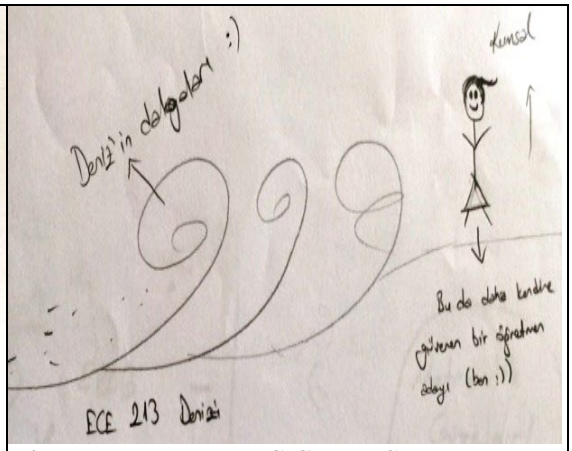
Participants' mathematics related images, emotions, MA, and MTA were explored during the TMEC course in this study. Therefore, findings were limited to the course experiences and duration. The findings were also limited to the data collection instruments used in the study. Participants were not observed during their

mathematics activities they conducted in their practice teaching course, therefore findings related to the implementation of the activities in real settings reflect participants' accounts of these practices.

I was both the instructor of the course and I also conducted my research throughout the course. The course students were the participants and they were aware that their course experiences constituted my research data. I tried to be as fair as possible throughout the course, build positive relationship with them and encourage them to be as honest as possible in their responses. My status as their instructor could have influenced their responses especially about the effect of the course experiences on their learning and teaching. At the end of the semester, they filled out anonymous evaluation forms regarding TMEC course, which were notably favorable, and they expressed the positive impact of the course experiences on their future profession as well as mathematical experiences. They also drew me in their end-of-the semester drawings as exemplified in below Table 5.1 and emphasized that they did not draw me or positive things about me to get a higher grade from the course, but because they felt this way. I felt that I had a closer relationship with the course students and I tried to maintain this relationship in their 4^{th} year and even after they graduated. However, I tried my best to analyze my data in the most objective way. Having another mathematics education researcher who helped me in the class during the semester and also observed the class for the purposes of this research enabled me to discuss and clarify my possible bias or subjectivity when I needed. Yet, the findings of the study were limited to the analysis and interpretation which were conducted in the most rigorous way by me who was also the course instructor and other researchers involved in data analysis.

Table 5.1

Me in Preservice Teachers' End-of-the Semester Drawings

	
(Teacher Deniz)	*(Deniz's wave..TMEC Course Sea (=Deniz)..It is me, a preservice teacher who have more self-confidence)*

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APPENDICES

APPENDIX A: UNDERGRADUATE CURRICULUM

First Year, First Semester	First Year, Second Semester
PSY100 General Psychology (3)	ECE104 Maternal and Child Health and First Aid(3)
ECE100 Introduction to Early Childhood Education (3)	ECE110 Child Development and Psychology (4)
ECE120 Anatomy and Physiology(3)	ECE126 Maternal and Child Nutrition(2)
EDS 200 Introduction to Education (3)	ENG102 English for Academic Purposes II (4)
ENG 101 English For Academic Purposes I (4)	Any 1 of The Following Set …
IS 100 Introduction to Information Technologies and Applications (0)	TURK104 Written Expression(2)
Any 1 of The Following Set …	TURK106 Turkish II (0)
TURK103 Oral Communication(2)	TURK202 Intermediate Turkish(0)
TURK105 Turkish I(0)	Any 1 of The Following Set …
TURK201 Elementary Turkish(0)	SOC100 Principles of Sociology(3)
	SOC104 Introduction to Sociology(3)
Second Year, First Semester	**Second Year, Second Semester**
ECE201 Music I(2)	ELE240 Probability And Statistics(3)
ECE215 Play in Early Childhood	ECE202 Music II(3)
ECE250 Basic Science (3)	ECE206 Mental Health and Adaptation Disorders(3)
CEIT100 Computer Applications In Education (3)	ECE208 Children S Literature(3)
EDS 220 Educational Psychology (3)	ECE214 Teaching Science In Early Childhood (3)
ENG211 Academic Oral Presentation Skills (3)	ECE220 Physical Education and Games(3)
Elective	ECE230 Curriculum In Early Childhood Education (3)
Third Year, First Semester	**Third Year, Second Semester**
ELE301 Research Methods(3)	ELE310 Community Service(2)
ECE213Teaching Mathematics In Early Childhood(3)	ECE302 Drama In Early Childhood Education(3)
ECE303 School Experience(3)	ECE325 Parent Involvement and Education(3)
ECE306 Visual Arts and Material Development(3)	ECE466 Instructional Principles and Methods(3)
ECE315Children With Special Needs(2)	CEIT319 Instructional Technology and Material Development(3)
ECE326 Methods of Teaching In Early Childhood Education(3)	Any 1 of The Following Set …
ECE340Classroom Management and Discipline In Ece(3)	HIST2201 Principles of Kemal Atatürk I(0)
Any 1 of The Following Set …	HIST2205 History of The Turkish Revolution I(0)
HIST2201 Principles of Kemal Atatürk I(0)	Elective
HIST2205 History of The Turkish Revolution I(0)	
Fourth Year, First Semester	**Fourth Year, Second Semester**
ECE409 Creativity and Children(3)	ECE430Practice Teaching II(5)
ECE410 Assessment and Evaluatin In Ece(3)	ECE480 School Readiness and Transition To Elementary School(2)
ECE411 Practice Teaching I(5)	EDS416 Turkish Educational System and School Management(3)
ENG311Advanced Communication Skills(3)	EDS424 Guidance(3)
Elective	Elective

APPENDIX B: ACTIVITY PLAN

PATTERN AND FUNCTION

The name of group:

Group Members :

Ages:

5-6 years of children

Focus:

Understanding how a pattern occurs

Description:

Putting objects in a specific order

Objectives and Signs:

BİLİŞSEL GELİŞİM

Kazanım 1. Nesne/durum/olaya dikkatini verir.
Göstergeleri: Dikkat edilmesi gereken nesne/durum/olaya odaklanır.

Kazanım 5. Nesne ya da varlıkları gözlemler.
Göstergeleri: Nesne/varlığın adını, rengini ve şeklini söyler.

Kazanım 7. Nesne ya da varlıkları özelliklerine göre gruplar.
Göstergeleri: Nesne/varlıkları rengine, şekline, büyüklüğüne göre gruplar.

Kazanım 9. Nesne ya da varlıkları özelliklerine göre sıralar.
Göstergeleri: Nesne/varlıkları renk tonlarına göre sıralar.

Kazanım 14. Nesnelerle örüntü oluşturur.
Göstergeleri: Modele bakarak nesnelerle örüntü oluşturur. En çok üç öğeden oluşan örüntüdeki kuralı söyler.

MOTOR GELİŞİM

Kazanım 4. Küçük kas kullanımı gerektiren hareketleri yapar.
Göstergeleri: Nesneleri takar, çıkarır, ipe vb. dizer. Malzemeleri keser.

Mathematical Connections

☐Number/Quantity ☐Space/Shape ● Pattern/Function/Algebra ☐Graphing

Math actions:

(0: not present at all, 1: present in small measure, 2: present in moderate measure, and affects solution, 3: a prominent presence, 4: a dominant presence)

2: Inferring/Drawing conclusions 4:Modeling/formulating 3:Communicating

1:Transforming/manipulating 0:Problem solving

Assumed Mathematical Background

- Being aware of colors

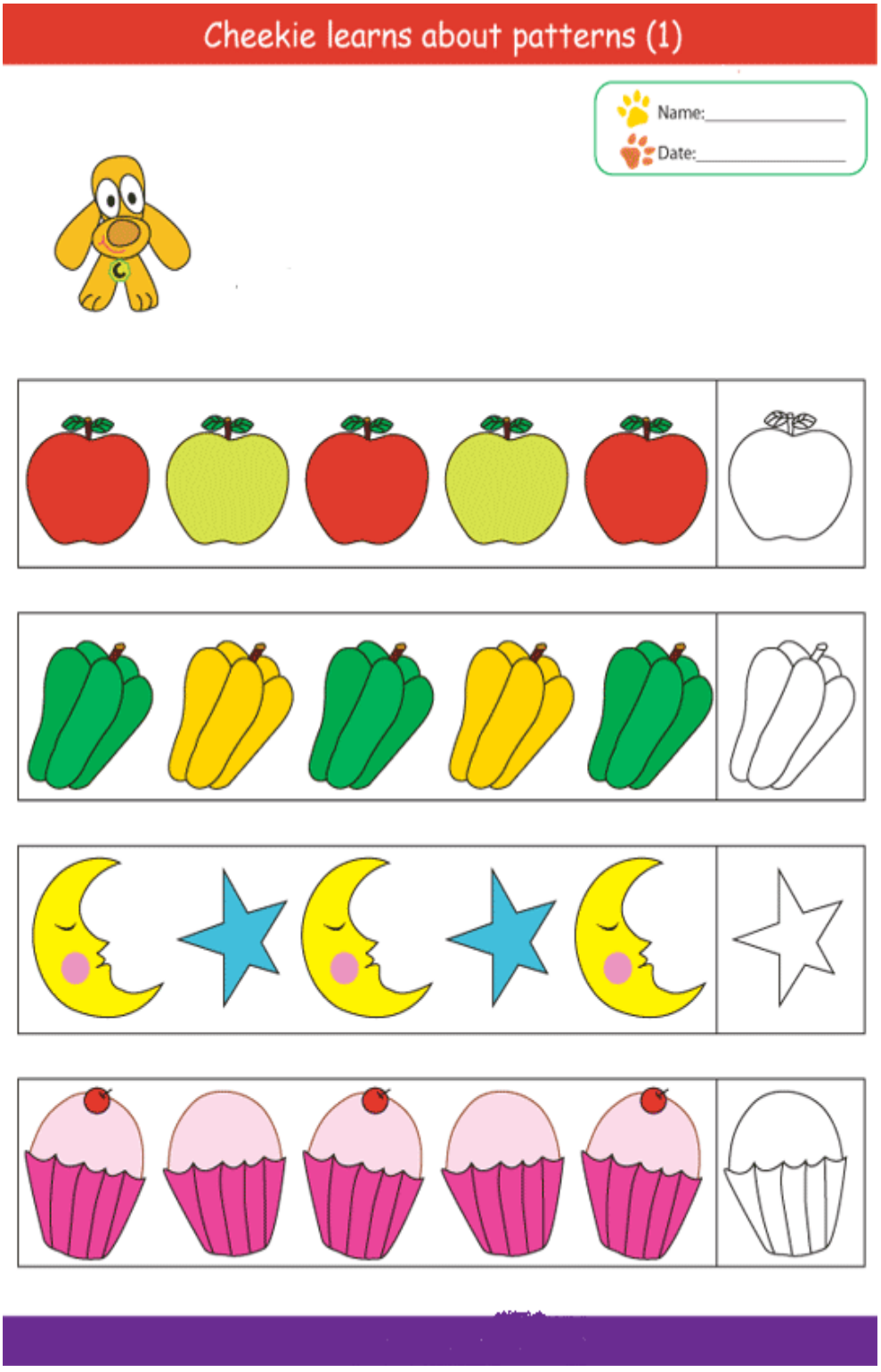
Materials

- Rope, a worksheet about patterns, certain shapes(smile, hearth, triangle) which are ready to be cut by children, scissors, straw, punch

Learning Process:

- **Integrated activity (art and math activity**

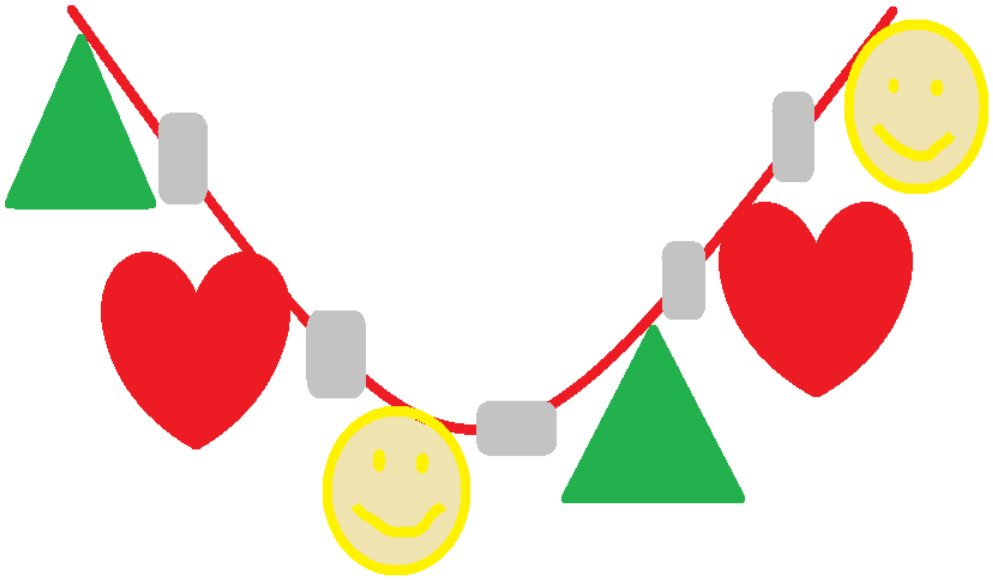
  First of all, teacher speaks with children and gives examples about pattern with wristband. For instance, s/he says 'one of my friends gave me this wristband and it has repetitive colors in it. Let's count them together by looking at it. First one is white, second one is orange and the last one is blue.' The teacher counts this order more than two and explains how a pattern is formed. In addition to that, she shows this worksheet and they talk about patterns:



Later, the teacher gives the children papers which include shapes and children start to cut them. During that time, the teacher drills papers with the punch. After all shapes are cut, the teacher says 'Let's make your own pattern by putting the shapes

on your desk.' All children do that and all of them tell their patterns to the class. After that, the teacher tells 'Now, let's make a necklace by stringing them and put a straw between two shapes. The activity continues until all children finish their own necklaces and show them their friends.

The possible outlook of the necklaces:



Evaluation of Activity

DEVELOPMENTAL SKILLS	**Contribution of the Activity**
Psychomotor Development	Grasping scissors and using them properly, stringing shapes on the rope(fine motor skills)
Social-Emotional Development	Helping friends during activity.
Language Development	Representing their own patterns to the class.
Cognitive Development	They learn a pattern concept and form their own patterns.
Self-care Skills	Collecting remainder materials and cleaning the classroom.

APPENDIX C: TEACHING MATHEMATICS IN EARLY CHILDHOOD

Course Description
This course is about teaching mathematics to young children. We will try to understand how young children learn mathematics and what might early childhood teachers do to make it better. You are **strongly advised to join the discussions** during the class sessions. This course is based on discussion and presentation of activities. Your input is highly important. You should seriously consider expressing your ideas in this course.

Attendance and Participation
You are strongly recommended to attend the lessons. This course is not only about reading the texts, but also preparing learning activities and engaging in discussions.

Main Text
Smith, S. S. (2009). *Early Childhood Mathematics (4th edition).* Boston: Pearson Education Inc.

Additional Resources
Kennedy, L.M., Tipps, S., & Johnson, A. (2004). *Guiding Children's Learning of Mathematics.* Belmont, CA: Thompson Wadsworth.
Van de Walle, J.A. (2004). *Elementary and Middle School Mathematics: Teaching Developmentally*. Boston, MA: Pearson
Van de Walle, J.A., Lovin, L.H. (2006). *Teaching Student-Centered Mathematics Grades K-3*. Boston: Pearson Education Inc.

There are a number of books about teaching mathematics to young children in the library. They are mostly helpful. I strongly recommend you check them for your activities.

Course Format
We will mostly follow Smith's book. You are required to read the specified text each week and prepare an activity about the content. In the first hour of the class, I will present the content and we will discuss it together. Then, you will present your activities as a group. We will discuss the activity and try to improve it. You get all the activities and put them in your portfolio.

Grading and Assignments
Mid-term exam: There will be one mid-term examination. The exam will cover the content presented in class and in the readings. We will have the midterm on November 29th in the regular class hour. **(%25)**
Final exam: There will be a comprehensive final examination. The final examination will include issues that are covered during the entire semester. **(%30)**
Project: Details of the project will be announced during the semester. You will be developing learning centers for a specific mathematics topic to support young learners' initial mathematical ideas. **(%15)**
Presentation of Activities: Each group will prepare one activity every week about the content recently presented. You will submit the activity plans on every Monday after your presentation to METU ONLINE. **(%10)**

Math Portfolio and Quizzes: All the activities presented in the class will be gathered in a portfolio. I want you to gather and organize them in the most meaningful way. This will be a teaching portfolio to use in the future. Besides, there will be pop-quizzes during the semester. The quizzes will cover issues from the readings. The dates of these quizzes are unknown. **(%5)**
Field Reflection: I want you to prepare a mathematics activity in your teaching practice. You should write a reflection regarding mathematics teaching process, your feelings, and challenges. Details will be announced during the semester. **(%15)**
Bonus: If you attend all the classes during the semester, you will receive (at least) 3 points as bonus and this will be added to your total score from this course. If you miss two weeks, you won't be able to receive these bonus points. Attending only one class hour does not count as attending to the whole week.

Academic Ethics
All assignments you hand in should be the result of your effort only. Academic dishonesty, including any form of **cheating** and **plagiarism** will not be tolerated and will result in failure of the course and/or formal disciplinary proceedings usually resulting in **suspension** or **dismissal**. Cheating includes but is not limited to acts such as; offering or receiving unpermitted assistance in the exams, using any type of unauthorized written material during the exams, handing in any part or all of someone else's work as your own, copying from the Internet. **Plagiarism** is a specific form of cheating. It means using someone else's work without giving credit. Plagiarism is a literary theft. Therefore, you have to acknowledge the sources you use in your assignments. LET US KNOW WHERE YOU GOT THE IDEA, ALWAYS GIVE THE REFERENCES.

Tentative Schedule

Week	Content	Readings and Activities
Week 1 27/09/13	First meeting	Introduction Course syllabus
Week 2 4/10/13	How Young Children Learn Mathematics: Content and Process Connections	Schwartz- Chp. 3
Week 3 11/10/13	Early Math Concepts	Smith – Chp. 5 Presentation of Activities
Week 4 25/10/13	Space and Shape	Smith – Chp. 12 Presentation of Activities
Week 5 1/11/13	Pattern, Function, and Early Algebra	Smith – Chp. 9 Presentation of Activities
Week 6 8/11/13	Pattern, Function, and Early Algebra	Smith – Chp. 9 Presentation of Activities
Week 7 15/11/13	Graphing	Smith – Chp. 8 Presentation of Activities
Week 8 22/11/13	Developing Number Sense	Smith – Chp. 6 Presentation of Activities
Week 9 29/11/13	MIDTERM	
Week 10 6/12/13	Problem Solving: Addition and Subtraction	Smith – Chp. 10 Presentation of Activities
Week 11 13/12/13	Measurement	Smith – Chp. 13 Presentation of Activities
Week 12 20/12/13	Problem Solving: Multiplication and Division	Smith – Chp. 11
Week 13 27/12/13	Early Fraction Concepts	Van de Walle – Chp. 16 Presentation of Activities
Week 14 03/01/14	Assessment	Smith – Dacey & Eston – Chp.3 Presentation of Activities
Week 15 10/01/14	Wrap-up	
	FINAL	

APPENDIX D: LEARNING CENTER PROJECT

What is a learning center?
Learning center is a special station that is located in the classroom where one or two students can quietly work and learn on his/her own pace. It includes a set of tasks/activities designed to foster student understanding of a particular concept or set of concepts. It may be used to introduce students to a topic, it may be used as follow-up, or it may be used as enrichment on a topic. Students may work individually or in pairs. All materials needed are provided at the learning center, including clear instructions for operation of the center.

What should you prepare?
What you need to do for this project is two-fold:

1-**The actual learning center** (physical materials, and settings, you can use shoe boxes, plastic containers etc., to store and organize your materials).
2-**Project report** (Includes information about the purpose, target teaching group, instructions for teachers, description of the design, list of materials, and resources)

In preparing your learning center project, you can use variety of different sources including, World Wide Web, textbooks, math activity books, CD's etc.

Which topics should you cover?
- Graphing
- Problem Solving: Addition and Subtraction
- Pattern, Function, and Early Algebra
- Space and Shape
- Developing Number Sense
- Early Math Concepts
- Measurement

Learning Center (30 points)
1. Form groups of 3 with your friends **who are in the same practice school with you** for this assignment (only and only for this assignment).
2. Talk to your teacher about this assignment and determine on a concept(s) together and also the time and the place. These are important for developing your learning center.
3. Develop 3-4 activities in which students will conceptually understand the concepts by involving in the activities in the learning center. You may guide them through the activities, but limit your guidance to informing them about the purpose and the requirements. Students are expected to work alone or

with their friends through the activities in order to benefit from the learning center. You have to design activities that they will work without your (or a teacher's) guidance.

4. You will implement your activities in your collaborating schools and write a report of your learning center development and the implementation based on the below criteria.

FORMAT:

ACTIVITIES:

1. First activity: "Name of the activity"

Objectives:
Target age group:
Description of the design:
Instructions for teachers:
List of materials:

2. Second activity: "Name of the activity"

Objectives:
Target age group:
Description of the design:
Instructions for teachers:
List of materials:

3. Third activity: "Name of the activity"

Objectives:
Target age group:
Description of the design:
Instructions for teachers:
List of materials:

IMPLEMENTATION OF LEARNING CENTER:

Example: We implemented our learning center in the entrance of school building. We were given "nöbetçi öğrenci masası" to place our concrete materials and a bulletin board for our posters…

.

1. First Activity

Purpose:
Students' reaction:
Difficulties of students:
Reasons for students' difficulties:

2. Second Activity

Purpose:
Students' reaction:
Difficulties of students:

Reasons for students' difficulties:

3. Third Activity

Purpose:
Students' reaction:
Difficulties of students:
Reasons for students' difficulties:

DISCUSSION PART:

1- **Our difficulties during implementation:**
2- **Our ways to overcome difficulties:**
3- **Re-implementation:** If we had a chance to re-implement our learning center to the same group of students, we ….
4- **Mathematics Teaching Anxiety:** (Compare and contrast the mathematics teaching anxiety level while during your real experience and the presentation of activity in the ECE 213 class. Is there any difference/similarities between them? Why? How? What can you do for reducing your mathematics teaching anxiety? What do you observe and learn about teaching and students'learning during your real experince?)

Checklist for Preparing your Learning Center Project Report (out of 60 in total)

……*ABOUT THE IDEAL LEARNING CENTER*…….. (out of 30 in total)

- ❑ The objectives of the activities are clearly stated._____ (out of 5)
- ❑ The target teaching age group is indicated. _____ (out of 1)
- ❑ Instructions for teacher are provided (How to use your learning center). _____ (out of 5)
- ❑ There are at least three different activities in your learning center. _____ (out of 5)
- ❑ Description of the design included (How can somebody prepare the same learning center?). __(out of 5)
- ❑ List of materials needed for each activity is given. _____ (out of 4)
- ❑ List of resources used given (Complete list of references). _____ (out of 1)
- ❑ Clear use of language OVERALL THE REPORT _____ (out of 4)

……*ABOUT THE IMPLEMENTATION*……(out of 30 in total):

- o The purpose of your learning project is indicated (Which mathematical concepts, terms, ideas will be covered?)._____ (out of 2)
- o A description of the actual implementation context (physical environment (Where did you implement?), duration and the period for the implementation (such as lunch break, regular class hour..), approximate number of students and their grade level(s), and available setting for the activities (Were you given a table? A wall?)._____ (out of 3)
- o Answers to the following questions in a narrative way:
  - How did the students react to the tasks? _____ (out of 2)

- What kinds of difficulties in students did you observe? Were you expecting these? _____ (out of 3)
- Why do you think students had those difficulties you have observed? _____ (out of 5)
- What kinds of difficulties did you have during the implementation? Were you expecting these? _____ (out of 3)
- How did you overcome those difficulties you had? _____ (out of 3)
- What would you consider if you had the chance to re-implement to the same group of students? _____ (out of 2)
- What are the differences/similarities between the real experience and the presentation of activity in the ECE 213 class? Why?How?_____ (out of 5)
- What can you do for reducing your mathematics teaching anxiety?_____ (out of 1)
- What do you observe and learn about teaching and students'learning during your real experince?)_____ (out of 1)

APPENDIX E: ECEMVQ

Bu çalışmanın amacı, okul öncesi öğretmen adaylarının matematiğe yönelik görüşlerini incelemektir.
Çalışmaya katılım tamamıyla gönüllülük temelinde olmalıdır. Ankette, sizden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamiyle gizli tutulacak ve sadece araştırmacılar tarafından değerlendiriIecektir; elde edilecek bilgiler bilimsel yayımlarda kullanılacaktır. Anket sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Çalışma hakkında daha fazla bilgi almak için,

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veya
Arş. Gör. Duygu Ören Vural (Tel: 0312 210 36 86; E-posta: doren@metu.edu.tr)
ile iletişim kurabilirsiniz.

Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz...

Cinsiyetiniz: Bayan ( ) Bay ( )

Sınıfınız: **1** ( ) **2** ( ) **3** ( ) **4** ( )

Mezun olduğunuz lise türü: Düz Lise ( ) Anadolu Lisesi ( ) Fen Lisesi( ) Anadolu Öğretmen Lisesi ( ) Meslek Lisesi/Anadolu Meslek Lisesi( ) Özel Lise( )

Okul Öncesi Eğitim'de Matematiğe Yönelik Görüşler Anketi

1- "Matematik" deyince aklınıza ilk ne geliyor? Neden bu şekilde düşünüyorsunuz?

2- Öğrenim hayatınız süresince(ilk-orta-lise), matematik dersine olan ilginizi nasıl değerlendirirsiniz?

3- Üniversite öncesi öğrenim hayatınızda matematiğin günlük hayatımızla ilişkisi hakkında ne düşünüyordunuz? Şuan ne düşünüyorsunuz?

4- Aşağıdaki matematikle ilgili görüşlerden hangisinin daha doğru olduğunu düşünürsünüz? Eğer her ikisine de katılmıyorsanız, lütfen kendi fikrinizi yazın:

a) Matematik bilgisi sürekli yenilenir ve toplumsal olaylar bunda etkilidir. ☐

b) Matematik bilgisi çoğunlukla değişmez ve toplumsal olaylardan etkilenmez. ☐

c) Yukarıdaki (a) ve (b) den herhangi birine katılmıyorum. Çünkü …….

5- Okul Öncesi Eğitimi'nde matematiksel kavramların öğretilmesinin yararlı olduğunu düşünüyor musunuz? Neden bu şekilde düşünüyorsunuz?

6- Öğretmen olduğunuzda, sınıfınızda matematiksel etkinliklere haftalık ders programınızda ne sıklıkta yer vermek istersiniz?

7- "Matematik sadece zeki çocukların yapabileceği bir derstir." Bu fikre katılıp katılmadığınızı nedenleriyle açıklayınız.

8- **a)** Okul öncesi dönem çocuklarına matematik öğretmek için, sahip olduğunuz matematik bilgisinin ne derece yeterli olduğunu düşünüyorsunuz?

b) Eğer bilginizi yeterli görmüyorsanız ne kadar matematik bilgisine ihtiyacınız olduğunu düşünüyorsunuz? Sizce hangi konularda, ne tür bilginiz olmalı?

APPENDIX F: MATEMATICS AND ME 1

1- Aşağıda verilen 1 den 10 a kadar olan derecelendirmede, 10 çok yüksek derecede *matematik kaygı* düzeyini göstermektedir. Bu derecelendirmede matematik kaygı düzeyinizin nerede olduğunu işaretler misiniz?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

a) Hangi seviyede matematiği düşünerek bu soruyu cevapladınız? Size göre farklı matematik türleri varsa, hangileri çok, hangileri az kaygılandırıyor?

b) Neden böyle düşünüyorsunuz? (Az kaygılıysanız bunun sebebi nedir?/ Çok kaygılıysanız bunun sebebi nedir?)

2- Aşağıda verilen 1 den 10 a kadar olan derecelendirmede, 10 çok yüksek derecede *matematik öğretimi kaygı* düzeyini göstermektedir. Bu derecelendirmede matematik öğretimi kaygı düzeyinizin nerede olduğunu işaretler misiniz?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

a) Neden böyle düşünüyorsunuz? (Az kaygılıysanız bunun sebebi nedir?/ Çok kaygılıysanız bunun sebebi nedir?)

3- ECE 213 dersinde ne öğrenmeyi bekliyorsunuz?

4- Sizce okul öncesindeki çocuklar için matematik gerekli midir? Neden?

a) Sizce hangi matematik konuları öğretilmeli? Neden?

5- a) Hiç okul öncesi çağındaki bir çocuğa matematik öğrettiniz mi? Evet ise, ne hissettiniz? Bu deneyiminizi ayrıntılı bir şekilde yazar mısınız?

b) Kendinizi matematik öğretmeye hazır hissediyor musunuz? Geleceğin okul öncesi öğretmeni olarak matematik öğretmekle ilgili sizi en çok ne/neler kaygılandırıyor?

APPENDIX G: DRAWING ACTIVITY 1

Let's Draw: What is Math?

I want you to draw your initial impressions of "math"?

- **Experiences,**
- **Emotions,**
- **Content,**
- **Any images you might use to "draw math".**

For clarification purposes, write several descriptive sentences related to drawing.

APPENDIX H: DRAWING ACTIVITY 2

Last Day of the ECE 213 Course:

Let's Draw: What is Math?

I want you to draw your final understandings of "math"? Draw a figure for your current understanding.

- **Experiences,**
- **Emotions,**
- **Content,**
- **Any images you might use to "draw math".**

For clarification purposes, write several descriptive sentences related to drawing. IN ADDITION TO THIS:

Did ECE 213 course change your undersandings and feelings towards mathematics? If yes, how? If no, what may be the resons?

APPENDIX I :FIELD REFLECTION REPORT

(due on January 8th)

I want you to prepare a mathematics activity in your teaching practice. You should write a reflection regarding your background experiences related to mathematics and your real classroom experiences while teaching mathematics. Is there any relationship between the Prior Mathematics Anxiety and Mathematics Teaching Anxiety? (Of course, it depends on your experiences.) Focus on mathematics teaching process, your feelings, and challenges.

APPENDIX J: MATEMATICS AND ME 3

1- Aşağıda verilen 1 den 10 a kadar olan derecelendirmede, 10 çok yüksek derecede *matematik kaygı* düzeyini göstermektedir. Bu derecelendirmede matematik kaygı düzeyinizin nerede olduğunu işaretler misiniz?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

a) Hangi seviyede matematiği düşünerek bu soruyu cevapladınız? Size göre farklı matematik türleri varsa, hangileri çok, hangileri az kaygılandırıyor?

b) Neden böyle düşünüyorsunuz? (Az kaygılıysanız bunun sebebi nedir?/ Çok kaygılıysanız bunun sebebi nedir?)

2- Aşağıda verilen 1 den 10 a kadar olan derecelendirmede, 10 çok yüksek derecede *matematik öğretimi kaygı* düzeyini göstermektedir. Bu derecelendirmede matematik öğretimi kaygı düzeyinizin nerede olduğunu işaretler misiniz?

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**

a) Neden böyle düşünüyorsunuz? (Az kaygılıysanız bunun sebebi nedir?/ Çok kaygılıysanız bunun sebebi nedir?)

3- Dönemin başındaki öğretim kaygı düzeyiniz ile şuan ki öğretim kaygı düzeyinizi karşılaştırın. Değişiklik oldu mu? Olduysa sebebi ne olabilir? Bir değişiklik olmadıysa nedenini açıklar mısınız?

4- "Matematik" deyince aklınıza ilk ne geliyor? Neden bu şekilde düşünüyorsunuz?

5- Kendinizi matematik öğretmeye hazır hissediyor musunuz? Geleceğin okul öncesi öğretmeni olarak matematik öğretmekle ilgili sizi en çok ne/neler kaygılandırıyor?

6- Öğretmen olduğunuzda, sınıfınızda matematiksel etkinliklere haftalık ders programınızda ne sıklıkta yer vermek istersiniz?

7- a) Okul öncesi dönem çocuklarına matematik öğretmek için, sahip olduğunuz matematik bilgisinin ne derece yeterli olduğunu düşünüyorsunuz?

b) Eğer bilginizi yeterli görmüyorsanız ne kadar matematik bilgisine ihtiyacınız olduğunu düşünüyorsunuz? Sizce hangi konularda, ne tür bilginiz olmalı?

8- Stajınız süresince, matematik öğretirken en unutulmaz anınızı tanımlayın. Bunu neden unutamadınız?

9- Çalışacağınız okuldaki çocukların matematik kaygısına sahip olduğunu düşünün. Bu kaygının üstesinden gelmeyi nasıl başarabilirsiniz?

10- Bir çocuk sizce matematikten neden korkar?

11- ECE213 sizin matematik kaygınızı azaltmanıza yardımcı oldu mu? Nasıl? Neden? Kaygınız da artışa neden oldu mu? Nasıl? Neden?

12- ECE213' ü almadan önceki matematik hakkındaki görüşleriniz ve duygularınız ile bu dersi aldıktan sonraki matematik görüşünüz ve duygularınız arasında nasıl bir değişiklik oldu? Neden? Değişiklik olmadıysa da sebebi ne olabilir?

13- ECE213 dersini almadan önceki öğrenim hayatınızda matematiğin günlük hayatımızla ilişkisi hakkında ne düşünüyordunuz? Şu an ne düşünüyorsunuz?

14- Eğer siz bu dersin hocası olsaydınız, bu dersin daha etkili olması için neler yapardınız?

15- a) ECE213'ün içeriğini düşünerek ileriye yönelik okul öncesinde matematik eğitimiyle ilgili başka bir ders almayı düşünür müsünüz? Neden?

b) Bu dersi almanız dönem açısından sizce uygun muydu? Daha önce ya da daha sonra mı almak isterdiniz? Neden?

APPENDIX K: INTERVIEWS

Görüşme Soruları A

(Hem Matematik Kaygısı Hem de Matematik Öğretimi Kaygı Düzeyi Yüksek Olanlar İçin)

1) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik kaygı düzeyini ..... olarak işaretlemiştin. Şimdi sana bu kaygı düzeyini daha iyi anlamak için birkaç soru sormak istiyorum:

a) Matematik diyince aklına hangi düzeydeki matematik geliyor? Neden?
b) Lisedeki matematik derslerin nasıldı? Mat1 ve Mat2 yi hatırlıyor musun?
c) Mat1 ve Mat 2 hakkında ne düşünüyorsun?

Sen bu kaygının nedenini de ..... olarak belirtmiştin.

d) Bu nedeni biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi? Bunlar bir olay, durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

2) " Matematik Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence "matematik kaygısı" ne olabilir?

3) Bu kaygının ne zaman başladığını düşünüyorsun? Hatırladığın, aklında yer eden bir olay var mı?

4) Matematik kaygını arttıran etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

5) Matematik kaygını azaltan etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

6) Matematik kaygını artıran belirli bir konu var mı? (Mesela örüntüler, üç boyut kavramı, problemler..vs.)

7) Genel olarak matematik hakkında ne hissediyorsun?

a. Matematik sende ne tip hisler uyandırıyor? (*Kabus, sıkıcı, zor, acı verici, eğlenceli, kolay, zevkli…vs.)*Dilersen bir şeye benzetebilirsin.

8) "Matematik Öğretimi Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence " matematik öğretimi kaygısı" ne olabilir?

9) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik öğretimi kaygı düzeyini ..... olarak işaretlemiştin ve bunun nedenini de ..... olarak belirtmiştin. Bu nedeni biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi?

10) Bu kaygının ne zaman başladığını düşünüyorsun? Hatırladığın, aklına yer eden bir olay var mı?

11) Matematik öğretimi kaygını arttıran etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

12) Matematik öğretimi kaygını azaltan etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

13) Matematik öğretimi kaygı düzeyini artıran belirli bir konu var mı? (Mesela örüntüler, üç boyut kavramı, problemler..vs.)

Şimdi biraz okul öncesi dönem matematiği hakkındaki düşüncelerini öğrenmek istiyorum:

14) Okul öncesi öğretmen adayı olarak 'okul öncesi dönem matematiği' hakkında ne düşünüyorsun?

a. Bu dönemdeki çocuklar matematiği öğrenmeli mi?
b. Öyle ise nasıl öğrenmeliler?
c. Nasıl bir matematik öğretilmeli bu dönemdeki çocuklara?

15) Daha önce bir çocuğa hiç matematik öğrettin mi? O zaman, matematik öğretirken yaşadığın duygularını tanımlayabilir misin? (Öğretmediysen, neler yaşayabilirsin hakkındaki fikirlerini merak ediyorum.)

a. Kendini matematik öğretmeye hazır hissediyor musun? Neden?
b. Günlük hayatta matematiği kullandığını düşünüyor musun? Nerede?

16) Okul öncesi dönemde matematik öğrettiğini düşünelim:

a. Bu dersi almadan önce, bu dönem çocuklarına matematik öğretmek konusunda ne hissediyordun? Kendine güveniyor muydun?
b. Şu anda kendine güveniyor musun? Matematik öğretmek konusunda şu anki hislerin neler?
c. İleride, öğretmen olduğunda matematik öğrettiğini düşündüğünde kendine güveniyor musun?

17) Bu dersi (ECE 213) düşündüğünde (derse gelirken, ders sırasında, etkinlikleri hazırlarken, etkinlikler sırasında) kaygılanıyor musun? Neden? (Kaygılanmıyor musun? Neden?)

18) ECE 213'ün okul deneyimi derslerinde yaptırdığın matematik etkinliklerine katkısı olduğunu düşünüyor musun? Nasıl?

19) Soracağımı düşündüğün, matematik ve/veya matematik kaygısı hakkında ya da ECE 213 dersi hakkında söylemek istediğin ama sormadığım bir şey var mı? Şimdi söylemek ister misin?

Görüşme Soruları B

(Hem Matematik Kaygısı Hem de Matematik Öğretimi Kaygı Düzeyi Düşük Olanlar İçin)

1) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik kaygı düzeyini ..... olarak işaretlemiştin. Şimdi sana bu kaygı düzeyini daha iyi anlamak için birkaç soru sormak istiyorum:

a) Matematik diyince aklına hangi düzeydeki matematik geliyor? Neden?
b) Lisedeki matematik derslerin nasıldı? Mat1 ve Mat2 yi hatırlıyor musun?
c) Mat1 ve Mat 2 hakkında ne düşünüyorsun?

Sen bu düşük kaygının nedenini de ..... olarak belirtmiştin.

d) Bu nedeni biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

2) " Matematik Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence "matematik kaygısı" ne olabilir?

3) Genel olarak matematik hakkında ne hissediyorsun?

a. Matematik sende ne tip hisler uyandırıyor? (*Kabus, sıkıcı, zor, acı verici, eğlenceli, kolay, zevkli…vs.)*Dilersen bir şeye benzetebilirsin.

4) "Matematik Öğretimi Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence " matematik öğretimi kaygısı" ne olabilir?

5) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik öğretimi kaygı düzeyini ..... olarak işaretlemiştin ve bunun nedenini de ..... olarak belirtmiştin. Bu nedeni (düşük kaygılı olma) biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

Şimdi biraz okul öncesi dönem matematiği hakkındaki düşüncelerini öğrenmek istiyorum:

6) Okul öncesi öğretmen adayı olarak ‘okul öncesi dönem matematiği’ hakkında ne düşünüyorsun?

- **a.** Bu dönemdeki çocuklar matematiği öğrenmeli mi?
- **b.** Öyle ise nasıl öğrenmeliler?
- **c.** Nasıl bir matematik öğretilmeli bu dönemdeki çocuklara?

7) Daha önce bir çocuğa hiç matematik öğrettin mi? O zaman, matematik öğretirken yaşadığın duygularını tanımlayabilir misin? (Öğretmediysen, neler yaşayabilirsin hakkındaki fikirlerini merak ediyorum.)

- **a.** Kendini matematik öğretmeye hazır hissediyor musun? Neden?
- **b.** Günlük hayatta matematiği kullandığını düşünüyor musun? Nerede?

8) Okul öncesi dönemde matematik öğrettiğini düşünelim:

- **a.** Bu dersi almadan önce, bu dönem çocuklarına matematik öğretmek konusunda ne hissediyordun? Kendine güveniyor muydun?
- **b.** Şu anda kendine güveniyor musun? Matematik öğretmek konusunda şu anki hislerin neler?
- **c.** İleride, öğretmen olduğunda matematik öğrettiğini düşündüğünde kendine güveniyor musun?

9) Bu dersi (ECE 213) düşündüğünde (derse gelirken, ders sırasında, etkinlikleri hazırlarken, etkinlikler sırasında) kaygılanıyor musun? Neden? (Kaygılanmıyor musun? Neden?)

10) ECE 213’ün okul deneyimi derslerinde yaptırdığın matematik etkinliklerine katkısı olduğunu düşünüyor musun? Nasıl?

11) Soracağımı düşündüğün, matematik ve/veya matematik kaygısı hakkında ya da ECE 213 dersi hakkında söylemek istediğin ama sormadığım bir şey var mı? Şimdi söylemek ister misin?

Görüşme Soruları C

(Matematik Kaygısı Yüksek; Matematik Öğretimi Kaygı Düzeyi Düşük Olanlar İçin)

1) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik kaygı düzeyini ..... olarak işaretlemiştin. Şimdi sana bu kaygı düzeyini daha iyi anlamak için birkaç soru sormak istiyorum:

a) Matematik diyince aklına hangi düzeydeki matematik geliyor? Neden?
b) Lisedeki matematik derslerin nasıldı? Mat1 ve Mat2 yi hatırlıyor musun?
c) Mat1 ve Mat 2 hakkında ne düşünüyorsun?

Sen bu kaygının nedenini de ..... olarak belirtmiştin.

d) Bu nedeni biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi? Bunlar bir olay, durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

2) " Matematik Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence "matematik kaygısı" ne olabilir?

3) Bu kaygının ne zaman başladığını düşünüyorsun? Hatırladığın, aklında yer eden bir olay var mı?

4) Matematik kaygını arttıran etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

5) Matematik kaygını azaltan etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

6) Matematik kaygını artıran belirli bir konu var mı? (Mesela örüntüler, üç boyut kavramı, problemler..vs.)

7) Genel olarak matematik hakkında ne hissediyorsun?

a. Matematik sende ne tip hisler uyandırıyor? (*Kabus, sıkıcı, zor, acı verici, eğlenceli, kolay, zevkli…vs.)*Dilersen bir şeye benzetebilirsin.

8) "Matematik Öğretimi Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence " matematik öğretimi kaygısı" ne olabilir?

9) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik öğretimi kaygı düzeyini ..... olarak işaretlemiştin ve bunun nedenini de ..... olarak belirtmiştin. Bu nedeni (düşük kaygılı olma) biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

Şimdi biraz okul öncesi dönem matematiği hakkındaki düşüncelerini öğrenmek istiyorum:

10) Okul öncesi öğretmen adayı olarak 'okul öncesi dönem matematiği' hakkında ne düşünüyorsun?

- **a.** Bu dönemdeki çocuklar matematiği öğrenmeli mi?
- **b.** Öyle ise nasıl öğrenmeliler?
- **c.** Nasıl bir matematik öğretilmeli bu dönemdeki çocuklara?

11) Daha önce bir çocuğa hiç matematik öğrettin mi? O zaman, matematik öğretirken yaşadığın duygularını tanımlayabilir misin? (Öğretmediysen, neler yaşayabilirsin hakkındaki fikirlerini merak ediyorum.)

- **a.** Kendini matematik öğretmeye hazır hissediyor musun? Neden?
- **b.** Günlük hayatta matematiği kullandığını düşünüyor musun? Nerede?

12) Okul öncesi dönemde matematik öğrettiğini düşünelim:

- **a.** Bu dersi almadan önce, bu dönem çocuklarına matematik öğretmek konusunda ne hissediyordun? Kendine güveniyor muydun?
- **b.** Şu anda kendine güveniyor musun? Matematik öğretmek konusunda şu anki hislerin neler?
- **c.** İleride, öğretmen olduğunda matematik öğrettiğini düşündüğünde kendine güveniyor musun?

13) Bu dersi (ECE 213) düşündüğünde (derse gelirken, ders sırasında, etkinlikleri hazırlarken, etkinlikler sırasında) kaygılanıyor musun? Neden? (Kaygılanmıyor musun? Neden?)

14) ECE 213'ün okul deneyimi derslerinde yaptırdığın matematik etkinliklerine katkısı olduğunu düşünüyor musun? Nasıl?

15) Soracağımı düşündüğün, matematik ve/veya matematik kaygısı hakkında ya da ECE 213 dersi hakkında söylemek istediğin ama sormadığım bir şey var mı? Şimdi söylemek ister misin?

Görüşme Soruları D

(Matematik Kaygısı Düşük; Matematik Öğretimi Kaygı Düzeyi Yüksek Olanlar İçin)

1) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik kaygı düzeyini ..... olarak işaretlemiştin. Şimdi sana bu kaygı düzeyini daha iyi anlamak için birkaç soru sormak istiyorum:

a) Matematik diyince aklına hangi düzeydeki matematik geliyor? Neden?
b) Lisedeki matematik derslerin nasıldı? Mat1 ve Mat2 yi hatırlıyor musun?
c) Mat1 ve Mat 2 hakkında ne düşünüyorsun?

Sen bu düşük kaygının nedenini de ..... olarak belirtmiştin.

d) Bu nedeni biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

2) " Matematik Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence "matematik kaygısı" ne olabilir?

3) Genel olarak matematik hakkında ne hissediyorsun?

a. Matematik sende ne tip hisler uyandırıyor? (*Kabus, sıkıcı, zor, acı verici, eğlenceli, kolay, zevkli…vs.)*Dilersen bir şeye benzetebilirsin.

4) "Matematik Öğretimi Kaygısı" sözcüğünü duyunca ne hissediyorsun? Sence " matematik öğretimi kaygısı" ne olabilir?

5) Dönemin başında sınıfta yaptığınız "Matematik ve Ben 1" de sormuş olduğum ilk soruda 1 den 10 a kadar olan derecelendirmede, matematik öğretimi kaygı düzeyini ..... olarak işaretlemiştin ve bunun nedenini de ..... olarak belirtmiştin. Bu nedeni biraz açıklar mısın? Daha sonra düşündüğünde aklına başka sebepler geldi mi?

6) Bu kaygının ne zaman başladığını düşünüyorsun? Hatırladığın, aklına yer eden bir olay var mı?

7) Matematik öğretimi kaygını arttıran etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

8) Matematik öğretimi kaygını azaltan etkenler nelerdir? Bunlar bir olay, bir durum, bir kişi olabilir, ya da başka şeyler. Bunlardan bahsedebilir misin?

9) Matematik öğretimi kaygı düzeyini artıran belirli bir konu var mı? (Mesela örüntüler, üç boyut kavramı, problemler..vs.)

Şimdi biraz okul öncesi dönem matematiği hakkındaki düşüncelerini öğrenmek istiyorum:

10) Okul öncesi öğretmen adayı olarak 'okul öncesi dönem matematiği' hakkında ne düşünüyorsun?

- **a.** Bu dönemdeki çocuklar matematiği öğrenmeli mi?
- **b.** Öyle ise nasıl öğrenmeliler?
- **c.** Nasıl bir matematik öğretilmeli bu dönemdeki çocuklara?

11) Daha önce bir çocuğa hiç matematik öğrettin mi? O zaman, matematik öğretirken yaşadığın duygularını tanımlayabilir misin? (Öğretmediysen, neler yaşayabilirsin hakkındaki fikirlerini merak ediyorum.)

- **a.** Kendini matematik öğretmeye hazır hissediyor musun? Neden?
- **b.** Günlük hayatta matematiği kullandığını düşünüyor musun? Nerede?

12) Okul öncesi dönemde matematik öğrettiğini düşünelim:

- **a.** Bu dersi almadan önce, bu dönem çocuklarına matematik öğretmek konusunda ne hissediyordun? Kendine güveniyor muydun?
- **b.** Şu anda kendine güveniyor musun? Matematik öğretmek konusunda şu anki hislerin neler?
- **c.** İleride, öğretmen olduğunda matematik öğrettiğini düşündüğünde kendine güveniyor musun?

13) Bu dersi (ECE 213) düşündüğünde (derse gelirken, ders sırasında, etkinlikleri hazırlarken, etkinlikler sırasında) kaygılanıyor musun? Neden? (Kaygılanmıyor musun? Neden?)

14) ECE 213'ün okul deneyimi derslerinde yaptırdığın matematik etkinliklerine katkısı olduğunu düşünüyor musun? Nasıl?

15) Soracağımı düşündüğün, matematik ve/veya matematik kaygısı hakkında ya da ECE 213 dersi hakkında söylemek istediğin ama sormadığım bir şey var mı? Şimdi söylemek ister misin?

APPENDIX L: ETHICAL COMMITTEE APPROVAL OF METU

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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06.11.2013

Gönderilen : Y. Doç. Dr. Çiğdem Haser
İlköğretim

Gönderen : Prof. Dr. Canan Özgen
IAK Başkanı

İlgi : Etik Onayı

Danışmanlığını yapmış olduğunuz İlköğretim Bölümü öğrencisi Deniz Mehmetlioğlu'nun "Okul Öncesi Öğretmen Adaylarının Matematik Kaygılarının İncelenmesi" isimli araştırması "İnsan Araştırmaları Komitesi" tarafından uygun görülerek gerekli onay verilmiştir.

Bilgilerinize saygılarımla sunarım.

Etik Komite Onayı

Uygundur

06/11/2013

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

APPENDIX M: TURKISH SUMMARY

Matematik becerilerinin küçük yaşlarda kazandırılması çocuklar için önemli olduğundan (Polat-Unutkan, 2007), okul öncesinde matematik eğitimi, araştırmalarda giderek artan bir ilgi kaynağı olmaktadır (Aydın, 2009). Matematik öğretiminin eğitimde önemli bir yeri olmasına rağmen (Sutherland, 1992), okul öncesi öğretmenleri çocuklara matematik öğretirken her zaman rahat olamayabilirler (Clement ve Sarama, 2007). Çocuklarla çalışan birçok öğretmen, matematiği zor, karışık, çetin, sıkıcı, korkutucu ya da acı verici gibi öğretmenlerin uygulamalarını etkileyebilecek ve çocukların uzun vadede matematik başarılarına zarar verebilecek şekilde olumsuz sözcüklerle tanımlamışlardır (Pound, 2006).

Öğretmen eğitimi programlarının, öğretmen adaylarının gelecekteki öğretimlerini ve sınıftaki eğilimlerini etkilemedeki önemi göz önünde tutulursa, bu çalışma okul öncesi öğretmen adaylarının, *Okul Öncesinde Matematik Öğretimi* dersini almadan önce ve aldıktan sonraki matematik kaygısı ve matematik öğretimi kaygısını ve nedenlerini incelemeyi amaçlamaktadır. Buna ek olarak, onların matematikle ilgili imge ve duyguları da dersten önce ve sonra incelenmiştir.

Duyuşsal alanda, matematik kaygısı karşılaşılan en yaygın sorundur (Baloğlu ve Koçak, 2006). Çocuklar matematiği eğlenceli olarak görürlerse, kaygıları azalır ve bu memnuniyetleri muhtemelen hayatları boyunca devam edebilir (Das ve Das, 2013). Kaygılı olan insanlar matematikle ilgili derslerden, matematikle ilgili aktivitelerden kaçınabilirler. Matematik kaygısı, öğretmenlerden ve onların öğretiminden kaynaklanmaktadır (Vinson, 2001). Öğrencilerin öğrenimini (Ma, 1999) ve öğretmenlerin öğretimdeki verimini etkilemektedir (Işıksal, Curran, Koç ve Aşkun, 2009).

Matematik kaygısına, kişisel, çevresel ve zihinsel sebepler yol açmaktadır (Trujillo ve Hadfield, 1999). Utanma duygusu yüzünden soru sorulduğunda isteksiz olma, düşük öz-saygı, ve özellikle kızlar için matematiği erkek egemen olarak görmek kişisel sebepleri oluşturmaktadır (Trujillo ve Hadfield, 1999). Çevresel sebepler, sınıftaki olumsuz deneyimler, ailenin isteği, duygusuz öğretmenler, kural ve formülleri ezberlemeyi, uzun hesaplamalar yapmayı ve sayılarla uğraşmayı içeren geleneksel öğretim yöntemlerinin kullanılmasıyla ilgilidir (İdris, 2006). Diğer taraftan, zihinsel sebepler ise, matematiğin yararının farkında olamama, öğrencilerin tutumu, matematik yeteneğinde yetersiz güven, sebat ve öğrenme biçimlerini yanlış bilmeden kaynaklanmaktadır (Trujillo ve Hadfield, 1999).

Peker (2006) matematik öğretimi kaygısını "Öğretmenlerin matematiksel kavram, teorem, formül veya problem çözme öğretiminde yaşadıkları gerginlik ve kaygı duygusu olarak" tanımlamıştır (s.77). Diğer bir deyişle, bir kişinin matematik öğretimi kaygısı, onun matematik öğretme yeteneği hakkında kaygı duyma hissi anlamına gelmektedir. Matematik kaygısından farklı olarak, bu kaygı türü matematik öğretirken görülür. Öğretmen adayları arasında matematik öğretimi kaygısına sıkça rastlanır (Levine, 1993). Konuların zorluğu, yetersiz alan bilgisi, öğretmenlik mesleğine az ilgi ve öğrencilerin gelişim süreçlerini düşünmeksizin yapılan uygun olmayan öğretim türü öğretmen adayları ve hizmet içi öğretmenlerin matematik öğretimi kaygısının sebepleri olabilir (Peker, 2009). Halbuki, öğretmen adaylarının matematik öğretimi kaygısıyla ve onun matematik kaygısıyla ilişkisi hakkında çok az şey bilinmektedir (Haciomeroglu, 2014). Bu ilişkiyi ve öğretmen adayları üzerindeki etkisini inceleyen çok az çalışma vardır (Brown, Westenskow ve Moyer-Packenham, 2012; Peker ve Ertekin, 2011).

Kuramsal Çerçeve

Çalışmadaki kuramsal çerçeve, duygu, matematik kaygısı ve nedensellik yükleme teorisine dayanmaktadır.

Matematik imgeleri, matematik öğretimini ve öğrenimini olumlu ve olumsuz şekilde etkileyebilir (Belbase, 2013). Bireyler, iyi ya da kötü bir ruh halinde olabilir veya iyi ve kötü duygulara sahip olabilirler. Ruh hallerinin altında yatan nedenlerin farkında

olmayabilirler, fakat duygularının altında yatan sebepler bilinir (Forgas, 2000). Matematik eğitiminin duyuşsal alanında, matematikle ilgili tutum ve inanışlara nazaran, duygular çalışılması kolay olmadığı ve duyuşsal alanın en az istikrarlı bileşeni olduğundan (Hannula, 2011; Martínez-Sierra ve García González, 2014) daha az dikkat çekmektedir (Hannula, 2011). Ancak, duygular matematik öğrenme sürecinin ve öğretiminin önemli bir parçasıdır (McLeod, 1992; Zan vd., 2006).

Weiner (1986), nedensellik yükleme teorisinin insanların olayları nasıl yorumladıkları ve onları nasıl düşüncelerine ve davranışlarına bağladıklarıyla ilgili olduğunu belirtir. Ona göre yapılan yüklemeler durağanlık (kalıcılık), denetimin kaynağı ve kontrol edilebilirlik olmak üzere üç boyutta incelenebilir. Nedensellik yükleme teorisi ışığında, okul öncesi öğretmen adaylarının kaygılarını matematikteki başarı ve başarısızlıklarına atfettikleriyle incelenecektir.

Okullardaki matematik öğretiminin kalitesi, okul öncesi öğretmen adaylarının ve sınıf öğretmenlerinin uygulamalarıyla ilgilidir (Battista, 1990). Matematik öğrenimi ve öğretiminde, matematik kaygısı en önemli problem olarak bulunmuştur (Battista, 1990). Matematik kaygısı, öğrenmeyi etkilendiğinden (Martinez, 1987), yüksek matematik kaygısına sahip öğretmenler olumsuz hislerini bilinçsizce öğrencilerine aktarabilirler (Tobias, 1998; Vinson, 2001; Wood 1988). Düşük matematik kaygısına sahip sınıf öğretmenlerinin aksine, yüksek matematik kaygısına sahip öğretmenler, matematikle ilgili etkinlikleri yapma ve planlamaya az vakit ayırırlar (Swetman, Munday ve Windham, 1993).

Genellikle matematik kaygısıyla ilgili çalışmalar sınıf öğretmeni adaylarıyla yapılmıştır (Işıksal, Curran, Koç ve Aşkun, 2009) ve oldukça az çalışmada okul öncesi öğretmenlerine odaklanılmıştır (Ginsburg, Lee ve Boyd, 2008). Eğer matematik öğrenmeye yeterli önem verilmezse ve okul öncesi öğretmenleri etkili matematik öğretmeni olarak yetiştirilmezse, matematikten uzak durmaya devam edecekler, verimsiz uygulamalar gerçekleştirecekler ve sonunda bu durum çocukların zayıf performansıyla sonuçlanacaktır (Stipek, 2008).

Okul öncesi öğretmen adaylarının matematik kaygısının ve matematik öğretimi kaygısının araştırılmasına ihtiyaç vardır. Matematik öğretimi kaygısı, matematik öğretimiyle ilgilidir ve öğretmen adayları arasında çok sık karşılaşılır (Levine, 1993). Bu yüzden de, mesleğe başlamadan matematik öğretimi kaygısının düşürülmesi, matematik öğretiminde başarılı ve kendine güvenen öğretmen adaylarının yetiştirilmesi için önemlidir (Peker, 2006).

Araştırma Soruları

Bu çalışmanın amacı, okul öncesi öğretmen adaylarının *Okul Öncesinde Matematik Öğretimi* dersini almadan önce ve aldıktan sonraki matematik kaygılarını ve matematik öğretimi kaygılarını; matematikle ilgili imgelerini ve duyguları; ve matematik ve matematik öğretimi kaygılarının nedenlerini ders süresince inceleyerek betimlemektir. Aşağıdaki araştırma soruları bu çalışmaya yön vermiştir:

1- Okul öncesi öğretmen adaylarının matematikle ilgili imge ve duygularını ders nasıl etkilemektedir?
   a) Okul öncesi öğretmen adaylarının, *Okul Öncesinde Matematik Öğretimi* dersini almadan önce matematikle ilgili imge ve duyguları nelerdir?
   b) Okul öncesi öğretmen adaylarının, *Okul Öncesinde Matematik Öğretimi* dersini aldıktan sonra matematikle ilgili imge ve duyguları nelerdir?
2- Ders, okul öncesi öğretmen adaylarının matematik kaygısını nasıl etkilemektedir?
   a) Ders, okul öncesi öğretmen adaylarının matematik kaygısı düzeylerini nasıl etkilemektedir?
   b) Okul öncesi öğretmen adaylarının matematik kaygısının sebepleri nelerdir?
3- Ders, okul öncesi öğretmen adaylarının matematik öğretimi kaygısını nasıl etkilemektedir?
   a) Ders, okul öncesi öğretmen adaylarının algıladıkları matematik öğretimi kaygı düzeylerini nasıl etkilemektedir?
   b) Ders, okul öncesi öğretmen adaylarının matematik öğretimi kaygısının sebeplerinin nasıl etkilemektedir?

c) Okul öncesi öğretmen adaylarının matematik öğretimi kaygısını etkileyen anahtar konumundaki ders deneyimleri nelerdir?

4- Okul öncesi öğretmen adaylarının matematik kaygısıyla matematik öğretimi kaygısı nasıl ilişkilidir?

Okul öncesinde matematik sadece sayma ve toplamadan ibaret değildir. Çocukların ilgilendiği sayma, sıralama, örüntü, şekiller, ölçme ve tahmin etme gibi birçok konu vardır (Clement, 2001). Bu yüzden de öğretmenler çocuklara anlamlı ve zengin matematik deneyimleri sağlamalıdır. Dahası, olumlu şekilde öğretim aynı zamanda öğrencilerin matematik öğrenmeye karşı olumlu eğilimleri açısından da önemlidir. Birçok okul öncesi öğretmen adayı ve hizmet içi öğretmen, matematiği sevmemekte, korkmakta ve matematik öğretmek istememektedir (Ginsburg, Lee ve Boyd, 2008). Onlardaki yetersiz ilgi ve matematiğin öneminin farkına varamama, öğretmenini örnek alan çocuklar için zararlı olabilir (Hachey, 2009).

Matematik kaygısının birçok tanımı vardır. Hem bilişsel hem duyuşsal öğeleri içerir (Ashcraft ve Faust, 1994; Bessant, 1995). Yüksek matematik kaygısına sahip olanlar, matematikle ilgili az seçmeli ders alırlar ve sınavlarda düşük not alırlar. Matematik yetenekleriyle ilgili tutum ve algıları olumsuzdur (Ashcraft ve Moore, 2009). Yüksek matematik kaygısı hem duygusal hem fiziksel huzursuzluğa yol açar ve meslek seçimini etkiler (Hendel, 1980). Matematik kaygısının sebeplerinin farklı sınıflandırılma şekilleri vardır, fakat en yaygın sınıflandırma, çevresel, zihinsel ve kişisel sebeplerden oluşmaktadır (Hadfield ve McNeil, 1994).

Matematik kaygısına nazaran matematik öğretimi kaygısından alanyazında çok bahsedilmemektedir. Matematik kaygısı ve matematik öğretimi kaygısı ile ilgili çalışmalar, matematik öğretimiyle ilgili yöntem derslerinin bu iki kaygıyı da azaltmada etkili olduğunu göstermiştir. Bu bağlamda, matematik öğretimi kaygısına yol açan sebepleri bilmek, dersleri planlarken ve öğretim yöntemlerini öğretirken bu faktörleri anlamak ve dikkat etmek açısından önemlidir (Bates, Latham ve Kim, 2013). Bu sebepleri Brown, Westenskow and Moyer-Packenham (2012) çalışmasında sınıflandırmıştır. Bu araştırmacılar ayrıca, 2011'deki çalışmalarında sınıf öğretmeni adaylarının önceki matematik kaygıları ile matematik öğretimi

kaygıları arasındaki ilişkiyi incelemiş ve bu iki kaygının her zaman ilişkili olmadıklarını bulmuştur. Bu bağlantılar, öğretmen adaylarının başarılı matematik öğretimleri yapabilmelerine destek olmak için bilinmelidir (Brown, Westenskow ve Moyer-Packenham, 2011).

Çalışmanın deseni olgubilimdir. Kırk yedi 3. sınıf okul öncesi öğretmen adayı çalışmanın örneklemini oluşturmaktadır. Veri toplama araçları olarak üç anket, uygulamalarıyla ilgili *Yansıtıcı Düşünceler Raporu* ve *Çizim Etkinlikleri* kullanılmıştır. Bunların yanı sıra, 20 öğretmen adayıyla, matematik kaygısı, matematik öğretimi kaygısı ve özel olarak ders deneyimleri hakkında daha derin bilgi alma amacıyla görüşmeler yapılmıştır. Toplanan veri, katılımcıların araştırma sorularına verdiği cevapların benzerlik ve ilişkisine göre kendi aralarında sınıflandırılarak analiz edilmiştir.

Bulgular

Öğretmen Adaylarının Dersten Önceki Matematikle İlgili İmgeleri

Öğretmen adaylarının *Okul Öncesinde Matematik Öğretimi* dersine getirdikleri imgeler, *Okul Öncesi Öğretmen Adaylarının Matematik Hakkındaki Görüşleri Anketi (OÖAMGA)* (2. sınıfın sonunda) ve *Çizim Aktivitesi 1* ile bu dersin hemen başında ve *Çizim Aktivitesi 2* ile dersin sonunda araştırılmıştır. *OÖAMGA*'da, 41 öğretmen adayına, matematiği nasıl gördükleri, matematik ile günlük hayat ilişkisi ve matematiğin doğası hakkında ne düşündükleri ile ilgili sorular sorulmuştur. Altı öğretmen adayı uygulamanın yapıldığı gün gelmemiştir. Daha sonra, buna ek olarak, 47 öğretmen adayına, 3. sınıfın güz döneminin başında, *Okul Öncesinde Matematik Öğretimi* dersinin ilk saatinde*, Çizim Aktivitesi 1* verilerek, adaylara, "matematik nedir?"i çizmeleri istenmiştir. Bu dersin en son günü de *Çizim Aktivitesi 2* verilerek tekrar "matematik nedir?"i çizmeleri istenmiştir. *OÖAMGA* bulgularında, katılımcıların zihninde matematik ile ilgili imgelerin iki genel boyutta olduğu bulunmuştur: (i) Matematiğin yapısı ve (ii) günlük hayat ve diğer alanlarla ilişkiler.

Matematiğin yapısı:

Katılımcıların matematiğin yapısı ile ilgili imgeleri sayılar, işlemler, hesaplamalar, ezberleme (formül), problem/bulmaca ve soyut kavramlar şeklinde ortaya çıkmıştır.

OÖAMGA' da, öğretmen adaylarına matematiğin yapısı ile ilgili bir soru sorulmuş ve 26 öğretmen adayı matematiğin *durağan* yapıda olduğunu düşünerek, matematik bilgisinin çoğunlukla değişmeyeceği ve toplumsal olaylardan etkilenmeyeceği yönünde soruyu cevaplamışlardır. On üç öğretmen adayı ise, matematiğin *dinamik* yapıda olduğuna katılarak, matematik bilgisinin sürekli yenilendiğini ve toplumsal olayların bunda etkili olduğu görüşüne katılmışlardır. İki öğretmen adayı ise hiçbir görüşe katılmamıştır. Öğretmen adaylarının dersin başındaki matematik ile ilgili imgeleri, onların çizimlerine de yansımıştır. Yirmi üç öğretmen adayı, matematiği tasvir ederken, *üst düzey* formüllerden, denklemler, cebirsel ifadeler, analiz kavramları, fonksiyonlar, trigonometri gibi soyut kavramlardan bahsetmiştir.

Öğretmen adaylarının matematikle ilgili imgeleri, genelde ileri düzeydeki matematik konuları ya da hesaplamalar, sayılar ve belli yapıların ezberlenmesi şeklinde belirmiştir. Çizimlerinde problem çözümüyle ilgili imgelere rastlanmamıştır. *ÖAMGA*'da ortaya çıkan matematiğin durağan yapıda olduğu düşüncesi, öğretmen adaylarının çizimlerine matematiğin, matematiksel ifadeler ve birçok formülden ibaret olduğu şeklinde yansımıştır. Diğer taraftan, 14 katılımcı da temel kavramları kullanarak, rakamlar, şekiller, toplama ve eşleştirmeyle ilgili çizimler yapmıştır.

Günlük Hayat ve Diğer Alanlarla İlişkiler

Yirmi dört öğretmen adayı matematik ve günlük hayat ilişkili derken, 17 öğretmen adayı da ya açık bir şekilde ilişkinin yokluğundan bahsetmişler ya da hiç ilişki belirtmemişlerdir. On yedi katılımcının 12'si ilişki hakkında dolaylı cevaplar vermiştir. Bazı dolaylı cevaplarda da genellikle matematiğin üniversiteye girmek için bir gereklilik olduğu vurgulanmıştır.

Kısaca, katılımcıların matematiğin günlük hayattaki yeri ile ilgili görüşleri bir düşüncede toplanmamıştır. Bazıları, matematiğin günlük hayatla ilgili olduğunu düşünürken, diğerleri günlük hayattan uzak bir kavram olarak görmüşlerdir. Günlük hayatla ilişkilendirenlerin matematik imgeleri ise, ilişkileri hesaplamalar ve olası mesleklerle ilişkilendirmelerin ötesine gitmemiştir. Çizimlerinde de gerçek hayat ya da diğer disiplinlerle ilgili bağlantılar görülmemiştir.

Sonuç olarak, okul öncesi öğretmen adaylarının üniversiteye gelirken matematikle ilgili imgelerinin matematik bilgisinin çoğunlukla değişmeyeceği ve toplumsal olaylardan etkilenmeyeceği yönünde olduğu bulunmuştur. Matematikle ilgili imgeleri genelde, matematiğin ezberlenen formüllerden ve soyut kavramlardan oluştuğu şeklinde ortaya çıkmıştır. Bu durum aynı zamanda onların çizimlerine de yansımıştır. Öğretmen adaylarının matematik hakkındaki çizimleri üst düzey formüller, denklemler, cebirsel ifadeler, türev, integral, sayılar, hesaplamalar, sinx, cos x, ve karmaşık sayılar içermiştir. Matematik ve günlük hayat ilişkisine gelince, sadece 24 katılımcı bir ilişki olduğunu vurgulamıştır. Fakat, yine de oldukça zayıf bağlantılar kurulmuştur. Diğer katılımcılar tarafından matematik günlük hayattan uzak olarak belirtilmiştir.

Öğretmen Adaylarının Dersten Önceki Duyguları

Öğretmen adayları, matematikle ilgili duygularını matematik hakkında nasıl hissettiklerini ve bu duyguların meydana geldiği ya da geliştiği *bağlamları* çizerek ifade etmişlerdir. Bu *bağlamlar*, matematik hakkında nasıl hissettiklerinin anlaşılmasında temel oluşturmuştur. Bu yüzden de bulgular *duygusal* ifadeler ve *bağlamsal* ifadeler olmak üzere iki kısımda incelenmiştir.

Başlangıçtaki *duygusal* ifadeler

Dersin başında, 11 katılımcının matematikle ilgili olumlu duygular gösterirken, 30 katılımcının olumsuz ve 6 katılımcının da nötr duygular resmettiği görülmüştür. Olumsuz duygular, gözyaşları, şaşkın yüzler, matematiğe karşı hevesleri kıran öğrenciler, ağlayan rakamlar, soru işaretleri ile ilgili olarak resmedilmiştir. Bu katılımcılara göre, matematik eğlenceli değildi ve daha çok rahatsızlık, üzüntü ve kaygı veriyordu. Bazı katılımcılar da matematiği düşününce geçmiş öğretmenlerini hatırlamışlardır. Diğer taraftan, olumlu duyguları içeren çizimler de gözlenmiştir. Bunlarda da matematiği sevdiğini ifade eden gülen yüzler, bulmacadan zevk alır gibi matematikten zevk alan yüzleri resmedilmiştir. Olumlu duygulara sahip olan katılımcılar da matematiği düşününce akıllarına olumlu duygular getiren geçmiş

öğretmenlerini çizmişlerdir. Nötr duyguları içeren resimlerde öğretmen adayları ne olumlu ne olumsuz duygular belirtmiş, sadece gelecekteki öğretimlerine yönelik merak içinde olduklarını resmetmişlerdir.

Başlangıçtaki *bağlamsal* ifadeler

Dersin başında, öğretmen adayları ortam olarak geleneksel öğrenme ortamlarını resmetmişlerdir. Duygular için de bu sosyal *bağlamlarda* bir yetişkinin (aile bireyi ya da öğretmen) kafası karışmış bir çocuğa matematik öğretme halini çizmişlerdir. Adaylar, genellikle matematik öğrenme ortamlarını çizip, bu ortamlardaki duygularını tasvir etmişlerdir. Fiziksel ortam bazen öğrencilerin yüzü tahtaya bakan ve öğretmenin masasında oturduğu bir sınıf olarak çizilmiştir. Daha detaylı bir şekilde, katılımcılar çoğu zaman öğretmeni tahtaya soru yazan, öğrencilerin sıralarından tahtaya baktığı, "YGS" başlıklı test kitapları, formül kâğıdı, saat ve liseden alınan bir ders şeklinde resmetmişlerdir.

Öğretmen Adaylarının Dersten Sonraki Matematikle İlgili İmgeleri

Matematiksel semboller, öğretmen adaylarının çizimlerinde *temel matematik kavramları* ve *gerçek hayat bağlantıları* olarak sınıflandırılmıştır. Dersin başında öğretmen adaylarının çizimlerinde yer alan *üst düzey* formüller ve soyut kavramlar, dersin sonunda görülmemiştir. Kırk iki öğretmen adayı, okul öncesi yaş çocuklarına uygun eşleştirme, örüntü, ölçme ve grafik gibi temel matematik kavramlarını çizmiştir. Temel matematik kavramlarını çizen 42 katılımcı arasından, 29'u aynı zamanda kavramlar ve gerçek yaşam arasında bağlantılar kurmuştur. Toplamda, 32 kişi gerçek yaşam bağlantılarını resmetmiştir. Örneğin, örüntüden oluşan yorgan, alışveriş için üstünde fiyatları yazılı sebzeler, örüntü kolyesi, camı, kapısı ve çatısı üçgen, kare ve dikdörtgen gibi şekillerden oluşan ev çizmişlerdir.

Öğretmen Adaylarının Dersten Sonraki Duyguları

Sondaki *duygusal* ifadeler

Dersin sonunda *duygusal* ifadeler, olumlu ve olumsuz olmak üzere ikiye ayrılmıştır. Bu duygular, genellikle matematiği sevmek, matematikle uğraşmaktan mutluluk duymak gibi şekillerde resmedilmiştir. Diğer taraftan, 2 öğretmen adayı, stajlarında ağlayan çocukları çizerek olumsuz deneyimi resmetmişlerdir.

Sondaki *bağlamsal* ifadeler

Dersin sonunda, öğretmen adayları öğrenme ortamını gelişime uygun öğretme ve öğrenme ortamları olarak çizmiştir. Örneğin, çocukları bir halka içinde oturur şekilde ve grup olarak çalışırlarken, matematiği oyun oynayarak öğreniyorlarken ve etkinliklere istekli bir şekilde katılıyorlarken resmetmişlerdir. Test kitaplarının üstü çizilmiş; onların yerini müzik notaları, hikaye kitapları, toplar ve rakamlardan oluşan ipler almıştır. Öğretmen ise öğrencilerin ortasına yerleştirilmiştir. Matematik içeriği, onların öğreteceği matematiğe ve sınıf ortamı onların öğretim yapacağı sınıfa dönüşmüştür. Sıralar ve geleneksel öğretim ortamları kaybolmuş, onların yerine anaokulu ortamı ve düzenlemeleri ortaya çıkmıştır. Aynı zamanda, onlar bu sınıflardaki çocukları matematik öğrenmeye hevesli çocuklar olarak resmetmişlerdir.

Kısaca, katılımcıların ilk çizimlerinde olumsuz duygular genellikle lise sınıflarında, ileri derecedeki kavram ve formüllerle tasvir edilmiştir. Bu sınıfla ve yetişkin tarafından verilen eğitimle birlikte oldukça geleneksel öğrenim ortamlarını yansıtmışlardır. Katılımcılar, olumsuz duygularını, kafa karışıklıklarını ve bazen de korkularını bu ortamlarda göstermişlerdir. Bu olumsuz duyguların sebebi, katılımcıların öğretecekleri doğru matematik bilgisine yeterli derecede sahip olmamaları ve derse gelirken getirdikleri imgeler olabilir.

Dersin sonunda, katılımcılar matematikle ilgili olumlu duygular sergilemiş ve okul öncesi sınıf ortamlarını düşünmeye başlamışlardır. Dersin başında matematik öğretimiyle ilgili hiç bir duygu ve ortamı resmedememişken, dersin sonunda okul öncesi ortamları ve okul öncesi öğretmenlerini resmetmişlerdir. Bu okul öncesi ortamlarda öğreten kişi ve öğrenen çocuk olarak kendilerini çizmişlerdir.

Katılımcıların soyut matematik kavramlarıyla ilgili olarak ortaya çıkan korku, üzüntü ve kaygı şeklinde resmettikleri olumsuz duygularının dersin sonunda değişmediği düşünülmektedir. Ancak, katılımcılar dersten sonra matematiğe ve matematiğin nasıl öğretilip öğrenildiğine, dersten önce sahip olmadıkları farklı bir perspektiften bakmaya başlamışlardır. Yeni oluşan bu imgeler, dersin sonunda daha güçlü olarak gözlenmiş ve katılımcılar daha önce var olan olumsuz duygularıyla birlikte ifade ettikleri imgelerden ziyade bu imgelere daha çok odaklanmışlardır.

Dersin Öğretmen Adaylarının Matematik Kaygısı Üzerine Etkisi

Adaylara, dersin başında *Matematik ve Ben 1* anketi uygulanmıştır. Bu ankette, 1 den 10 'a kadar numaralandırılmış ölçekte öğretmen adayları, kendi matematik öğretimi kaygı düzeylerini derecelendirmişlerdir. Ölçekte, 1 en az matematik kaygısını gösterirken, 10 en çok matematik kaygısını göstermiş, öğretmen adaylarından 5'i işaretleyenler ise, orta dereceli matematik kaygılı adaylar olarak belirlenmiştir. Benzer şekilde, dersin sonunda öğretmen adaylarının son kaygı düzeylerini belirlemek üzere *Matematik ve Ben 3* anketi verilmiştir.

Öğretmen Adaylarının Dersin Başındaki ve Sonundaki Matematik Kaygı Düzeyleri:

Öğretmen adaylarından matematik kaygı düzeyini 1'den 4'e kadar işaretleyenler düşük matematik kaygılı, 6'dan 10'a kadar işaretleyenler yüksek matematik kaygılı ve 5' i işaretleyenler orta derece matematik kaygılı olarak değerlendirilmiştir. Dersin başındaki ve sonundaki matematik kaygı düzeyleri incelenince, matematik kaygısının çok değişmediği, fakat öğretmen adaylarının iki uygulamada verdikleri cevap sırasında düşündükleri matematiğin farklılık gösterdiği görülmüştür. Yüksek kaygılı 8 öğretmen adayı ve düşük kaygılı 26 öğretmen adayı hem başta hem sonda matematik kaygı düzeylerini korumuşlardır. Diğer taraftan, 12 öğretmen adayının dersin sonunda farklı düzeyde matematik düzeyini işaretledikleri görülmüştür. Dört öğretmen adayının matematik kaygı düzeyleri düşükten yükseğe çıkarken, 5 öğretmen adayının matematik kaygı düzeyi yüksekten düşüğe bir düşüş göstermiştir.

Toplamda, 35 öğretmen adayının matematik kaygı düzeyi, dersin sonunda aynı kalmıştır.

Dersin sonunda, öğretmen adaylarının matematik kaygılarının sebeplerinde değişiklikler olduğu görülmüştür. On sekiz katılımcının 11'i farklı sebeplerden bahsetmiştir. Dersin sonunda matematik kaygısı yüksekten düşüğe kayan dört katılımcı da farklı sebepleri ifade etmiştir. Bu dört aday, dersin başında yüksek matematik kaygısı olarak lise matematiğini, dersin sonunda ise düşük matematik kaygısı olarak oldukça daha düşük düzeylerdeki matematiği düşünmüşlerdir.

Bu bulgular, dersin, adayların matematik kaygı düzeyleri üzerinde etkisi olmadığını göstermiştir. Bunun sebebi öğretmen adaylarının matematik kaygılarının okul öncesi öğretmenliği programına gelmeden önce aldıkları eğitimde gelişmiş ve sağlamlaşmış olmasıdır. Dersin sonundaki matematik düzeylerindeki değişiklik, onların bir şekilde farklı bir matematiği düşünmelerinden kaynaklanmaktadır. Ders, bu bağlamda adayların farklı açıdan matematiğe bakmasını sağlamış ve bu da onların matematik kaygılarını etkileyerek, dersin sonunda matematik kaygı düzeylerinde değişiklikler ortaya çıkarmıştır.

Matematik Kaygısının Nedenleri

Dersin başında, öğretmen adaylarının matematik kaygısını daha iyi anlamak için bu kaygıya yol açan nedenler *Matematik ve Ben 1* ile sorulmuştur. Buna ek olarak, kaygının nedenlerini araştırırken, dersin sonunda öğretmen adaylarının, kendi matematik geçmişlerinden bahsettikleri *Yansıtıcı Düşünceler Raporundan* da yararlanılmıştır.

Yüksek Matematik Kaygısının Nedenleri

Çalışmanın başında, yüksek kaygılı 13 öğretmen adayı bulunmakta idi. Yüksek matematik kaygısına yol açan sebepler analiz edildiğinde, iki ana sebep bulunmuştur:

Durumsal ve Zihinsel sebepler. Bu sebepler, bir takım değişikliklerle alan yazına yansımış sebeplerin sınıflandırılmasını genellikle yansıtmaktadır.

Durumsal sebepler, algılanan olumsuz öğretmenlerinin özelliklerinin, önceden aldığı derslerin, sınıf arkadaşlarının ve ailenin etkisini içermiştir. Zihinsel sebepler ise, algılanan matematik bilgisinin zorluğu, matematik yeteneğine güven eksikliği, olumsuz tutum ve sınıfta öğretilen yetersiz matematik alan bilgisi olarak bulunmuştur. Beş öğretmen adayı, yüksek matematik kaygısını durumsal sebeplere bağlamışlardır. Adayların çoğu, matematikle ilgili üniversite öncesi geçmiş kötü deneyimlere sahip olduklarını ve bunların çoğunu öğretmenlerine bağladıklarını belirtmişlerdir. Kaygılarının nedeni olarak, etkili olmayan öğretmenlerinin yanı sıra, aileleri, sınıf arkadaşları ve matematiğin zor olduğuna dair genel anlayıştan bahsetmişlerdir. Kötü geçmiş deneyimler, adaylarda matematik kaygısına neden olmuştur ve bunlar aile ve toplum baskısıyla birleştiğinde adaylar için matematik kaygısı giderek güçlenmiştir.

Sekiz öğretmen adayı, yüksek matematik kaygısını zihinsel sebeplere bağlamıştır. Bazı adaylar, lise yıllarındaki yüksek matematiğin zorluğundan bahsederek lise eğitimi sırasında aldıkları Matematik 2 dersindeki soyut ve karmaşık konuların yüksek matematik kaygısına yol açtığını belirtmişlerdir. Matematikteki tüm formülleri ezberlemek zorunda olduklarını hissettikleri için, matematik dersleri onlarda hoş olmayan deneyimlere dönüşmüştür. Matematiğe giderek yabancılaşmışlar ve matematik hakkındaki yetenekleriyle ilgili ön yargılar geliştirmişlerdir. Dahası, yetersiz başarı ve yetersiz matematik alan bilgisi, matematiğe karşı az ilgi uyandırmış ve bunlar da adaylarda yüksek matematik kaygısına yol açmıştır.

Düşük Matematik Kaygısının Nedenleri

Düşük matematik kaygısının nedenleri de iki kategoride toplanmıştır: Durumsal ve zihinsel sebepler. Durumsal sebepler, öğretmenlerinin algılanan olumlu özelliklerinin, önceden alınan derslerin ve ailenin etkisi şeklinde bulunmuştur.

Nitelikli öğretmenlere sahip olmak katılımcıları olumlu şekilde etkilemiş ve yüksek matematik kaygısı geliştirmemişlerdir. Dahası, ailenin de matematik öğrenimi üzerinde olumlu bir etkisi olmuştur. Katılımcıların, matematikte başarılı olan kardeşleri, onlardaki matematik kaygısının düşmesine ve matematiğe karşı olumlu hislerin oluşmasına katkı sağlamışlardır.

Zihinsel sebepler ise, algılanan matematiğin yapısındaki yeterlik, matematiğin faydaları ve matematik yeteneğindeki yüksek güven şeklindedir. Düşük matematik kaygılı katılımcılar, matematiği ya mantıklı bilgi seti olarak, ya da formüllerden oluşan bir set olarak algılamışlar ve matematiği eğlenceli, kaygıya yol açmayan yapı olarak düşünmüşlerdir. Matematikle uğraşırken zevk aldıkları için, matematik kaygıları düşük olarak belirmiştir. Dahası, matematiğin faydalı olduğunu düşünmeleri, onların düşük matematik kaygısı taşımalarını ve matematiğe olan ilgilerinin artmasını sağlamıştır. Matematikteki yeteneklerine inanmışlar ve bunun sonucu olarak da matematikte kendine güvenmişlerdir.

Kısacası, okulun ve ailenin, katılımcıların matematik kaygısını ya olumlu ya da olumsuz bir şekilde etkilediği ortaya çıkmıştır. Olumlu tutuma sahip öğretmenler, katılımcıların matematikten zevk almasına yardımcı olup, matematik kaygısı geliştirmemelerini sağlamıştır. Aileler de, katılımcıların matematik öğrenmelerini olumlu tutumla desteklemişlerdir. Diğer taraftan, olumsuz tutuma sahip öğretmenler ve öğrencileri desteklemeyen aileler, katılımcılarda yüksek matematik kaygısı oluşmasına neden olmuştur. Bu durumsal faktörler, yetersiz matematik alan bilgisi ve katılımcıların güven eksikliği ile birleşince, yüksek matematik kaygısına yol açmıştır.

Dersin Öğretmen Adaylarının Matematik Öğretimi Kaygısı Üzerine Etkisi

Adaylara, dersin başında *Matematik ve Ben 1* anketi uygulanmıştır. Bu ankette, 1 den 10 ‘a kadar numaralandırılmış ölçekte öğretmen adayları, kendi matematik öğretimi kaygı düzeylerini derecelendirmişlerdir. Ölçekte, 1 en az matematik öğretimi kaygısını gösterirken, 10 en çok matematik öğretimi kaygısını göstermiştir.

Öğretmen adaylarından 5'i işaretleyenler ise, orta dereceli matematik öğretimi kaygısı olan adaylar olarak belirlenmiştir. Benzer şekilde, dersin sonunda öğretmen adaylarının son kaygı düzeylerini belirlemek üzere *Matematik ve Ben 3* anketi uygulanmıştır.

Öğretmen Adaylarının Dersin Başındaki ve Sonundaki Matematik Öğretimi Kaygı Düzeyleri

Öğretmen adaylarından matematik öğretimi kaygı düzeyini 1'den 4'e kadar işaretleyenler düşük matematik öğretimi kaygılı, 6'dan 10'a kadar işaretleyenler yüksek matematik öğretimi kaygılı ve 5' i işaretleyenler orta derece matematik öğretimi kaygılı olarak değerlendirilmiştir. *Matematik ve Ben 1'*de, 15 öğretmen adayı yüksek matematik öğretimi kaygı düzeyini seçerken, 26 öğretmen adayı ise düşük matematik öğretimi kaygı düzeyini seçmiştir. Yüksek matematik öğretimi kaygılı 1 katılımcı ile düşük matematik öğretimi kaygılı 24 katılımcının dersin başı ve sonunda matematik öğretimi kaygı düzeylerini korudukları görülürken; 22 öğretmen adayının ise dersin sonunda farklı matematik öğretimi kaygı düzeylerinde oldukları görülmüştür. Bir katılımcının matematik öğretimi kaygı düzeyi düşükten yükseğe çıkarken, 11 katılımcının matematik öğretimi kaygı düzeyi yüksekten düşüğe kaymıştır. Toplamda, 25 öğretmen adayının matematik öğretimi kaygı düzeyi, dersin sonunda aynı kalmıştır.

Dersin başında ve dersin sonunda öğretmen adaylarının matematik öğretimi kaygılarının sebepleri araştırılmıştır. Ek olarak, bu kaygıların nedeni hakkında, 20 öğretmen adayıyla görüşme yapılarak da detaylı bilgiler elde edilmiştir. Dersin sonunda, 2 öğretmen adayı yüksek matematik öğretimi kaygısına sahipken, 41 katılımcının düşük matematik öğretimi kaygısına sahip olduğu bulunmuştur. Bunun yanı sıra, 5'i seçen 4 öğretmen adayının da orta derecede matematik öğretimi kaygısına sahip olduğu görülmüştür.

Dersin sonunda, katılımcıların matematik öğretimi kaygısının sebeplerinde farklılıklar görülmüştür. Katılımcılar, aldıkları *Okul Öncesinde Matematik Öğretimi*

dersinin katkılarından bahsetmişlerdir. Bu bulgular, dersin katılımcıların matematik öğretimi kaygı düzeylerini etkilediğini ortaya çıkarmıştır.

Matematik Öğretimi Kaygısının Nedenleri

Katılımcıların dersin başında algıladıkları matematik öğretimi kaygılarının nedenlerini daha iyi anlamak için *Matematik ve Ben 1* yardımıyla yüksek ve düşük matematik öğretimi kaygısına sahip öğretmen adaylarındaki bu kaygıya yol açan nedenler sorulmuştur. Brown, Westenskow ve Moyer-Packenham (2012), sınıf öğretmeni adaylarının matematik öğretimi kaygısının nedenlerini üç şekilde sınıflandırmış: Kurulu öğretim yapısına uyma, matematik etkinlikleri için hazırlık yapma ve matematik öğretimi için kişisel özelliklerin farkında olma.

Dersin Başındaki Yüksek Matematik Öğretimi Kaygısının Nedenleri

Dersin başında 15 öğretmen adayı, matematik öğretimi kaygısını yüksek olarak belirlemiştir ve bu kaygılarının nedenleri iki kategoride toplanmıştır: Matematik etkinlikleri için hazırlık yapma ve Matematik öğretimi için kişisel özelliklerin farkında olma. Brown, Westenskow ve Moyer-Packenham'dan (2012) farklı olarak, sadece Kurulu öğretim yapısına uyma ile ilgili bir kategori ortaya çıkmamıştır çünkü bu öğretmen adayları çalışmanın gerçekleştirildiği sırada 3. sınıfta olup dersin başında henüz okullarda gerçekleştirdikleri stajlara başlamamışlardır. Bu sebeple bu kategori dersin başında oluşmamıştır.

Matematik Etkinlikleri İçin Hazırlık Yapma

Yüksek matematik öğretimi kaygısına sahip 15 adayın 12'si, *çocukların anlamasının* ve *uygulamaların* matematik etkinlikleri için hazırlık yapmada büyük öneme sahip olduğunu belirtmişlerdir. Bu yüzden de, okul öncesi eğitimi kurumlarına farklı düzeylerden öğrencilerin gelmesi onları korkutmuştur. Matematiğin çocuklar için de soyut olacağını düşündüklerinden, yüksek matematik öğretimi kaygısına sahip oldukları gözlenmiştir. Dört katılımcı ise yüksek matematik öğretimi kaygılarını matematik öğretimiyle ilgili uygulama yapmamalarına atfetmiştir. Deneyimsizlik ve

öğretim yöntemini bilmeme, yüksek matematik öğretimi kaygısına yol açmıştır. Kısaca, 12 öğretmen adayı, çocukların anlamasıyla baş etmedeki zorluklar ve matematikle ilgili uygulama yapmamaları yüzünden dersin başında yüksek matematik öğretimi kaygısına sahip olmuşlardır.

Matematik Öğretimi için Kişisel Özelliklerin Farkında Olma

Üç öğretmen adayı yüksek matematik öğretimi kaygısını, geçmişte yaşadıkları deneyimleri yüzünden sahip oldukları yüksek matematik kaygısına bağlamışlardır. Matematik kaygılarından ve yetersiz matematik alan bilgisinden dolayı, okul öncesi matematiğini etkili öğretemeyeceklerini düşündüklerini belirtmişlerdir Adayların çocuklara matematik öğretmekle ilgili herhangi bir anısı ya da deneyimi olmamasına rağmen, var olan yüksek matematik kaygıları yüzünden gelecekteki matematik öğretimi deneyimlerine yönelik önyargılara sahip olmuşlardır. Bu nedenler de onlarda yüksek matematik öğretimi kaygısına yol açmıştır.

Dersin Başındaki Düşük Matematik Öğretimi Kaygısının Nedenleri

Dersin başında 26 öğretmen adayı, matematik öğretimi kaygılarını düşük düzeylerde işaretlemiştir. Matematik öğretimi kaygılarının nedenleri de üç bölümde sınıflandırılmıştır: matematik etkinlikleri için hazırlık yapma, matematik öğretimi için kişisel özelliklerin farkında olma ve dersten beklentiler.

Matematik Etkinlikleri İçin Hazırlık Yapma

On sekiz öğretmen adayının bu kategoride verdikleri cevaplar *çocukların anlaması* ve *uygulamalar* olmak üzere iki bölümde incelenmiştir. Katılımcılar, bilginin aktarımı için çocukların yaş gruplarını bilmenin önemli olduğunu, eğer bilirlerse olumlu yönde etkileneceklerini ve yüksek matematik öğretimi kaygısı geliştiremeyeceklerini belirtmişlerdir. Matematiği somut olarak görüp, kolayca öğretebileceklerini düşünmüşler ve çocuklar için matematiği basitleştirebilme yeteneklerine güvenmişlerdir. Diğer taraftan, dört katılımcı ise ilginç bir şekilde,

düşük matematik öğretimi kaygılarını hiç uygulamama yapmalarına bağlamıştır. Çocukların anlamasını sağlayacaklarına emin olduklarını belirtmişlerdir. Bu güven de onların henüz hiç gerçek ortamlarda matematik öğretimi yapmamalarından kaynaklanmış olabilir ve gelecekte de okul öncesi sınıflarında matematik öğretmede problem yaşamayacaklarını düşünmüş olabilirler.

Matematik Öğretimi için Kişisel Özelliklerin Farkında Olma

Bu kategoride ise 5 öğretmen adayı vardı. Düşük matematik öğretimi kaygısına yol açan faktörler ise *duygusal etkiler* ve *matematikle ilgili geçmiş deneyimler* şeklinde incelenmiştir. *Duygusal etkiler*, üç katılımcının düşük matematik öğretimi kaygısına sahip olmasına yardımcı olmuştur. İki öğretmen adayı da, düşük matematik öğretimi kaygısını, matematik öğretirken başarılı olan geçmiş öğretmenleriyle olan olumlu deneyimlere atfetmiştir.

Sonuç olarak, düşük matematik öğretimi kaygısına sahip olan adaylar matematiği eğlendikleri bir uygulama olarak görmüşler ve düşük matematik öğretimi kaygıları geliştirmişlerdir. Geçmiş öğretmenlerinin matematiği öğretirken etkili olduğunu düşünmeleri sonucu da düşük matematik öğretimi kaygısına sahip olmuşlardır.

Dersten Beklentiler

Brown, Westenskow ve Moyer-Packenham'ın (2012) çalışmasından farklı olarak bu kategori ortaya çıkmıştır ve üç öğretmen adayı düşük matematik öğretimi kaygısını *Okul Öncesinde Matematik Öğretimi* dersinden beklentilerine bağlamışlardır.

Okul Deneyimi ve *Okul Öncesinde Matematik Öğretimi* dersleri aynı dönemde olduğundan, öğretmen adaylarının daha önceden matematik öğretimiyle ilgili deneyimleri yoktu. Bu yüzden de, dersin başında bahsettikleri bu nedenleri *algılanmış matematik öğretimi kaygısı nedenleri* olarak görebiliriz. Öğretmen adaylarının matematik kaygısı öğrenci olarak yaşadıkları geçmiş deneyimlere uzanmaktayken, şu anki matematik öğretimi kaygıları gelecekte yaşayacaklarıyla

şekillenebilir (Brown, Westenskow ve Moyer-Packenham, 2012). Bu yüzden, bu adayların dönem boyunca uygulamalarda kazandıkları deneyimlerden dolayı, dersin sonunda tekrar *Matematik ve Ben 3* ile bu kaygıların nedeni sorulmuştur.

Dersin Sonundaki Yüksek Matematik Öğretimi Kaygısının Nedenleri

Dersin sonunda, 47 adaydan ikisinin yüksek matematik öğretimi kaygısına sahip olduğu görülmüştür. Matematik etkinlikleri için hazırlık yapmada yer alan *çocukların anlaması* ile ilgili olan neden, onlarda yüksek matematik öğretimi kaygısına yol açan temel nedendir.

Matematik Etkinlikleri İçin Hazırlık Yapma

İki katılımcı çocukların anlamasının yani yaş gruplarının farklılığının onlarda yüksek matematik öğretimi kaygısına yol açtığını belirttiler ama matematik öğretimi kaygıları çok yüksek düzeyde değildi. Sadece, çocukların yaş düzeylerine göre matematik öğretimlerini ayarlamada tereddüt ettiklerini ifade ettiler.

Dersin Sonundaki Düşük Matematik Öğretimi Kaygısının Nedenleri

Dersin sonunda, 41 öğretmen adayı düşük matematik öğretimi kaygı düzeyine sahip olarak bulunmuştur ve kaygılarının nedenleri dört ana başlıkta toplanmıştır: Kurulu öğretim yapısına uyma, Matematik etkinlikleri için hazırlık yapma ve Matematik öğretimi için kişisel özelliklerin farkında olma ve *Okul Öncesinde Matematik Öğretimi* dersinin katkıları şeklinde incelenmiştir.

Kurulu Öğretim Yapısına Uyma

Bu kategori, *sınıf yönetimini* içermiştir. Dönem başında çıkmayan bu neden, dönem sonunda öğretmen adaylarının birçok etkinlik hazırlayıp sınıfta sunmalarıyla ve staj için gittikleri anaokullarında yaptıkları etkinliklerle ortaya çıkmıştır. Dersin başında

bunlardan bahsetmemişlerken, dersin sonunda iki aday, sınıf yönetimini sağlamada zorluk yaşadıklarını belirtmişlerdir.

Matematik Etkinlikleri İçin Hazırlık Yapma

Bu faktör *uygulamalarla* ilgili olarak ortaya çıkmıştır. Okul öncesinde matematik öğretiminde kendine güvenen 10 adayın üçü, daha çok uygulama yapmaya ihtiyaçlarının olduğunu, zamanla ve deneyimle bu uygulamalarda daha başarılı olacaklarına inandıklarını belirtmişlerdir. Geriye kalan yedi katılımcı ise matematik öğretimiyle ilgili olumlu deneyimlere sahip olduklarını ifade etmişler ve düşük matematik öğretimi kaygı düzeylerini de çocuklarla yaptıkları uygulamalara bağlamışlardır. Diğer bir deyişle, uygulamalar katılımcıların matematik öğretimi kaygı düzeyini düşürmüştür.

Matematik Öğretimi için Kişisel Özelliklerin Farkında Olma

Üç katılımcı düşük matematik öğretimi kaygı düzeyini *duygusal etkilere* atfetmiştir. Matematik öğretirken kendilerine güvenmişler ve zevk aldıkları için de düşük matematik öğretimi kaygı düzeyine sahip olmuşlardır. Dersin başında, bu kategoride geçmiş matematik deneyimlerinin etkisinden bir sebep olarak bahsederken, dersin sonunda buna hiç değinmemişlerdir.

Okul Öncesinde Matematik Öğretimi dersinin katkıları

Bu çalışmada, Brown, Westenskow ve Moyer-Packenham'dan (2012) farklı olarak bu kategori ortaya çıkmıştır. Dersin sonunda, 41 öğretmen adayından 26'sı aldıkları *Okul Öncesinde Matematik Öğretimi* dersinin onlardaki düşük matematik öğretimi kaygısına olan katkısından bahsetmiştir. Neredeyse katılımcıların yarısı kaygılarının azalmasını bu derse atfetmiş ve bu ders yardımıyla çocuklara matematiği nasıl öğreteceklerini, çeşitli etkinlikleri nasıl hazırlayacaklarını öğrendiklerini ifade etmişlerdir. Bu ders, matematik öğretimi kaygılarını azaltmanın yanı sıra, çocuklara öğretecekleri matematikte kendilerine güven oluşturmuştur.

Dersin sonunda Matematik Öğretimi Kaygısının Detaylı İncelenmesi

Matematik ve Ben 1 ve *Matematik ve Ben 3*'e ek olarak, dersin sonunda daha detaylı bilgi almak üzere 20 öğretmen adayıyla görüşmeler yapılmıştır. Bu adaylara, *Matematik ve Ben 1*'de yaptıkları derecelendirmeler hatırlatılarak, dersin sonunda bu kaygılarının nedenini detaylandırmaları istenmiştir.

Üniversite öncesi matematikle ilgili olumsuz geçmiş deneyimlere sahip adayların, matematiği öğretirken ve çocukları aktivitelere dahil ederken daha çok dikkatli oldukları görülmüştür. Çocukların matematiğe karşı olumsuz tutum geliştirmemeleri için ellerinden gelenin en iyisini yapmaya çalışmışlardır. Bu yüzden de, dönem boyunca matematik etkinliklerini özenle hazırlayarak ve uygulamışlardır. Dönem sonunda da, matematik öğretimi kaygıları azalmıştır.

Yüksek ve orta dereceli matematik öğretimi kaygısı olan katılımcılar, bu kaygılarının dersin verildiği dönemin başında başladığını belirtmiştir. Sonuç olarak, matematik öğretimi kaygısının, ilk olarak, adayların *Okul Öncesinde Matematik Öğretimi* dersini aldıkları zaman ortaya çıktığı ve ders sayesinde de matematik ile ilgili farkındalıklarının oluştuğu görülmüştür.

Matematik Öğretimi Kaygısı İçin Temel Ders Deneyimleri

Katılımcıların, *Matematik ve Ben 3*, *Yansıtıcı Düşünceler Raporları* ve görüşmelerdeki yanıtları, dersteki temel deneyimlerin onların düşük matematik öğretimi kaygısına sahip olmalarını sağladığını göstermiştir. Bu temel deneyimleri de 3 kategoride toplanabilir: *Dersin genel olarak etkisi, dersteki spesifik görevler ve Okul Öncesinde Matematik Öğretimi dersi* ile *Okul Deneyimi dersi arasındaki etkileşim*.

Dersin Genel Olarak Etkisi

Derste, çocuklar matematiği nasıl öğrenir, matematik nasıl öğretilmeli ve etkinliklerin öğretilmesi-öğrenilmesinin uygulamasıyla ilgili teorik bilgilere yer verilmiştir. Bu deneyimler, öğretmen adaylarının oldukça düşük düzeyde matematik öğretimi kaygısını geliştirmelerini ve okul öncesindeki matematiğe karşı olumlu bir bakış açısı kazanmalarını sağlamıştır. Adaylar, etkinlikleri teorik bilgi ve aldıkları dönütleri düşünerek uygulamışlardır. Bu derste, umduklarından daha farklı bir matematiği öğrendiklerini belirtmişlerdir. Bu da, dersin sonunda onların daha düşük matematik öğretimi kaygısına sahip olmalarına yardımcı olmuştur.

Dersteki spesifik görevler

Bu kategori ise, ders boyunca yapılan tüm görevleri (sunumlar, aktivite planları, öğrenme merkezi projesi, *Yansıtıcı Düşünceler Raporu*) içermektedir. O haftanın konusuyla ilgili bir aktivite yapılacak şekilde, beş grup her hafta sınıf arkadaşlarına etkinliklerini sunmuştur. Bu yüzden de, derse gelmeden önce o haftanın konusunu okumuşlar ve dersin sonunda, okul öncesindeki matematik konularıyla ilgili toplam 100 etkinlik planı hazırlamışlardır. Dahası, öğrenme merkezi etkinliklerini gerçek ortamda (anaokulunda) çocuklara birebir uygulamışlardır. Dersin sonunda da, matematikle ilgili geçmiş deneyimlerini ve şimdiki matematik öğretim deneyimlerini kıyas yapacak şekilde kendi görüşlerini yansıtan rapor yazmışlardır. Bu görevler, dönem boyunca, adayların matematik kavramlarını, çocukların olası tepkilerini, ve farklı yollardan uygulama yapmalarını düşünmelerini sağlamıştır. Bu deneyimler, adayların etkinlik tasarlamada ve uygulamada kendilerine güven kazanmalarına ve matematik öğretimi kaygılarının düşmesine yardımcı olmuştur.

Okul Öncesinde Matematik Öğretimi dersiyle Okul Deneyimi dersi arasındaki Etkileşim

Bu kategoride, *Okul Öncesinde Matematik Öğretimi* dersi ile Okul Deneyimi dersi arasındaki etkileşim incelenmiştir. Üçüncü sınıfın güz döneminde, öğretmen adayları

bu dersleri almışlardır. Öğretmen adaylarının, *Okul Öncesinde Matematik Öğretimi* dersinde öğrendikleri matematiksel bilgileri, staj derslerinde kullanması onların matematik öğretimi kaygılarının azalmasına katkı sağlamıştır.

Önceki Matematik Kaygısına Karşı Matematik Öğretimi Kaygısı

Katılımcılardan bir etkinlik hazırlayıp gittikleri stajda çocuklarla uygulamaları ve orada yaşadıkları ve buna bağlı olarak geçmişteki matematik deneyimleriyle şimdiki öğretim kaygıları arasında ilişkinin olup olmadığından bahsetmeleri istenmiştir. Ayrıca *Okul Öncesinde Matematik Öğretimi* dersini değerlendirmişlerdir. Brown, Westenskow ve Moyer-Packenham (2011) çalışmalarında, sınıf öğretmenlerinin geçmiş matematik kaygısı varsa matematik öğretimi kaygısına sahip olacaklarını ya da sınıf öğretmenlerinin geçmiş matematik kaygısı yoksa matematik öğretimi kaygısına sahip olamayacaklarını belirten önceki bir varsayım üzerinde çalışmışlardır. Fakat, çalışmalarında bu varsayımdaki ilişkinin her zaman olmadığını görmüşlerdir. Diğer bir deyişle, geçmişte yüksek düzeyde matematik kaygısına sahip öğretmen adaylarının, matematik öğretimi kaygısına sahip olmadıklarını bulmuşlardır. Bu yüzden de, yazarlar bu varsayıma uyan ve uymayan adayları kendi çalışmalarında çeyrekler halinde açıklamışlardır. Bu çeyrekler (A, B, C ve D), alan yazına matematik öğretimi kaygısıyla ilgili yeni bir anlayış getirdiğinden (Brown, Westenskow ve Moyer-Packenham, 2011), matematik kaygısı ve matematik öğretimi kaygısı ile ilgili olan varsayım, bu çalışmada okul öncesi öğretmen adaylarının durumu açısından incelenmiştir. Brown, Westenskow ve Moyer-Packenham'ın (2011) çerçevesi kullanılarak, 47 öğretmen adayının görüşleri analiz edilmiştir.

Brown, Westenskow ve Moyer-Packenham'dan (2011) farklı olarak bu çalışmadan bir kayma kategorisi ortaya çıkmıştır. Bu çalışmada *kayma* çok vurgulanmıştır çünkü öğretmen adaylarının çoğu dersin sonundaki matematik öğretimi kaygılarında kayma göstermişlerdir. Bu kayma E ve E' olmak üzere iki grupta incelenmiştir. E grubundaki öğretmen adaylarının geçmiş matematik kaygısı ve matematik öğretimi kaygısı olmasına rağmen matematik öğretimi kaygısı dersin sonunda azalmıştır. E' grubundaki öğretmen adaylarının geçmiş matematik kaygısı olmamasına rağmen

matematik öğretimi kaygısı vardı, fakat bu matematik öğretimi kaygısı dersin sonunda azalmıştır.

A Alanı

Geçmiş matematik kaygıları olmayan ve dersin başında ve dersin sonunda matematik öğretimi kaygıları olmayan 10 katılımcı bulunmuştur. Bu katılımcılar bu iki çeşit kaygıyı birbirine bağlamışlardır. Geçmişte matematikte başarılı olduklarını, matematiği eğlenceli bulduklarını belirtirken, anaokulunda da çocuklarla olumlu deneyimler yaşadıklarını ve bir problemle karşılaşmadıklarını belirtmişlerdir. Katılımcıların hepsi, geçmiş olumlu deneyimlerin çocuklarla olan matematik öğretimi deneyimleri üzerinde büyük etkisi olduğunu vurguladı. Geçmişte matematik kaygısına sahip olmadıklarından, stajda olumlu matematik öğretimi deneyimlerine sahip olduklarını düşündüler.

D Alanı

D alanındaki iki öğretmen adayının geçmiş matematik kaygıları ve dersin başında ve dersin sonunda matematik öğretimi kaygıları olduğu ortaya çıkmıştır. Bu öğretmen adayları, matematikle ilgili geçmiş kötü deneyimlere sahip olup, çocuklara matematik öğretirken bazı zorlukla karşılaşmışlardır. Stajda karşılaştıkları bu zorlukların geçmiş matematik kaygılarıyla ilgili olabileceğini ifade etmişlerdir.

B Alanı

B alanı, geçmiş matematik kaygısı olan dört öğretmen adayının hem dersin başında hem de dersin sonunda matematik öğretimi kaygısına sahip olmamalarını temsil ediyordu. Bu alandaki öğretmen adayları çoğunlukla geçmişte matematik kaygısına sahip olduklarını, fakat matematik öğretimi kaygısını deneyimlemediklerini belirtmişlerdir. Matematikle ilgili geçmiş olumsuz deneyimlere sahip oldukları için, çocukların da matematikle ilgili benzer deneyimlerine sahip olmasını istememişler, bu yüzden de, etkinliklerin hazırlanmasına çok önem vermişlerdir. Etkinlikleri hazırlarken, çocukların gelişimlerini düşündüklerini belirtmişlerdir.

C Alanı

C alanı, geçmiş matematik kaygısı olmayan üç öğretmen adayının hem dersin başında hem de dersin sonunda matematik öğretimi kaygısına sahip olmalarını temsil ediyordu. Öğretmen adaylarının geçmiş matematik deneyimleri olumlu olmasına rağmen, bu adaylar çocukların matematikle uğraşmasını sağlarken ve matematik öğretirken zorluklar yaşamışlardır. Stajda etkinliklerin uygulanması süresince de kaygı hissettiklerini belirtmişlerdir.

Kayma (E ve E' Grupları)

Dersin sonunda, *Yansıtıcı Düşünceler Raporunda*, 23 öğretmen adayının matematik öğretimi kaygısının yüksekten düşüğe bir kayma gösterdiği görülmüştür. Bu öğretmen adayları, geçmiş matematik kaygılarının varlığına göre gruplandırılmıştır.

E grubu, geçmiş matematik kaygısı olan ve dersin başında matematik öğretimi kaygısına sahip olup dersin sonunda bu kaygıya sahip olmayan 11 öğretmen adayını temsil ediyordu. Bu adayların, *Okul Öncesinde Matematik Öğretimi* dersine gelmeden önce olumlu geçmiş matematik deneyimleri olmamıştır. Dönemin başında aynı zamanda matematik öğretimi kaygısına sahip oldukları bilinmektedir. Etkinlikleri yapmadan önce, çocukların yaş düzeyleri, işledikleri matematik konuları, uygun öğretim teknikleri ile ilgili endişeleri vardı. Dersin sonunda, önceki kaygılarına rağmen, matematik öğretimleriyle ilgili olumlu deneyimler yaşadıklarından bu adayların matematik öğretimi kaygılarında kayma görülmüştür.

E' grubunda ise, 12 öğretmen adayının geçmiş matematik kaygısı yoktu ve dersin başında matematik öğretimi kaygısına sahiplerken, kayma göstererek dersin sonunda bu kaygıları kaybolmuştur. Dersin başında, 12 öğretmen adayı tarafından paylaşılan ortak düşünce, hepsinin dersin başında matematik öğretimi kaygısı varken, dersin sonunda çocuklara matematik öğretirken bu kaygılarının yok olması ve rahatlık hissetmeleridir. Zamanla birlikte matematik öğretimi kaygılarını yenmişlerdir.

Çalışmanın bulguları matematik kaygısı ve matematik öğretimi kaygısının okul öncesi öğretmen adaylarında her zaman ilişkili olmayacağını göstermiştir. Diğer bir deyişle, yüksek matematik kaygısına sahip her öğretmen adayının, matematik öğretimi kaygısına da sahip olacağını söyleyemeyiz. D alanındaki iki öğretmen

adayının matematik kaygısı varken matematik öğretimi kaygısı da vardı ve A alanındaki 10 öğretmen adayının matematik kaygısı yokken matematik öğretimi kaygısı da yoktu. Bunlar varsayımı desteklerken, B alanındaki dört öğretmen adayı ve C alanındaki üç öğretmen adayı bu varsayımı desteklememektedir. Yani, öğretmen adayları geçmişte olumsuz deneyimleri olup matematik kaygısına sahip olsalar da matematik öğretimi kaygısını göstermemişler ya da geçmişte olumlu deneyimleri olup da matematik kaygısı olmayanlar, uygulama yaparken matematik öğretimi kaygısını göstermişlerdir.

Kaymaya Yakından Bir Bakış

Bu çalışmada, Brown, Westenskow ve Moyer-Packenham'ın (2011) çalışmasından farklı olarak kayma kategorisi adayların *Yansıtıcı Düşünceler Raporları* sayesinde ortaya çıkmıştır. Bu kayma kategorisinde, başta matematik öğretimi kaygısına sahip adayların, dersin sonunda bu kaygılara sahip olmadığı görülmüştür. Daha açık bir şekilde E ve E' gruplarında bahsedildiği gibi, 23 öğretmen adayının matematik öğretimi kaygısında kayma görülmüştür. Fakat, bu kayma matematik öğretimi kaygısına sahip olan ve olmayan katılımcılarla karşılaştırılınca, kayma gösteren adayların farklılık gösterdiği ortaya çıkmıştır. Yani, dersin başında ve sonunda kendi matematik öğretimi kaygısını derecelendirip kayma gösteren 22 aday vardı. Oysa, hem bu derecelendirme sonucu hem de *Yansıtıcı Düşünceler Raporları* sonucu kayma gösterenlerden sadece 10 katılımcı aynı kişilerdi. Diğer katılımcılar incelendiğinde, *Yansıtıcı Düşünceler Raporlarında* kayma gösteren katılımcıların, *Matematik ve Ben 1* ve *3*'teki iki ankette de aynı düzeyde kendilerini derecelendirdikleri görülmüştür. Yani, dersin başında ve sonunda 12 katılımcı kendini düşük matematik öğretimi kaygısında, bir öğretmen adayı da kendini yüksek matematik öğretimi kaygı düzeyinde derecelendirmiştir. Bu adaylar, dersin başında da sonunda da hala aynı düzeyde olduklarından bir değişiklik göstermemiştir. Ancak, raporlarında matematik öğretimiyle ilgili deneyimlerinden, dersin başındaki ve sonundaki matematik öğretimi kaygılarını kıyaslayarak bahsetmişlerdir ve bu da kaymayı göstermiştir. Matematik öğretimi kaygılarındaki bu gizli kayma *Yansıtıcı Düşünceler Raporlarında* ortaya çıkmıştır.

Benzer şekilde, 9 öğretmen adayı da *Matematik ve Ben 1* ve *3*'te kayma gösterirken, *Yansıtıcı Düşünceler Raporlarında* göstermemişlerdir. Geçmiş matematik kaygısı ve matematik öğretimi kaygısı arasındaki ilişkiye odaklanmışlardır. Aslında bu adaylardan, dersin başındaki matematik öğretimi kaygısıyla şu andaki matematik öğretimi kaygısını açıkça kıyaslamaları istendiğinde kaymayı detaylı bir şekilde açıklamışlardır. Ayrıca, bir değişiklik olup olmadığı, bu değişimin altında yatan nedenin ne olduğu sorulmuştur. Kırk yedi katılımcıdan 44'ü dersin başındaki matematik öğretimi kaygısı ile dersin sonundaki matematik öğretimi kaygısı arasında bir değişiklik olduğunu belirtmiştir. Bu soru kayma hakkında daha genel bir bakış sağlamıştır. Örneğin, *Matematik ve Ben 1* ve *3*'teki derecelendirmelerinde matematik öğretimi kaygı düzeylerinde kayma gösterip, *Yansıtıcı Düşünceler Raporlarında* kayma göstermeyen bu 9 aday, ilk ve son matematik öğretimi kaygıları hakkında detaylı bilgiler verirken kaymaya değinmişlerdir. Bu bulgular, öğretmen adaylarının matematik öğretimi kaygılarında *Matematik ve Ben 1* ve *3* ile *Yansıtıcı Düşünceler Raporlarındaki* farkları göstermiştir. Dersin başında algıladıkları matematik öğretimi kaygısı bazı adaylar için düşük düzeydeyken bile, dersin sonunda bu adaylar da dersin başındaki matematik öğretimi kaygılarından dersin sonundaki matematik öğretimi kaygısına olan kaymadan bahsetmişlerdir. Bulgular, neredeyse tüm katılımcıların dönem boyunca matematik öğretimi kaygılarında bir değişiklik olduğunu göstermiştir.

Tartışma ve Öneriler

Bulgular, dersin başında katılımcıların imgelerinin okul öncesinde öğretecekleri matematikle ilgili olmadığını göstermiştir. Dersin sonunda bu soyut ve ileri matematikle ilgili imgeler, okul öncesinde öğretecekleri matematik ile ilgili matematik kavramlarına dönmüştür ve matematikle ilgili birçok olumsuz duygu, olumlu duygu ile yer değiştirmiştir. Matematikle ilgili yeni bir perspektif kazanmışlar ve bu bakış açısı onların geçmiş imgelerini bir yana itmiştir. Muhtemelen, bu katılımcıların geçmiş deneyimleri silinmemiştir. Dersten sonra oluşan bu yeni imge ve duygular o kadar güçlüydü ki katılımcılar matematik ve günlük hayatla ilgili birçok bağlantılar kurabilmiştir.

Dersin katılımcıların matematik kaygısı düzeyleri üzerinde çok etkisi olmadığı ortaya çıkmıştır. Geçmiş okul deneyimleri o kadar güçlü olmasaydı, belki ders onların matematik kaygısını düşürmede yardımcı olabilirdi. Ayrıca geçmiş okul deneyimlerinin süresi, ders deneyimlerinden daha uzun olduğundan dersin katılımcılarının matematik kaygısına büyük bir etkisi olmamıştır.

Dersin başında, katılımcıların bazılarının matematik öğretimi kaygısı düşüktü. Bu durum onların okul öncesindeki matematiği kolay zannedip, bir problemle karşılaşmayacaklarını düşünmelerinden kaynaklı olabilir. Matematik öğretimi kaygısıyla ilgili sınırlı alan yazın olduğundan bulgular Brown ve arkadaşlarının (2012) çalışmasıyla karşılaştırılmıştır. Dersin başında, Kurulu öğretim yapısına uyma kategorisi, bu adaylar 3. sınıfa kadar okullarda staj yapmadıkları için ortaya çıkmamıştır. Dersin sonunda, bazı adaylar sınıf yönetimi konusundan ve bunun onların kontrolü dışında gerçekleştiğinden bahsetmişlerdir. Brown ve arkadaşlarının (2012) çalışmasıyla paralel şekilde, çocukların anlayışının bazen kaygılarını artırırken bazen azalttığı; uygulama yapmanın ise öğretim kaygısını azalttığı görülmüştür. Matematik öğretimi kaygısını azaltmada, dersin genel olarak etkisi içinde yer alan dönütün önemi ve dersteki görevlerle katılımcıların gerekli deneyimleri kazandığı görülmüştür.
Haciomeroglu (2014) ve Peker ve Ertekin (2014)'in çalışmaları, matematik kaygısı ve matematik öğretimi kaygısı arasında anlamlı bir ilişki olduğunu ortaya koyarak bu çalışmadaki A ve D alanlarını desteklemektedir. Öğretmen adaylarının geçmiş deneyimleri iyice yerleşmiş ve güçlenmiştir ve onlar da çocuklarla ilgili gelecekteki öğretimlerinde aynı deneyimleri yaşayacaklarını düşünmüşlerdir. Diğer taraftan da B ve C alanındaki katılımcılar da, geçmiş öğretmenleri gibi olmak istemediklerini ve çocukları matematikten korkutmayacaklarını belirmişlerdir.

Dersin sonunda kayma görülmüş ve bu kayma ancak üç farklı veri toplama aracıyla ortaya çıkmıştır. Yani, katılımcıların hepsi tüm ölçeklerde kayma olduğundan bahsetmemiştir. Farklı ölçeklerde farklı kayma göstermelerinin nedeni, matematik öğretimi kaygısının dinamik yapısından kaynaklanmış olabilir. Bir başka neden de *Yansıtıcı Düşünceler Raporunun* yapısından kaynaklanmış olabilir. Bu ödev ile

katılımcılar öğretim uygulamalarına ve duygularına daha yakından bakıp kendilerini değerlendirmişlerdir.

Matematik kaygısının sebeplerini bilmek ve farkında olmak öğretmenlerin strateji geliştirmesi açısından önemlidir. Öğretmenlerin öğretme-öğrenme aktivitesi süresince matematik kaygısıyla nasıl baş edeceklerine dair araştırmalar yapılabilir. Öğretmen eğitimi programları kaygı oluşturmamak ve kaygı döngüsünü önlemek için iyi bir şekilde tasarlanmalı ve uygulanmalıdır. Öğretmen eğitimcileri ve danışman öğretmenler matematik öğretimi kaygısının nedenlerini staj uygulamalarını yeniden düzenlemek adına iyi bilmelidir. Dahası, öğretmen eğitimcileri matematik öğretim yöntemleri dersini daha iyi şekilde düzenlemelidir. Örneğin, kısa videolar, rol yapma senaryoları ya da kısa hikâyelerden yararlanarak öğretmen adaylarının karşılaşacağı durumlar bu derslerde kullanılarak tartışma ortamları yaratılabilir. Bu sayede de öğretmen adayı diğer kişilerin de benzer duygulara sahip olduğunu görüp kendini yalnız hissetmemiş olur. Hem kendini keşfeder, hem de kişisel farkındalığını geliştirmiş olur. *Çizim Aktiviteleri* de adayların matematikle ilgili imge ve duygularını tanımak amacıyla bu dersin bir parçası olabilir. Öğretmen adaylarının geçmiş deneyimleri ve matematik öğretimleri arasındaki bağla ilgili izleme çalışmaları yapılarak mezun olduktan sonra ve meslekte gerçeklerle karşılaştıklarındaki kaygıları gözlenerek araştırmalar yapılabilir. Bir başka çalışmada da öğretmen adayları ve hizmet içi öğretmenlerin kendi matematik kaygıları ve matematik öğretimi kaygılarındaki farkındalık ve bunun öğretim uygulamaları üzerindeki etkisine bakılabilir. Daha başka bir çalışmada, öğretmen adayları 4. sınıfın sonundayken ve öğretmen olduktan sonrada *Çizim Aktiviteleri* tekrar yaptırılarak, bu imge ve duyguların sürdürülebilirliği ve değişimi incelenebilir. Onların öğrencilerine de matematik imgeleri çizdirilerek, çocukların çizimiyle öğretmenin çizimi arasında ilişki araştırılıp karşılaştırılabilir. Başka bir çalışmada da, öğretmenlerin matematik öğretimi kaygılarının çocukların matematiğe karşı tutum ve performanslarını nasıl etkiledikleri incelenebilir.

Öğretmen adaylarına öğretimle, uygulamayla ilgili daha iyi fırsatlar sunmak, dönütler vermek ve desteklemek için *Okul Öncesinde Matematik Öğretimi* dersinin

süresi artırılmalıdır. Böylece öğretmen adaylarına öğretecekleri matematik ile ilgili daha uzun deneyimler verilerek üniversite öncesinden taşıdıkları matematik kaygılarının etkisi azaltılabilir.

Son olarak, öğretmen adayları zaman zaman danışman öğretmenlerinin olumlu dönütlerinin ve cesaretlendirmelerinin matematik öğretimi kaygılarını düşürdüğünden bahsetmişlerdir. Bu nedenle danışman öğretmenler, öğretmen adayları ve öğretmen eğitimcileri arasında etkili iş birlikleri kurulmalıdır.

APPENDIX N: CURRICULUM VITAE

PERSONAL INFORMATION

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Degree	Institution	Year of Graduation
MS	METU Elementary Science and Mathematics Education	2010
BS	Baskent University Elementary Mathematics Education	2007
High School	Anafartalar (Super) High School, Denizli	2002

WORK EXPERIENCE

Year	Place	Enrollment
2008- Present	METU- Elementary Education	Research Assistant

FOREIGN LANGUAGES

Advanced English, Basic Italian

PUBLICATIONS

JOURNAL ARTICLES:

1. **Mehmetlioglu, D.** & Ozdem, Y. (2014). Connectivity Theory at work: The referrals between science and mathematics in a science unit. *International Journal of Education in Mathematics, Science and Technology, 2*(1), 36-48.

2. **Mehmetlioglu, D.,** & Haser, C. (2013). Preservice elementary mathematics teachers' preparedness for the teaching profession. *Pamukkale University Journal of Education*, *34*(2), 91-102.

INTERNATIONAL CONFERENCE PAPERS

1. Cebesoy, U. B., & Yeniterzi, B., & **Mehmetlioglu, D.** (2015, August). *An example of integrating mathematics to science: Graphs and living organisms.*

Paper presented at European Science Education Research Association Conference, Helsinki, Finland.

2. **Mehmetlioglu, D.**, & Arslan, M., & Balgalmis, E. (2015, September.). *Exploring preservice early childhood education teachers' views regarding what a mathematics problem is.* Paper presented at European Conference on Educational Research Pre-conference, Budapest, Hungary.

3. **Mehmetlioglu, D.**, & Karaarslan, G. (2015, July). *Looking into mathematics education in early childhood through sustainability lens*. Paper presented at 2015 OMEP World Assembly and Congress, Washington, America.

4. **Mehmetlioglu, D.**, & Çetinkaya Aydin, G. (2015, June). *Music integration into early childhood mathematics: Beliefs and attitudes of pre-service early childhood education*. Paper presented at ERPA Congress 2015, Athens, Greece.

5. Karaarslan, G., & **Mehmetlioglu, D.** (2015, May). *Transforming mathematics education for sustainability: An initial attempt.* Paper presented at International Congress on Education for the Future: Issues and Challenges, Ankara, Turkey.

6. **Mehmetlioglu, D.** (2014, June). *Misconceptions of elementary school students about comparing decimal numbers.* Paper presented at ERPA Congress 2014, Istanbul, Turkey. (Procedia - Social and Behavioral Sciences 152, 569-574).

7. **Mehmetlioglu, D**., & Haser, C. (2014, May). *Exploring preservice early childhood teachers' mathematics-related emotions.* Paper presented at International Conference on Education in Mathematics, Science and Technology, Konya, Turkey.

8. Karaarslan, G., & **Mehmetlioglu, D.** (2013, September). *Sustainability practices in the university campuses: Three UK models of sustainable campuses.* Paper presented at European Conference on Educational Research Pre-conference, Istanbul, Turkey.

9. **Mehmetlioglu, D.** (2013, September). *Reasons for beginning mathematics teachers' inconsistent beliefs and practices: Designing an effective support system*. Paper presented at European Conference on Educational Research Pre-conference, Istanbul, Turkey.

10. **Mehmetlioglu, D**., & Oren-Vural, D. (2013, July). *Early childhood preservice teachers' beliefs about nature of mathematics.* Paper presented at 2013 OMEP World Assembly and Congress, Shanghai, China.

11. **Mehmetlioglu, D.** (2012, September). *Historical development of place value*. Paper presented at European Conference on Educational Research Pre-conference, Cádiz, Spain.

12. **Mehmetlioglu, D.**, & Özdem, Y. (2011, September). *A case study of a science unit to make connections between elementary science and mathematics.* Paper presented at European Science Education Research Association Conference, Lyon, France.

13. **Mehmetlioglu, D**. (2011, July). Investigating relationship between readiness and self-efficacy of preservice teachers towards profession. In Ubuz, B. (Ed.). *Proceedings of the 35th Conference of the International Group for the Psychology of Mathematics Education*. (p. 359). Ankara, Turkey: PME

14. Balgalmış, E., Durmus T., & **Mehmetlioglu, D.** (2010, August). *Math anxiety level of elementary school studets' in Turkey*. Paper presented at European Conference on Educational Research Main conference, Helsinki, Finland.

15. **Mehmetlioglu, D**., & Haser, C. (2010, August). *Investigating the readiness of preservice teachers towards teaching profession.* Paper presented at European Conference on Educational Research Pre-conference, Helsinki, Finland.

COURSES/ SEMINARS/ WORKSHOPS:

Utrecht Summer School in Science and Mathematics Education 2009
Freudenthal Institute for Science and Mathematics Education
Universiteit of Utrecht, The Netherlands

Writing educational research for international journal publications, 2011
conferences, book chapters and theses
European Educational Research Summer School
University of Gothenburg in collaboration with EERA.

The YERME-day (for Young Researchers in ERME (European Society 2013
For Research In Mathematics Education)
Eighth Congress of European Research in Mathematics Education
Middle East Technical University, Antalya

Educators' Delegation Summer School 2014
Xiamen University, China in collaboration with Confucius
Institute at METU

AWARDS/CERTIFICATES:

Student of Honour and High Honour Başkent University	2003-2007
"Towards a Sustainable METU Campus Student Project Competition" held in collaboration with British Council Turkey and METU's Science and Society Center The 1st. Prize Winner	2011
ESERA 2011 Fellowship Winner	2011
European Educational Research Association- EERA Bursary Winner	2012
Scientific and Technological Research Council of Turkey (TUBITAK) (2224) Travel Award	2013

HOBBIES

Learning Foreign Languages, Movies, Zumba, Swimming

APPENDIX O: TEZ FOTOKOPISI IZIN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü ☐

Sosyal Bilimler Enstitüsü ■

Uygulamalı Matematik Enstitüsü ☐

Enformatik Enstitüsü ☐

Deniz Bilimleri Enstitüsü ☐

YAZARIN

Soyadı : Mehmetlioğlu Demirkıran
Adı : Deniz
Bölümü : İlköğretim

TEZİN ADI (İngilizce) : Exploring the Influence of Teaching Mathematics in Early Childhood Course on Preservice Early Childhood Teachers' Images and Emotions of Mathematics, Mathematics Anxiety and Mathematics Teaching Anxiety

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: