EXAMINING PROSPECTIVE ELEMENTARY AND MIDDLE SCHOOL
MATHEMATICS TEACHERS’ MATHEMATICS ANXIETY AND
MATHEMATICS TEACHING ANXIETY

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY
FATMA NUR ÖZLÜ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
MATHEMATICS EDUCATION IN MATHEMATICS AND SCIENCE
EDUCATION

APRIL 2024
Approval of the thesis:

EXAMINING PROSPECTIVE ELEMENTARY AND MIDDLE SCHOOL MATHEMATICS TEACHERS’ MATHEMATICS ANXIETY AND MATHEMATICS TEACHING ANXIETY

submitted by FATMA NUR ÖZLÜ in partial fulfillment of the requirements for the degree of Master of Science in Mathematics Education in Mathematics and Science Education, Middle East Technical University by,

Prof. Dr. Naci Emre Altun
Dean, Graduate School of Natural and Applied Sciences

Prof. Dr. Mine Işiksal Bostan
Head of the Department, Mathematics and Science Education

Assist. Prof. Dr. Işıl İşler Baykal
Supervisor, Mathematics and Science Education, METU

Examinining Committee Members:

Assist. Prof. Dr. Bahadır Yıldız
Mathematics and Science Education, Hacettepe University

Assist. Prof. Dr. Işıl İşler Baykal
Mathematics and Science Education, METU

Assoc. Prof. Dr. Sibel Kazak
Mathematics and Science Education, METU

Date: 24.04.2024
I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name Last name : Fatma Nur Özlü

Signature :
ABSTRACT

EXAMINING PROSPECTIVE ELEMENTARY AND MIDDLE SCHOOL MATHEMATICS TEACHERS’ MATHEMATICS ANXIETY AND MATHEMATICS TEACHING ANXIETY

Özlü, Fatma Nur
Master of Science, Mathematics Education in Mathematics and Science Education
Supervisor : Assist. Prof. Dr. İşıl İşler Baykal

April 2024, 87 pages

This quantitative survey method research investigated prospective elementary and middle school mathematics teachers’ mathematics anxiety, mathematics teaching anxiety, and the relationship between them. It also specified any differences in the levels of mathematics anxiety and mathematics teaching anxiety among prospective teachers based on factors such as academic year, gender, and program. Data was collected from 425 prospective teachers, including 182 elementary and 243 middle school mathematics teachers, during the first semester of the 2023-2024 academic year in Ankara. Prospective elementary and middle school mathematics teachers were administered the Mathematics Anxiety Scale for Teachers (MAST), created by Deniz and Üldaş (2008), and the Mathematics Teaching Anxiety Scale (MATAS), developed by Peker (2006). This study’s findings indicated prospective elementary and middle school mathematics teachers exhibited low levels of mathematics anxiety and mathematics teaching anxiety. This study revealed a strong positive correlation between mathematics anxiety among prospective elementary and middle school mathematics teachers and their anxiety in teaching mathematics. There was no
statistically significant difference in the mathematics and mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers and middle school mathematics teachers. Female prospective elementary teachers had significantly higher mathematics anxiety and mathematics teaching anxiety scores than males. Also, while female prospective middle school mathematics teachers had significantly higher mathematics anxiety scores than males, there was no significant difference in their mathematics teaching anxiety scores. Lastly, the study indicated prospective elementary teachers had significantly higher mathematics anxiety and mathematics teaching anxiety compared to prospective middle school mathematics teachers.

Keywords: Mathematics Anxiety, Mathematics Teaching Anxiety, Prospective Middle School Mathematics Teachers, Prospective Elementary Teachers
ÖZ

SINIF VE ORTAOKUL MATEMATİK ÖĞRETMEN ADAYLARININ MATEMATİK KAYGILARI VE MATEMATİK ÖĞRETME KAYGILARININ İNCELENMESİ

ÖZlü, Fatma Nur
Yüksek Lisans, Matematik Eğitimi, Matematik ve Fen Bilimleri Eğitimi
Tez Yöneticisi: Dr. Öğr. Üyesi Işıl İşler Baykal

Nisan 2024, 87 sayfa

matematik ve matematik öğretme kaygısı puanları arasında istatistiksel olarak anlamlı bir fark bulunmamıştır. Kadın sınıf öğretmen adaylarının matematik ve matematik öğretimi kaygı puanları erkekler göre anlamlı derecede daha yüksektir. Ayrıca, kadın ortaokul matematik öğretmen adaylarının matematik kayğı puanları erkekler göre anlamlı derecede yüksek iken, matematik öğretimine yönelik kaygı puanlarında anlamlı bir fark bulunmamıştır. Son olarak, çalışma sınıf öğretmeni adaylarının matematik kaygısı ve matematik öğretme kaygısı düzeylerinin ortaokul matematik öğretmeni adaylarına kıyasla istatistiksel olarak daha yüksek olduğunu göstermiştir.

Anahtar Kelimeler: Matematik Kaygısı, Matematik Öğretimi Kaygısı, Ortaokul Matematik Öğretmeni Adayları, Sınıf Öğretmeni Adayları
To My Beloved Family,

ix
ACKNOWLEDGMENTS

I would like to begin by expressing my heartfelt thanks to my esteemed advisor, Assistant Professor Işıl İşler Baykal, who provided unwavering support throughout my studies. I am extremely grateful to my dear advisor, who provided invaluable guidance throughout this challenging work and answered all my questions in a meticulous and careful manner. Her positive outlook, kindness, and thoughtfulness were instrumental in helping me to persevere and complete this study successfully. This study made me realize the significance of encountering an exceptional educator throughout one’s life. I feel very fortunate because my dear advisor has been a role model to me not only in this study but also in life, with her diligence, humility, and tolerance.

I express my gratitude to the esteemed committee members, Assistant Professor Dr. Bahadır Yıldız and Associate Professor Dr. Sibel Kazak, for their invaluable assistance and guidance in the successful completion of this study. Your invaluable feedback has greatly enhanced this study.

I would like to thank my parents, Hatice Özlü and İlhan Özlü, who have been there for me every step of the way throughout my graduate education. I'm truly grateful to them for everything they've done for me. I would also like to thank my dear big brother and brother Mustafa Yasir Özlü and Arif Emre Özlü, who have always been there for me with their advice and motivation.

I would also like to thank my dear friend Ayşe Nur Yağcı, who has been there for me through thick and thin, guiding me and supporting me. I'm so lucky to have such a wonderful friend!
# TABLE OF CONTENTS

ABSTRACT ........................................................................................................................................... v  
ÖZ ................................................................................................................................................... vii  
ACKNOWLEDGMENTS ..................................................................................................................... x  
TABLE OF CONTENTS ................................................................................................................... xi  
LIST OF TABLES ............................................................................................................................ xiv  
LIST OF FIGURES ........................................................................................................................... xvii  
LIST OF ABBREVIATIONS ............................................................................................................. xviii  

## CHAPTERS

1 INTRODUCTION ................................................................................................................................. 1  
1.1 Purpose of The Study .................................................................................................................... 4  
1.2 Research Questions ..................................................................................................................... 4  
1.3 Significance of The Study .......................................................................................................... 5  
1.4 Definition of Important Terms ................................................................................................ 6  

2 LITERATURE REVIEW ..................................................................................................................... 9  
2.1 Mathematics Anxiety .................................................................................................................. 9  
2.1.1 Definition of Mathematics Anxiety ....................................................................................... 9  
2.2 Factors Affecting Mathematics Anxiety .................................................................................... 11  
2.2.1 Gender .................................................................................................................................... 11  
2.2.2 Year ....................................................................................................................................... 12  
2.2.3 Program .................................................................................................................................. 12  
2.3 Mathematics Anxiety of Prospective Teachers ......................................................................... 13  
2.4 Mathematics Teaching Anxiety ................................................................................................ 18  
2.4.1 Definition of Mathematics Teaching Anxiety ......................................................................... 18
5.2 Implications for Prospective Teachers, Teachers, and Teacher Educators 76

5.3 Recommendations for Future Research ........................................... 79

REFERENCES .......................................................................................... 81

APPENDICES

A. The University Human Subjects Ethics Committee's Approval .......... 87
LIST OF TABLES

TABLES

Table 3.1 Number of Prospective Teachers Participating in the Study Regarding Programs and Years ................................................................. 28
Table 3.2 Number of Prospective Teachers Participating in the Study Regarding Gender .................................................................................. 29
Table 4.1 Descriptive Statistics Regarding Prospective Elementary Teachers’ Anxiety .................................................................................. 38
Table 4.2 Descriptive Statistics Regarding Prospective Middle School Mathematics Teachers’ Anxiety .................................................................... 39
Table 4.3 Skewness and Kurtosis Values for Prospective Elementary and Middle School Mathematics Teachers ......................................................... 41
Table 4.4 Correlations between Mathematics and Teaching Anxiety regarding Prospective Elementary Teachers .................................................. 45
Table 4.5 Correlations between Mathematics Anxiety and Mathematics Teaching Anxiety regarding Middle School Mathematics Teachers .................. 46
Table 4.6 Skewness and Kurtosis Values for Mathematics Anxiety of Prospective Elementary and Middle School Mathematics Teachers Regarding Years .................................................................................. 48
Table 4.7 Skewness and Kurtosis Values for Mathematics Teaching Anxiety of Prospective Elementary and Middle School Mathematics Teachers Regarding Years .................................................................................. 48
Table 4.8 Descriptive Statistics Regarding Prospective Elementary Teachers’ Mathematics Anxiety According to Years ........................................ 49
Table 4.9 Test of Homogeneity of Variance Regarding Prospective Elementary Teachers’ Mathematics Anxiety According to Years .................. 50
Table 4.10 One Way Anova Regarding Mathematics Anxiety of Prospective Elementary Teachers ........................................................................ 51
<table>
<thead>
<tr>
<th>Table No.</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.11</td>
<td>Descriptive Statistics Regarding Prospective Elementary Teachers’ Mathematics Teaching Anxiety According to Years</td>
<td>51</td>
</tr>
<tr>
<td>4.12</td>
<td>Test of Homogeneity of Variance Regarding Prospective Elementary Teachers’ Mathematics Teaching Anxiety According to Years</td>
<td>52</td>
</tr>
<tr>
<td>4.13</td>
<td>One Way Anova Regarding Mathematics Teaching Anxiety of Prospective Elementary Teachers</td>
<td>52</td>
</tr>
<tr>
<td>4.14</td>
<td>Descriptive Statistics Regarding Prospective Middle School Mathematics Teachers’ Mathematics Anxiety According to Years</td>
<td>53</td>
</tr>
<tr>
<td>4.15</td>
<td>Test of Homogeneity of Variance Regarding Prospective Middle School Mathematics Teachers’ Mathematics Anxiety According to Years</td>
<td>54</td>
</tr>
<tr>
<td>4.16</td>
<td>Robust Tests of Equality of Means Regarding Mathematics Anxiety</td>
<td>54</td>
</tr>
<tr>
<td>4.17</td>
<td>Descriptive Statistics Regarding Prospective Middle School Mathematics Teachers’ Mathematics Teaching Anxiety According to Years</td>
<td>55</td>
</tr>
<tr>
<td>4.18</td>
<td>Test of Homogeneity of Variance Regarding Prospective Middle School Mathematics Teachers’ Mathematics Teaching Anxiety According to Years</td>
<td>55</td>
</tr>
<tr>
<td>4.19</td>
<td>One Way Anova Regarding Mathematics Teaching Anxiety of Prospective Middle School Mathematics Teachers</td>
<td>56</td>
</tr>
<tr>
<td>4.20</td>
<td>Skewness and Kurtosis Values for Prospective Elementary Teachers Regarding Gender</td>
<td>57</td>
</tr>
<tr>
<td>4.21</td>
<td>Levene’s Test for Equality of Variances for Mathematics Anxiety of Prospective Elementary Teachers Regarding Gender</td>
<td>58</td>
</tr>
<tr>
<td>4.22</td>
<td>Prospective Elementary Teachers’ Mathematics Anxiety Regarding Gender</td>
<td>58</td>
</tr>
<tr>
<td>4.23</td>
<td>Levene’s Test for Equality of Variances for Mathematics Teaching Anxiety of Prospective Elementary Teachers Regarding Gender</td>
<td>59</td>
</tr>
<tr>
<td>4.24</td>
<td>Prospective Elementary Teachers’ Mathematics Teaching Anxiety Regarding Gender</td>
<td>60</td>
</tr>
<tr>
<td>4.25</td>
<td>Skewness and Kurtosis Values for Prospective Middle School Mathematics Teachers Regarding Gender</td>
<td>61</td>
</tr>
</tbody>
</table>
Table 4.26 Mann-Whitney U Test for Prospective Middle School Mathematics Teachers’ Mathematics Anxiety Regarding Gender .............................................61

4.27 Levene’s Test for Equality of Variances for Mathematics Teaching Anxiety of Middle School Mathematics Teachers Regarding Gender .............................................63

Table 4.28 Prospective Middle School Mathematics Teachers’ Mathematics Teaching Anxiety Regarding Gender ...............................................................63

Table 4.29 Levene’s Test for Equality of Variances for Mathematics Anxiety Regarding Program .................................................................64

Table 4.30 Skewness and Kurtosis Values for Prospective Teachers Regarding Program ............................................................................................65

Table 4.31 Prospective Teachers’ Mathematics Anxiety Regarding Program ..........................................................66

Table 4.32 Levene’s Test for Equality of Variances for Mathematics Teaching Anxiety Regarding Program ........................................................................67

Table 4.33 Prospective Teachers’ Mathematics Teaching Anxiety Regarding Program ..................................................................................................67
LIST OF FIGURES

FIGURES

Figure 4.1 Scatterplot for Outliers for Prospective Elementary Teachers .......... 40
Figure 4.2 Scatterplot for Outliers for Middle School Mathematics Teachers...... 41
Figure 4.3 Histogram for Normality of Mathematics Anxiety of Prospective
Elementary Teachers ....................................................................................... 42
Figure 4.4 Histogram for Normality of Mathematics Teaching Anxiety of
Prospective Elementary Teachers ..................................................................... 43
Figure 4.5 Histogram for Normality of Mathematics Anxiety of Prospective Middle
School Mathematics Teachers .......................................................................... 43
Figure 4.6 Histogram for Normality of Mathematics Teaching Anxiety of
Prospective Middle School Mathematics Teachers ............................................. 44
Figure 4.7 Scatter plot for Linearity for Prospective Elementary Teachers ........ 44
Figure 4.8 Scatter plot for Linearity for Prospective Middle School Mathematics
Teachers .............................................................................................................. 45
LIST OF ABBREVIATIONS

ABBREVIATIONS

METU: Middle East Technical University

MAST: Mathematics Anxiety Scale toward Teachers

MATAS: Mathematics Teaching Anxiety Scale

MATH: Mathematics
CHAPTER 1

INTRODUCTION

Mathematics is one of the oldest and most fundamental sciences ever found in the history of humanity. According to Baykul (2009), it fosters creative thinking and facilitates comprehension of the world. In addition, mathematics has always been an essential component of advancing technology, scientific research, and economic development (Algani, 2022). Countries that place a high priority on mathematics have consistently led to significant advancements. Mathematics can be found in every aspect of life, from the most basic to the most complex. For this reason, almost everyone must have a fundamental understanding of mathematics. Also, the interdependence of mathematics with other fields of study is evidence of the significance of mathematics and the widespread application of mathematics in a variety of fields of research and innovation. To summarize, mathematics is a scientific discipline that applies to all fields and functions in all aspects of life, so its significance in education and teaching cannot be overemphasized.

Mathematics is taught at almost every level of education. When incorrect and negative environmental attitudes and prejudices regarding mathematics are combined with negative educational experiences, then mathematics learning may transform into a complete failure to engage in the subject. This circumstance gives rise to a sequence of adverse emotions, cognitions, and actions pertaining to mathematics, including avoidance of the subject. Such behavior restricts an individual, diminishes his or her performance, induces stress, pressure, and restlessness, and is referred to as mathematics anxiety. Mathematics anxiety is defined as a negative emotional response to mathematics (Ashcraft, 2002). Since the 1950s, mathematics anxiety has been recognized as a challenging issue in educational environments. Afterward, a substantial amount of research was
conducted specifically on the topic of anxiety in mathematics. This is not only because mathematics is a crucial component of the school curriculum but also because it is an essential element of life. So, mathematics anxiety is one of the subjects that this study focuses on.

Possible causes of math anxiety have also been the subject of research (e.g., Alkan, 2010; Bekdemir, 2007; Özdemir & Sezginsoy Şeker, 2017). The classification system that is widely employed categorizes the primary factors contributing to mathematics anxiety as situational, personality, and personal causes (Byrd, 1982). A significant situational determinant of mathematics anxiety has been identified as the influence that mathematics teachers have on their students. Also, according to Luttenberger et al. (2018), the origins of mathematics anxiety can be categorized into individual and environmental factors. Personal causes refer to individual characteristics, such as previous knowledge, trait anxiety, or gender. On the other hand, environmental causes encompass factors like educational or cultural values and the impact of important people in their lives.

As they are held accountable for its occurrence, teachers and prospective teachers have also been the subject of mathematics anxiety research. Moreover, individuals with anxiety who are tasked with teaching mathematics may unintentionally transmit their anxieties to their students (Bekdemir, 2010). As a result, their pedagogical approach might induce mathematics anxieties among their students. It is important to note that individuals who experience mathematics anxiety may eventually become teachers of the future. Hence, it is critical to interrupt the recurring pattern of math anxiety before it becomes unbreakable.

Prospective teachers and teachers also may encounter anxiety related to teaching mathematics in addition to mathematics anxiety. This anxiety is a lesser-known phenomenon that emerges from the personal experiences of prospective teachers prior to teaching mathematics (Peker, 2009). Peker (2009) defines mathematics teaching anxiety as the emotions of tension and concern that prospective teachers and teachers undergo when teaching mathematical concepts, theories, and formulas.
or when solving problems. This form of anxiety distinguishes itself from the more frequently employed term mathematics anxiety as it specifically relates to an individual's anxiety regarding their competence in teaching mathematics (Brown et al., 2011). It may not be possible to separate prospective teachers' anxiety about mathematics from their anxiety about teaching mathematics. Therefore, it can be important to address prospective teachers' anxieties before becoming teachers.

Math anxiety might emerge as early as elementary school (Beilock & Willingham, 2014). Therefore, elementary and middle school mathematics teachers in charge of mathematics education have a significant duty and responsibility to prevent mathematics anxiety in students. Given that mathematically anxious teachers frequently transmit their anxiety and tendency to avoid math to their students, it is necessary to assess prospective teachers' mathematics anxiety and conduct studies to alleviate any existing anxiety. When the literature is examined, there are studies examining prospective elementary teachers' mathematics anxiety (e.g., Doruk & Kaplan, 2013), their mathematics teaching anxiety (e.g., Demir et al., 2016; Yavuz, 2018), prospective middle school mathematics teachers’ mathematics anxiety (e.g., Aydin et al., 2009; Doruk & Kaplan, 2013), their mathematics teaching anxiety (e.g., Çenberci, 2019; Tatar et al., 2016; Yavuz, 2018) and the differences in anxiety levels in terms of variables such as gender, age, year and program. Some studies examined the relationship between these two types of anxiety (e.g., Haciomeroglu, 2014; Peker & Ertekin, 2011; Serin, 2017; Unlu et al., 2017; Yazlık & Çetin, 2020). Studies examining the relationship between mathematics anxiety and mathematics teaching anxiety have been conducted by Peker and Ertekin (2011) with prospective elementary, middle, and secondary school mathematics teachers, by Haciomeroglu (2014) with elementary teachers, by Serin (2017) with prospective elementary teachers and by Yazlık and Çetin (2020) with prospective middle school mathematics teachers. This study examined mathematics anxiety, mathematics teaching anxiety, and the relationship between these anxieties among prospective
elementary teachers and middle school mathematics teachers. It also investigated whether these anxieties differ based on year, gender, and program.

1.1 Purpose of The Study

The purpose of the study was to investigate prospective elementary teachers' and prospective mathematics teachers’ mathematics anxiety, mathematics teaching anxiety, and the relationship between these anxieties. Additionally, this study aimed to compare prospective teachers' mathematics anxiety and mathematics teaching anxiety in terms of variables such as gender, year, and program.

1.2 Research Questions

1) What are prospective elementary teachers' mathematics anxiety and mathematics teaching anxiety mean scores?

2) What are prospective middle school mathematics teachers' mathematics anxiety and mathematics teaching anxiety mean scores?

3) Is there a relationship between mathematics anxiety scores and mathematics teaching anxiety scores for prospective elementary teachers?

4) Is there a relationship between mathematics anxiety scores and mathematics teaching anxiety scores for prospective middle school mathematics teachers?

5) Is there a difference in the mathematics anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers?

6) Is there a difference in the mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers?

7) Is there a difference in the mathematics anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective middle school mathematics teachers?
8) Is there a difference in the mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th year prospective middle school mathematics teachers?

9) Is there a difference in the mathematics anxiety scores of female and male prospective elementary teachers?

10) Is there a difference in the mathematics teaching anxiety scores of female and male prospective elementary teachers?

11) Is there a difference in the mathematics anxiety scores of female and male prospective middle school mathematics teachers?

12) Is there a difference in the mathematics teaching anxiety scores of female and male prospective middle school mathematics teachers?

13) Is there a difference in the mathematics anxiety scores of prospective elementary teachers and prospective middle school mathematics teachers?

14) Is there a difference in the mathematics teaching anxiety scores of prospective elementary teachers and prospective middle school mathematics teachers?

1.3 Significance of The Study

One of the motivations for conducting this study was that extensive research had been conducted in the Western context regarding mathematics anxiety; however, since Turkey's cultural and educational environment differs significantly, more research needs to be conducted using Turkish participants (Bekdemir, 2010). Alkan (2018), in her systematic review of research on mathematics anxiety in Turkey, states that there is a limited number of studies examining mathematics anxiety and anxiety about teaching mathematics in Turkey in the literature. Even though there were some studies examining mathematics anxiety and anxiety about teaching mathematics in Turkey (e.g., Haciomeroglu, 2014; Peker & Ertekin, 2011; Serin, 2017; Unlu et al., 2017; Yazlık & Çetin, 2020), the difference from the previous studies is that this study was conducted with a different sample. While certain studies on mathematics
anxiety and mathematics teaching anxiety focused exclusively on prospective elementary teachers (e.g., Çatlıoğlu et al., 2009), others specifically examined prospective middle school mathematics teachers (e.g., Peker & Ertekin, 2011). However, there is a lack of research that includes a sample consisting of both prospective elementary and middle school mathematics teachers. According to Beilock and Willingham (2014), math anxiety can manifest in elementary school. Consequently, it is imperative for elementary and middle school mathematics teachers, who are responsible for mathematics education, to actively work towards preventing mathematics anxiety in students.

In addition, there is a dearth of comprehensive studies that encompass all years of university students, including first-year, second-year, third-year, and fourth-year. Also, this study was carried out in 3 different universities apart from other studies. So, unlike most of the other studies, this study was conducted with prospective teachers studying in both the Elementary Education and Elementary Mathematics Education programs in Ankara in the 2023-2024 semester. Furthermore, this study aimed to investigate prospective teachers’ mathematics anxiety levels and mathematics teaching anxiety levels and to determine any differences in the levels of mathematics anxiety and mathematics teaching anxiety among prospective teachers based on factors such as academic year, gender, and program.

1.4 Definition of Important Terms

The year is the class level at the university.

The programs are the Elementary Education program and the Elementary Mathematics Education program.

Prospective elementary teachers consisted of university students studying in the Elementary Education program at a public university in Ankara from the 1st to the 4th year.
Prospective middle school mathematics teachers consisted of university students studying in the Elementary Mathematics Education program at two public universities in Ankara from the 1st to the 4th year.

Mathematics Anxiety: Richardson & Suinn (as cited in Dowker et al., 2016, p. 1) provides the following definition for mathematics anxiety: “a feeling of tension and anxiety that interferes with the manipulation of numbers and the solving of mathematical problems in ... ordinary life and academic situations.”

Mathematics Teaching Anxiety: Peker (2009, p. 336) provides the following definition for mathematics teaching anxiety: "Mathematics teaching anxiety refers to the experience of tension and anxiety by both pre-service and in-service teachers while instructing mathematical concepts, theories, and formulas, or while solving problems."
CHAPTER 2

LITERATURE REVIEW

This chapter will introduce the relevant literature in four sections. The initial section will provide a comprehensive explanation of the concept of mathematics anxiety. The second section will give information about factors affecting mathematics anxiety. The third section will provide details regarding the research conducted on the mathematics anxiety of prospective teachers. Finally, the final portion will address research on anxiety related to teaching mathematics.

2.1 Mathematics Anxiety

2.1.1 Definition of Mathematics Anxiety

Math anxiety has been recognized for a very long time as a problematic issue in education. Investigations into math anxiety have been ongoing since the 1950s. Mathematics anxiety encompasses a multitude of distinct definitions. Richardson and Suinn (1972) define mathematics anxiety as "feelings of tension ... that hinder the manipulation of numbers and the resolution of mathematical problems in various everyday life and academic contexts" (p. 551), which is the most widely accepted definition. Similarly, mathematics anxiety is typically defined as a state of tension, unease, or worry that hinders one's ability to perform well in mathematical tasks. Anxiety related to mathematics can cause stress or worry, which might impede one's ability to succeed in the subject (Ashcraft, 2002). Mathematics anxiety has been linked to negative attitudes toward the subject, weak performance on mathematics achievement tests, and avoidance of the subject, according to Hembree (1990).
Over time, the study of mathematics anxiety has become important as its influence on students’ mathematics performance has been recognized. Despite advances in technology and innovative teaching methods aimed at improving mathematics education, students continue to experience anxiety related to the subject. Therefore, further research has been devoted to identifying the underlying causes of mathematics anxiety. As a result, research is being conducted in Turkey and other countries to explore the concept of 'mathematics anxiety.'

Mathematics anxiety studies have been conducted with a wide range of participants, including primary and secondary school students (e.g., Hill et al., 2016), prospective teachers (e.g., Cenberci, 2019; Gresham, 2007), and in-service teachers (e.g., Beilock et al., 2010).

Research on mathematics anxiety has primarily focused on developing anxiety scales (Richardson & Suinn, 1972), evaluating the effectiveness of intervention strategies (Hendel & Davis, 1978), identifying factors related to mathematics anxiety, such as self-concept (Ahmed et al., 2012), and investigating the relationships between anxiety and achievement (e.g., Ramirez et al., 2016), and avoidance (e.g., Kelly & Tomhave, 1985).

Upon examination of the literature concerning mathematics anxiety studies in Turkey, a variety of themes emerged. Some research examined the relationship between anxiety and achievement factors (e.g., İlhan & Öner Sünkür, 2013), while others examined the relationship between anxiety and attitude and self-efficacy (e.g., Adal & Yavuz, 2017; Akın & Kurbanoğlu, 2011; Doruk et al., 2016; Kurbanoğlu & Takunyacı, 2012). Alkan (2018), in her systematic review of research on math anxiety in Turkey, found that the existing body of literature on the causes of mathematics anxiety in Turkey was found to be relatively scarce. Furthermore, limited studies were found in the literature that examined mathematics anxiety and anxiety regarding teaching mathematics in Turkey. As a result, one of the motivations for conducting this study was as follows: First and foremost, extensive research has been carried out within the Western context. Nevertheless, further
research is required using Turkish participants, as Turkey's cultural and educational environment differs significantly (Bekdemir, 2010).

2.2 Factors Affecting Mathematics Anxiety

Lazarus (as cited in Baloğlu, 2001, p. 4) asserts that mathematics anxiety is a phenomenon that arises from the interplay of various factors. These factors may pertain to the field of mathematics itself, as well as educational, familial, and personal values. In fact, Baloğlu (2001) indicated that attitudes toward mathematics are among the most frequently examined personality-related causes of mathematics anxiety. Also, the personal factors most commonly examined in studies on mathematics anxiety include gender, age, ethnicity, educational program, academic class, and socio-economic class (Baloğlu, 2001). Nevertheless, the literature also includes studies that qualitatively examine the impact of the teacher or teacher characteristics on mathematics anxiety (e.g., Wilson, 2018).

According to Keçeci (2011), mathematics anxiety can be attributed to three primary factors. The first is related to the nature of the subject itself, the second is associated with the students or their surroundings, and the third is linked to the educational system or the teachers. As a result, based on the literature, this study examined prospective teachers' mathematics anxiety in terms of factors such as gender, year, and program.

2.2.1 Gender

Gender disparities in mathematics anxiety have been the subject of research. Although gender is the most researched personal factor, there is still no agreement on the findings (Baloğlu, 2001). Some researchers found noticeable differences between the mathematics anxiety scores of male and female prospective teachers (Brady & Bowd, 2005; Malinsky et al., 2006). There are studies that have shown that
the scores of mathematics anxiety among female prospective teachers are significantly higher than the scores of mathematics anxiety among male prospective teachers (e.g., Brady & Bowd, 2005). For example, the majority of early childhood and elementary teachers are female, and they were found to be significantly more prone to have elevated levels of mathematics anxiety and unfavorable attitudes toward mathematics (Maloney & Beilock, 2012). However, it appeared that female prospective teachers exhibited reduced computation anxiety compared to their male counterparts (Haciomeroğlu, 2011).

2.2.2 Year

Year can also impact math anxiety levels for both students and teachers. The initial stage in developing interventions that reduce mathematics anxiety is the early identification of this condition. Such interventions can potentially positively impact the overall math achievement of the population (Ramirez et al., 2018). As such, early detection of mathematics anxiety is crucial.

In addition, depending on the fact that different courses, such as methods courses, are taken between years at the university, year-dependent differences can be observed in prospective teachers' mathematics anxiety levels (e.g., Çatloğlu et al., 2009). Therefore, in this study, the factor of year for both mathematics anxiety and mathematics teaching anxiety was taken into consideration.

2.2.3 Program

When analyzing studies on mathematics anxiety, it is evident that certain studies have explored whether there are differences in mathematics anxiety among university students based on their program. For instance, the study investigating the factors associated with math anxiety among engineering students at a private university revealed that the major of informatics engineering exhibited the highest degree of math anxiety in comparison to other majors (Prahmana et al., 2019).
Another example is provided by Üldaş (2005), who found that teachers in social sciences programs displayed greater levels of mathematics anxiety compared to teachers in science programs, particularly in the fields of physics, chemistry, and mathematics. Similarly, because prospective teachers from elementary mathematics education programs, as well as elementary education programs participated in this study, the question of whether or not there is a difference between these two programs in terms of mathematics anxiety was investigated.

2.3 Mathematics Anxiety of Prospective Teachers

Teachers might have a substantial impact on the extent of mathematical anxiety that students experience. This means teachers with high levels of anxiety can transfer these anxieties they have about mathematics teaching to their students. Given that teachers can pass on their mathematics anxiety to their students, it is critical to determine the mathematics anxiety levels of elementary teachers and middle school mathematics teachers who are responsible for this level of education or to conduct studies to eliminate this anxiety (Doruk & Kaplan, 2013). Therefore, one of the aims of this study is to determine the mathematics anxiety of prospective teachers before they become teachers.

Based on the findings of various researchers (e.g., Gresham, 2009; Levine, 1996; McAnallen, 2010), it has been determined that a significant proportion of elementary school teachers and prospective teachers experience high levels of anxiety regarding mathematics. It is worth noting that teachers who experience mathematics anxiety tend to pass on their fear and avoidance of the subject to their students (Bekdemir, 2010). As an additional point of interest, a number of researchers have investigated the relationship between mathematics teaching anxiety and mathematics anxiety among teachers (e.g., Brown et al., 2011; Hadley & Dorward, 2011).
Üldaş (2005) conducted a study to investigate and analyze the levels of mathematics anxiety among teachers and prospective teachers regarding variables such as gender, age, and program. The Mathematics Anxiety Scale Teacher (MAS-T), designed by Üldaş, was used to measure anxiety and explore its relationship with these variables. The study sample comprised 502 teachers employed in 16 distinct schools and programs in Istanbul and 947 first and fourth-year prospective teachers enrolled in various programs at a university in Istanbul. The data obtained using MAS-T was examined using one-tailed variance analysis and t-test. A statistically significant difference (p<0.01) emerged when the scores of teachers and prospective teachers from MAS-T were compared. The study revealed that the level of mathematics anxiety among prospective teachers was significantly greater than that of teachers. Moreover, the study findings indicated a statistically significant and negative correlation between teachers' anxiety towards mathematics and the variable of age. The one-tailed variance analysis revealed a statistically significant difference between teachers' total math anxiety scores and the programs they belong to in the MAS-T scale. However, there was no statistically significant difference observed between the math anxiety levels of the teachers according to their gender. Furthermore, when considering mathematics anxiety, it was noted that teachers in the social sciences program exhibited higher levels of mathematics anxiety compared to teachers in the science programs (specifically, physics, chemistry, and mathematics). In the results related to prospective teachers, no statistically significant difference was observed between the math anxiety scores of prospective teachers and their year variable. No statistically significant difference was observed between university students in their first year and those in their fourth year. Nevertheless, a statistically significant difference was found between the mathematics anxiety ratings of prospective teachers regarding program variable. Based on the findings, prospective teachers specializing in science fields such as mathematics, physics, and chemistry exhibited lower levels of mathematics anxiety than prospective teachers focusing on social sciences.
Bekdemir (2010) aimed to investigate the potential impact of the most distressing and worst mathematics classroom experience on the development of mathematics anxiety among prospective elementary school teachers. The investigation of the relationship between these negative experiences and the underlying causes of their anxiety was an additional aim of the study. A mixed-method explanatory approach was employed in the study. The term "worst" denoted a negative and anxiety-inducing student experience, whereas "troublesome" pertained to enduring experiences that induce profound stress. Participants in the research were 167 pre-service elementary teachers in their final year at a small, newly established university in northeastern Turkey. Data were collected using the Mathematics Anxiety Scale (MANX), developed by Erol in 1989 with Turkish students in mind. Furthermore, to examine the distinction between mathematics anxiety and the most challenging and distressing classroom experiences, the Worst Experience and Most Troublesome Mathematics Classroom Experience Reflection Test (WMTMCERT) was administered. Interview Protocol (IP) Interviews were utilized to gain a deeper understanding of previous adverse experiences that contributed to math anxiety. According to the analysis of their MANX scores, 53% of participants fell into the moderate category, whereas 6% fell into the very or extremely anxious category. An examination of the MANX and WMTMCERT revealed that anxiety levels differed significantly between individuals who claim to have encountered mathematics at its worst and those who do not. Based on these findings, there was a notable difference in mean anxiety scores between students who had the most distressing mathematics classroom experience and students who did not have the worst experience. A significant proportion of the respondents were found to encounter adverse experiences, with some of these negative occurrences dating back ten years in their individual academic careers. It can be inferred that these experiences either induced or exacerbated mathematics-related anxiety in the long run. Furthermore, the most distressing and worst experiences in mathematics classes were the primary causes of mathematics anxiety, according to the findings of this study. This study found that a significant number of prospective teachers experienced mathematics anxiety and that
the worst and most distressing experiences in the mathematics classroom directly contributed to their anxiety. Moreover, the primary cause of the participants’ mathematics anxiety was ascribed to their past teachers, specifically their conduct and instructional methods.

The aim of Doruk and Kaplan's study (2013) was to assess the levels of mathematics anxiety among prospective elementary teachers and prospective middle school mathematics teachers. Additionally, they aimed to investigate whether mathematics anxiety varied based on specific variables. Three hundred twenty-eight prospective teachers, including 216 prospective elementary teachers and 112 prospective middle school mathematics teachers, participated in the study. These individuals were in the second and fourth years and were enrolled at a state university during the first semester of the 2011-2012 academic year. The study utilized the Mathematics Anxiety Scale developed by Üldaş (2005). The level of general mathematics anxiety was assessed by analyzing the data collected from the mathematics scale. The study also investigated whether there were any differences in mathematics anxiety scores based on the variables of year and program of study. The study concluded that prospective teachers generally exhibited low mathematics anxiety. Furthermore, it was found that the level of mathematics anxiety among prospective teachers was not influenced by the program they were studying in. However, second-year prospective teachers exhibited higher levels of mathematics anxiety compared to fourth-year prospective teachers. Additionally, female prospective teachers experienced higher levels of mathematics anxiety than their male counterparts.

Gürbüz and Yıldırım's study (2016) aimed to assess mathematics anxiety among teachers and identify factors influencing it. Five hundred fifty-nine teachers took part in the study. The Mathematics Anxiety Scale created by Üldaş (2005) was used in this study. The study revealed that elementary teachers had low levels of mathematics anxiety. Furthermore, there was a statistically significant difference in teachers' mathematics anxiety based on gender. It was discovered that female teachers experienced higher levels of mathematics anxiety than male teachers. The age variable revealed that teachers' overall mathematics anxiety decreased as they
aged. Finally, the program variable revealed that graduates of the elementary education program had lower levels of mathematics anxiety than graduates of others.

Juniati and Budayasa (2020) conducted a study in Indonesia to determine the level of mathematics anxiety among prospective mathematics teachers. They also examined how mathematics anxiety varies based on gender and academic year and explored the impact of mathematics anxiety on mathematics performance. The research sample comprised 148 prospective mathematics teachers, including first-year, second-year, and third-year university students. The study's findings indicated that prospective mathematics teachers exhibited high levels of mathematics anxiety, which had a significant negative effect on their performance in mathematics. The study found that there was no significant difference in the level of mathematics anxiety between male and female students, and no difference was observed across different academic years.

Basso (2019), in her review, aimed to gain a deeper comprehension and investigation into the impact of mathematics anxiety on the teaching of prospective elementary teachers, as well as to identify potential strategies for reducing these adverse emotions towards mathematics. Social factors, including interactions between prospective teachers and their former or current instructors, were found to contribute to the exacerbation of mathematics anxiety among the participants or facilitate the transmission of this anxiety to others. It was suggested that by examining this, one could anticipate the potential ramifications for future students and ascertain whether this cycle of anxiety could be resolved.
2.4  Mathematics Teaching Anxiety

2.4.1  Definition of Mathematics Teaching Anxiety

Peker (2009, p. 336) provides the following definition of mathematics teaching anxiety: "Mathematics teaching anxiety refers to the experience of tension and anxiety by both pre-service and in-service teachers while instructing mathematical concepts, theories, and formulas, or while solving problems." Moreover, teaching anxiety, as defined by Gardner and Leak (1994), refers to the experience of anxiety that teachers have when preparing and implementing classroom activities. Brown et al. (2011) stated that anxiety about teaching mathematics is distinct from anxiety about mathematics in that it focuses on an individual's anxiety about their ability to teach mathematics and may not depend on the individual's knowledge of mathematics.

According to Levine (1996), preservice elementary school teachers commonly feel anxious about teaching mathematics and exhibit symptoms of mathematics anxiety. According to Levine (1996), high anxiety levels might interfere with learning new material in a methods course. Levine suggested that understanding how individuals' varying levels of anxiety can impact their responses to an activity can be utilized to shape curriculum development in a methods course.

2.5  Mathematics Teaching Anxiety of Prospective Teachers

Multiple studies have been conducted on the phenomenon of teaching anxiety specifically related to mathematics (e.g., Levine, 1996; Peker, 2006; Peker, 2009). For example, Peker's (2009) study aimed to examine the impact of expanded microteaching on the teaching anxiety of pre-service mathematics teachers in a teaching practicum course. The study found a statistically significant difference in
teaching anxiety levels between prospective mathematics teachers who used expanded microteaching and those who followed traditional methods in the teaching practicum course. In other words, the participants who were taught in the traditional way had a higher level of anxiety when teaching mathematics compared to those who were in the expanded micro-teaching group.

The aim of the research conducted by Çatlıoğlu et al. (2009) was to determine the extent of mathematics anxiety experienced by prospective elementary teachers. The study's sample comprised 207 prospective elementary teachers. This research comprised 120 fourth-year and 87 first-year students. In order to evaluate the level of mathematics anxiety, Üldaş's (2005) mathematics anxiety scale was utilized. As a result of the analysis, it was determined that the level of mathematics anxiety among prospective elementary school teachers was low and that there was no statistically significant difference by gender. Alternatively, substantial variations were observed in the year variable. This research indicated that first-year students were more likely than fourth-year students to experience mathematics anxiety.

Peker and Ertekin (2011) sought to explore the correlation between the level of mathematics anxiety among prospective teachers and their anxiety specifically related to teaching mathematics. Additionally, they aimed to analyze any potential gender disparities in these two types of anxieties. The researchers utilized the 23-item Mathematics Teaching Anxiety Scale (MATAS) created by Peker (2006) and the Mathematics Anxiety Scale (MAS) developed by Ertekin et al. (2006) as instruments for gathering data. The study involved a total of 316 prospective teachers, with 100 of them aspiring to become elementary school teachers, 115 middle school mathematics teachers, and 101 secondary school mathematics teachers. A significant, positive, and moderate correlation was found between the mathematics teaching anxiety of prospective teachers and their own mathematics anxiety. As a result, it was observed that the mathematics teaching anxiety of prospective teachers increased in tandem with their mathematics anxiety. Additionally, no notable disparity was observed between pre-service teachers based
on gender. The researchers suggested teacher educators be aware of the anxiety that their students experience when it comes to mathematics as well as their own anxiety regarding teaching mathematics. They contended that this might help to either increase prospective teachers' confidence in their ability to teach mathematics or to create an environment that supports them in their efforts to teach mathematics.

Brown et al. (2011) conducted a study in the United States of America to examine the frequency of mathematics anxiety that results in anxiety specifically related to teaching mathematics. Fifty-three prospective elementary teachers participated in the study, and their written reflections were examined and evaluated. The study's findings indicated that the relationship between mathematics anxiety and mathematics teaching anxiety varies among prospective teachers, making it challenging to predict this relationship accurately. An observation was made that prospective teachers who experience low mathematics anxiety may exhibit high anxiety when it comes to teaching mathematics, or conversely, prospective teachers with high mathematics anxiety may display low anxiety toward teaching mathematics. Brown et al. (2011) demonstrated that mathematics anxiety and mathematics teaching anxiety might be distinct constructs that require additional studies.

Haciomeroglu (2014) conducted a study to investigate the potential correlation between the level of mathematics anxiety among prospective elementary teachers and their mathematics teaching anxiety. The study's sample comprised 260 prospective elementary teachers enrolled at a state university in the northwest region of Turkey. The study utilized the Turkish version of the Mathematics Anxiety Rating Scale-Short Version (Baloglu, 2010) to assess the level of mathematics anxiety among prospective elementary teachers. The MATAS, developed by Peker in 2006, was also employed to measure teachers' mathematics teaching anxiety. The study's findings revealed that prospective teachers had low levels of both mathematics anxiety and mathematics teaching anxiety. Similarly, it was discovered that prospective teachers had relatively low levels of mathematics teaching anxiety. Furthermore, the study's findings revealed an important relationship between
prospective teachers' mathematics anxiety and mathematics teaching anxiety, and mathematics anxiety has a statistically significant effect on mathematics teaching anxiety. This study found a significant difference in the computation anxiety scores of female and male prospective teachers based on gender. Female pre-service teachers demonstrated lower computation anxiety than male pre-service teachers. However, no significant difference was found in terms of year.

Tatar et al. (2016) conducted a study to assess the extent of mathematics teaching anxiety among prospective mathematics teachers. The study was conducted with a sample size of 475 prospective mathematics teachers enrolled in the Faculty of Education at a Turkish university. Out of the total number of prospective teachers, 316 were prospective middle school mathematics teachers, while 159 were prospective secondary mathematics teachers. The data collection tool employed in this study was the Mathematics Teaching Anxiety Scale (MATAS) developed by Peker (2006). Based on the research findings, it was deduced that the general anxiety level of prospective mathematics teachers' mathematics teaching anxiety was low. Also, it was observed that prospective middle school mathematics teachers exhibited lower levels of mathematics teaching anxiety than prospective secondary mathematics teachers. Furthermore, it was ascertained that prospective middle school mathematics teachers' overall mathematics teaching anxiety levels did not differ significantly by year. Finally, the research findings revealed no statistically significant difference in the general mathematics teaching anxiety scores of prospective teachers based on gender.

Demir et al. (2016) conducted a study to assess the anxiety levels of prospective elementary teachers in relation to teaching mathematics, taking into account various variables. The study involved a group of 150 prospective elementary teachers, specifically those in the third and fourth years. The study found that there was no statistically significant difference in the anxiety levels of prospective elementary teachers toward teaching mathematics based on gender. However, it was observed that prospective elementary teachers in the third year had higher anxiety levels compared to those in the fourth year. It has been suggested that the reasons for
this may be attributed to the fact that third-year students have not yet undergone a mathematics teaching course or commenced their internship.

Serin (2017) sought to determine prospective elementary teachers’ mathematics anxiety levels, as well as their anxiety about teaching mathematics. At the same time, the relationship between mathematics anxiety and mathematics teaching anxiety was investigated in this study. The study included 233 prospective elementary teachers. The study used two basic data collection tools: Uldas's (2005) Mathematics Anxiety Scale for Teachers and Teacher Candidates (MAS-T) and Peker's (2006) Mathematics Teaching Anxiety Scale (MATAS). The data was analyzed using the arithmetic mean, t-test for independent samples, and Pearson's moment's correlation coefficient. The research revealed that prospective elementary teachers exhibited low levels of both mathematics anxiety and mathematics teaching anxiety. In addition, prospective elementary teachers in their third year exhibited greater levels of mathematics and mathematics teaching anxiety compared to those in their fourth year. It was ultimately determined that mathematics teaching anxiety and mathematics anxiety were positively strongly correlated.

Deringöl (2018) conducted a study to assess the levels of anxiety and competencies in mathematics teaching among prospective teachers in elementary schools. The study also investigated the impact of various variables on these factors. The study sample comprised 222 prospective teachers from elementary schools enrolled at a state university. The data collection tools utilized in this study were the Mathematics Teaching Anxiety Scale and the Mathematics Teaching Competency Scale, both of which were administered to elementary school teachers. The study concluded that prospective elementary teachers exhibited low levels of mathematics teaching anxiety and medium levels of mathematics teaching efficacy. The analysis of gender differences revealed that women exhibited lower levels of content knowledge anxiety in mathematics teaching compared to men. Furthermore, it was observed that the level of mathematics teaching anxiety among prospective teachers did not exhibit any significant changes based on the year. A strong negative correlation was observed between levels of anxiety related to teaching mathematics and levels of
competence in teaching mathematics. Put simply, when the mathematical teaching abilities of prospective teachers improved, their anxieties about teaching mathematics decreased, or vice versa.

Turan and Asal (2020) conducted a study to investigate the anxiety levels among prospective classroom teachers regarding mathematics teaching, considering various factors. The study's sample comprised 282 prospective elementary teachers enrolled in the undergraduate classroom teaching program. The study utilized the Anxiety Scale for Mathematics and Science Education (Aytekin et al., 2017), developed initially by Liu in 2016 and later adapted into Turkish in 2017. The results indicated that female students exhibited higher levels of mathematics teaching anxiety compared to male students. Furthermore, based on the year 1 variable, it was found that the levels of mathematics teaching anxiety among prospective teachers in the third year were higher compared to those in the second and fourth years.

The study's objective by Yazlık and Çetin (2020) was to determine whether prospective middle school mathematics teachers' mathematics anxiety could predict their mathematics teaching anxiety. Furthermore, an investigation was conducted to determine whether the levels of anxiety experienced in relation to mathematics and mathematics teaching varied by year. A sample of 307 prospective teachers enrolled in the Mathematics Education program participated in the research. As instruments for data collection, Üldaş's (2005) "Mathematics Anxiety Scale for Teachers and Teacher Candidates" and Peker's (2006) "Mathematics Teaching Anxiety Scale" were utilized. It was determined that prospective mathematics teachers had minimal anxiety regarding mathematics and mathematics teaching. A positive and moderately significant correlation was found between mathematics anxiety and mathematics teaching anxiety of prospective teachers. Furthermore, no significant variation was observed in the anxiety levels of prospective mathematics teachers regarding mathematics and mathematics teaching based on year.
Summary of the Literature Review

Consequently, the body of research presented studies on the anxiety that prospective teachers experience regarding mathematics and their anxiety regarding teaching mathematics. It was observed that prospective teachers had high levels of mathematics anxiety in some of the studies (Hembree, 1990). On the other hand, it was observed that prospective teachers had low levels of mathematics anxiety in some of the studies (e.g., Doruk & Kaplan, 2013; Yazlık & Çetin, 2020) that were conducted. On top of that, when the topic of prospective teachers’ mathematics teaching anxiety was investigated, some of the researchers found low levels of mathematics teaching anxiety in prospective teachers (e.g., Haciomeroglu, 2014; Yazlık & Çetin, 2020)

While numerous studies have established a correlation between mathematics anxiety and mathematics teaching anxiety, others indicated that the two might not be related. For example, Peker and Ertekin (2011) determined a notable and favorable correlation between mathematics anxiety and mathematics teaching anxiety in a study involving prospective high and middle school mathematics teachers. Nevertheless, Brown et al. (2011) determined that teachers who experienced low mathematics anxiety may exhibit high anxiety when it comes to teaching mathematics, or conversely.

Moreover, to assess mathematics anxiety and mathematics teaching anxiety, factors such as age, academic year, and gender were considered. Some studies concluded that there was no difference between males and females in terms of mathematics anxiety (e.g., Tatar et al., 2016), while other studies concluded that the level of mathematics anxiety in females was higher than in males (e.g., Gürbüz & Yıldırım, 2016). Also, some studies have investigated whether or not there was a distinction between prospective teachers regarding the academic year. In this particular instance, some studies have found a significant difference between years (e.g., Doruk & Kaplan, 2013). However, some studies have found no significant difference between years (e.g., Üldaş, 2005).
In addition, although less than other variables, there are studies on whether mathematics anxiety or anxiety towards teaching mathematics differs according to the program of the university. In some studies, a statistically significant difference was observed between prospective teachers' mathematics anxiety scores according to the program variable (e.g., Üldaş, 2005). However, other studies found that prospective teachers' mathematics anxiety levels were not affected by the program they studied (Doruk & Kaplan, 2013).

Lastly, although some studies on mathematics anxiety and mathematics teaching anxiety only involved prospective elementary teachers (e.g., Çatlıoğlu et al., 2009), some of them only involved prospective middle school mathematics teachers (e.g., Peker & Ertekin, 2011). Nevertheless, there is a scarcity of studies that include a sample comprising prospective elementary and prospective middle school mathematics teachers. Furthermore, there is a lack of comprehensive studies that include each year of university students, including those in their first, second, third, and fourth years.
CHAPTER 3

METHODOLOGY

This chapter will provide details regarding the study's design, sampling process, participants and context of the study, data collection tools and process, data analysis, and reliability and validity. Also included will be descriptions of the study’s ethical considerations and limitations of the study.

3.1 Design of the Study

This study was quantitative research. The study was a survey research design. Survey design is characterized by three primary attributes: information gathering through the formulation of inquiries, information collecting from a representative sample, and information gathering from a collective of individuals with the intention of fulfilling specific attributes (Fraenkel & Wallen, 2006). The purpose of the research was to investigate the mathematics anxiety and mathematics teaching anxiety of prospective elementary and middle school mathematics teachers through mathematical anxiety scales "Mathematics Anxiety Scale toward Teachers (MAST)" created by Deniz and Üldaş in 2008 and "Mathematics Teaching Anxiety Scale (MATAS)" created by Peker in 2006. In addition, the study aimed to determine whether there was a correlation between prospective teachers' mathematics anxiety and mathematics teaching anxiety. Additionally, the research aimed to determine any differences in mathematics anxiety and mathematics teaching anxiety among prospective teachers based on factors such as academic year, gender, and program.
3.2 Sampling Process

Convenience sampling was used to select the sample for this study. A convenience sample refers to a group of persons who are readily accessible and, therefore, suitable for research purposes (Fraenkel & Wallen, 2006). Three universities from Ankara were selected that were convenient for the researcher. The study's target population consisted of undergraduate students enrolled in the elementary and elementary mathematics education programs at three public universities in Ankara.

3.3 Participants of the Study

The research was performed involving a total of 425 prospective teachers. While 182 of the participants were prospective elementary teachers, 243 were prospective middle school mathematics teachers.

Table 3.1 Number of Prospective Teachers Participating in the Study Regarding Programs and Years

<table>
<thead>
<tr>
<th>Programs</th>
<th>First Year</th>
<th>Second Year</th>
<th>Third Year</th>
<th>Fourth Year</th>
<th>Total (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Education</td>
<td>53</td>
<td>43</td>
<td>48</td>
<td>38</td>
<td>182</td>
</tr>
<tr>
<td>Elementary Mathematics</td>
<td>39</td>
<td>68</td>
<td>62</td>
<td>74</td>
<td>243</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total (N)</td>
<td>92</td>
<td>111</td>
<td>110</td>
<td>112</td>
<td>425</td>
</tr>
</tbody>
</table>

Table 3.1 shows that 53 first-year, 43 second-year, 48 third-year, and 38 fourth-year students enrolled in the Elementary Education Program participated in the study.
Also, a total of 243 students from the Elementary Mathematics Education program participated in the study. Data were collected from 39 first-year, 68 second-year, 62 third-year, and 74 fourth-year students.

Table 3.2 Number of Prospective Teachers Participating in the Study Regarding Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Number of Prospective Elementary Teachers</th>
<th>Number of Prospective Middle School Mathematics Teachers</th>
<th>Total (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>29</td>
<td>62</td>
<td>91</td>
</tr>
<tr>
<td>Female</td>
<td>153</td>
<td>181</td>
<td>334</td>
</tr>
<tr>
<td>Total (N)</td>
<td>182</td>
<td>243</td>
<td>425</td>
</tr>
</tbody>
</table>

The number of male and female participants is presented in Table 3.2. The study included 153 prospective female elementary teachers and 29 prospective male elementary teachers as participants. In addition, 181 were female, and 62 were male among the prospective middle school mathematics teachers.

### 3.4 Context of the Study

This study was conducted with prospective teachers from the Elementary Education and the Elementary Mathematics Education programs.

The program's first year in the Elementary Education program included a Basic Mathematics in Elementary course, while the second year included no mathematics or mathematics-related courses. The third year included Mathematics Education I and Mathematics Education II courses, and the fourth year included Practice Teaching I and II courses.
When the courses offered for the Elementary Mathematics Education program (EME) are considered, the first and second years included mostly mathematics courses such as Calculus and Discrete Mathematics. In contrast, the third and fourth years included courses mostly related to teaching mathematics, such as Teaching Numbers, Mathematics Teaching Methods, and Practice Teaching I and II.

3.5 Data Collection Tools

In this study, two different questionnaires were applied to prospective elementary teachers and prospective middle school mathematics teachers. In particular, it was decided to use the "Mathematics Anxiety Scale for Teachers (MAST)" developed by Deniz and Üldaş in 2008 and the "Mathematics Teaching Anxiety Scale (MATAS)" developed by Peker in 2006 in this study. The scales were chosen because they are in Turkish and because of the availability of information about them.

The Mathematics Anxiety Scale Toward Teachers Scale is a 39-item, four-point Likert scale, while the Mathematics Teaching Anxiety Scale consists of 23 items, a five-point Likert scale. In addition to the utilization of the two measures, the participants were also provided with a demographic information form, including the participant's gender, year, and program.

The range of the MAST scale was 1 to 4, consisting of item-specific evaluations: (1) "I would not feel anxious," (2) "I would feel a little anxious," (3) "I would feel anxious," and (4) "I would feel extremely anxious.” Also, it consisted of 7 subscales. These are, respectively, the anxiety about understanding mathematics, the anxiety about teaching mathematics, the anxiety about problem-solving, the anxiety about arithmetic operations, mathematical self-efficacy, the anxiety about mathematical interpretation, and the anxiety about making mathematical mistakes. The information regarding the subgroups was acquired through email correspondence with Prof. Dr. Levent Deniz, who explicitly provided written permission to use the survey in this study.
The range of the MATAS scale was 1 (strongly disagree) to 5 (strongly agree). MATAS consisted of four different sub-factors. Factor one (items 21, 23, 24, 25, 26, 27, 28, 30, 31, and 33) was named as prospective teachers' content knowledge of anxiety towards teaching mathematics. Factor two (items 8, 9, 10, 13, 16, and 18) was named as prospective teachers' self-confidence and anxiety toward teaching mathematics. Factor three (items 6, 12, 15, and 17) was named as prospective teachers' attitudes towards teaching mathematics in anxiety towards teaching mathematics. Factor four (items 3, 4, and 5) was named as prospective teachers' field education knowledge in anxiety towards teaching mathematics. The information regarding the sub-scales was acquired through email correspondence with Prof. Dr. Murat Peker, with his explicit permission to use the survey in this study.

3.6 Data Collection Process

Prior to commencing the data collection process, ethical approval was acquired from the Middle East Technical University Human Subject Ethics Committee. Data were gathered from prospective elementary teachers and prospective middle school mathematics teachers enrolled at three public universities in Ankara during the first semester of the 2023-2024 academic year. University instructors were informed of the research by e-mail or by meeting them during their breaks, and permission was sought to administer the questionnaires during class hours. Once permission was obtained from the university instructors, the questionnaires were personally distributed during their scheduled class hours.

Prior to distributing the questionnaires, a brief overview of the study's purpose was provided. Moreover, the prospective teachers in the classrooms were told that there was an informed consent form and two different scales in the study, and the participation was voluntary. It was also emphasized that participants should read the questions carefully and answer them honestly. Students were given time to complete the questionnaires, which took approximately 20 minutes. The papers of the students who completed the study were collected. For the Google Form of the survey, the
informed consent form was placed on the first page, and after the participants had approved it, they could fill in the questionnaires.

### 3.7 Data Analysis

Initially, identification numbers were allocated to each individual in the gathered surveys. After the questionnaires were numbered, the data were entered into SPSS V22 for analysis. The descriptive statistics section employed frequencies to analyze categorical variables, such as gender (male and female), programs (elementary education and elementary mathematics education), and year (1, 2, 3, and 4).

SPSS V22 was used to calculate the means for continuous variables. Prior to commencing the analysis, a missing value analysis was conducted in SPSS. Missing values were identified by SPSS V22. There was only 1 missing value, and it was excluded from the study. Moreover, the Mathematics Teaching Anxiety Scale (MATAS) consisted of 23 items, with the first 10 items being negative and the next thirteen items being positive. A system of scoring was used, where “strongly agree” was assigned five points and “strongly disagree” was assigned one point. For the positive items, the answers were reverse coded, meaning that “strongly agree” was assigned one point and “strongly disagree” was assigned five points. The total anxiety score was then calculated, with higher scores indicating higher levels of anxiety among prospective teachers regarding teaching mathematics. Also, the total mathematics anxiety score was determined by coding all 39 items on the Mathematics Anxiety Scale Toward Teachers (MAST) as follows: one point was allocated for "I would not feel anxious," and four points were deducted for "I would feel extremely anxious." In addition, the assessment of normality was conducted by getting the values of skewness and kurtosis. According to Tabachnick and Fidell (2001), it is also advisable to examine the form of the distribution. Thus, the histogram was employed to assess normality. Kurtosis and skewness values were also analyzed. In cases where the assumptions were not met, non-parametric tests were used.
For descriptive statistics, the means and standard deviations were computed. For the inferential statistics, each prospective teacher's mathematics teaching anxiety and mathematics anxiety scores were calculated by combining the results from each scale. The research questions were addressed using correlation and group comparison methods.

3.8 Reliability and Validity

An internal consistency reliability analysis was conducted to assess the reliability of the Mathematics Anxiety Scale for Teachers (MAST). Optimally, the Cronbach's alpha coefficient of a scale should exceed 0.70 (Pallant, 2011). According to Deniz and Üldaş (2008), the MAST has good internal consistency, with a Cronbach α coefficient reported of 0.95. In the current study, the Cronbach's alpha coefficient for the MAST was 0.93.

Deniz and Üldaş (2008) conducted item discrimination analyses for each item in the MAST to assess internal criterion validity. The total scores from the entire scale were also considered. The independent group t-test was conducted on the separate scores obtained from each item of the MAST and the scores obtained from the entire scale. The results showed that all items were discriminative at a significance level of p<.01 for the entire scale. The discrimination analyses were also evaluated based on the total scores derived from the MAST, and it was found that the entire scale was statistically significant. Based on the obtained discrimination results, it can be emphasized that the scale's validity is guaranteed.

In addition, the Cronbach Alpha reliability coefficient was computed to assess the reliability of the Mathematics Teaching Anxiety Scale (MATAS). According to Peker (2006), MATAS has good interval consistency, with a Cronbach α coefficient reported of 0.91. In the current study, the Cronbach's alpha coefficient for the MATAS was 0.94. Based on these findings, it can be concluded that the scale yielded adequately reliable results.
Regarding validity, Peker (2006) found that the total correlations of the 23 items in the MATAS ranged from 0.20 to 0.74. This outcome indicated that these 23 items aligned with the entire scale.

3.9 The Study’s Ethical Considerations

Throughout the study, utmost care was taken to prioritize the well-being of the participants, both in terms of their physical and mental safety. During the administration of the questionnaires, it was emphasized that voluntary participation was essential. In addition, an informed consent form was distributed to all participants. Protecting the confidentiality of responses and restricting any connections between data respondents and participants was essential. By detaching ID from responses, it is possible to securely protect an individual's identity (Fraenkel & Wallen, 2006). The participants' consent forms and questionnaires were gathered independently to ensure confidentiality, and their identities were protected by assigning them unique ID numbers throughout the study. It was explicitly declared that the responses of the participants would be maintained in strict confidence and solely utilized for research purposes. It was also emphasized in the consent form that the questions in the questionnaire were not disturbing questions but that people who felt uncomfortable in any situation were free to leave the study and leave.

3.10 Limitations of the Study

The study is restricted to prospective elementary and middle school mathematics teachers enrolled in the 2023–2024 academic year at three public universities in Ankara. The study is restricted to utilizing the "Mathematics Anxiety Scale toward Teachers (MAST)" to assess the amount of mathematics anxiety among aspiring teachers.

Since the data collection coincided with the end of the first semester of the 2023-2024 academic year, the participation rate of students in the lessons was rather low.
Therefore, fewer prospective teachers might have been reached. For example, more female and male participants could have been included in the analysis of the gender component.

Also, the study is limited to the use of the "Mathematics Teaching Anxiety Scale (MATAS)," a tool employed to assess the extent of anxiety experienced by prospective teachers in relation to teaching mathematics.
CHAPTER 4

RESULTS

This section provides a thorough summary and findings of the data analysis conducted in the study. Initially, descriptive statistics, such as the mean and standard deviation, were employed to categorize, summarize, and visually display the results derived from the quantitative data. Additionally, inferential statistical methods such as Pearson Correlation, One-Way ANOVA, and Independent Samples T-test were employed to respond to the research questions. Before performing the analyses, initial analyses were conducted for each research question to check the assumptions. Each result will be presented by research questions.

4.1 Descriptive Results

Research Question 1: What are prospective elementary teachers' mathematics anxiety and mathematics teaching anxiety mean scores?

As indicated in the methods section, a four-point scale was employed to develop the MAST. The scale assigns points as follows: '1' goes for the response "I would not feel anxious," '2' for "I would feel a little anxious," '3' for "I would feel anxious," and '4' for "I would feel extremely anxious." The total score of the MAST was utilized to derive a score from which a general mathematics anxiety score was computed.

Moreover, as mentioned in the previous section of the study, MATAS was designed as a 5-point Likert scale, with options scored as strongly agree' (5 points), 'agree' (4 points), 'undecided' (3 points), 'disagree' (2 points), and strongly disagree' (1 point). The responses to the positive items were changed to 'Strongly agree': 1 point, 'Agree': 2 points, 'Undecided': 3 points, 'Disagree': 4 points, and 'Strongly disagree': 5 points and the score obtained was used to calculate the overall mathematic teaching anxiety
score. In other words, as the score increases, so does the anxiety of prospective teachers about teaching mathematics.

Table 4.1 Descriptive Statistics Regarding Prospective Elementary Teachers’ Anxiety

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>183</td>
<td>1.76</td>
<td>0.42</td>
<td>3.26</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>183</td>
<td>2.21</td>
<td>0.68</td>
<td>4.39</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4.1 shows the descriptive statistics regarding prospective elementary teachers anxiety. It shows that for the prospective elementary teachers, a mean of 1.76 and a standard deviation of 0.42 for mathematics anxiety was obtained. Also, a mean of 2.21 and a standard deviation of 0.68 were obtained for mathematics teaching anxiety.

Research Question 2: What are prospective middle school mathematics teachers’ mathematics anxiety and mathematics teaching anxiety mean scores?
Table 4.2 Descriptive Statistics Regarding Prospective Middle School Mathematics Teachers’ Anxiety

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>( \bar{X} )</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>244</td>
<td>1.66</td>
<td>0.36</td>
<td>3.15</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>244</td>
<td>1.88</td>
<td>0.53</td>
<td>3.61</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4.2 shows that for the middle school mathematics teachers, there was a mean of 1.66 and a standard deviation of 0.36 for mathematics anxiety. Also, a mean of 1.88 and a standard deviation of 0.53 were obtained for mathematics teaching anxiety.

Tables 4.1 and 4.2 show that prospective elementary teachers obtained higher mean scores regarding mathematics anxiety (M=1.76, SD=0.42) than prospective middle school mathematics teachers (M=1.66, SD=0.36). Moreover, prospective elementary teachers obtained higher mean scores (M=2.21, SD=0.68) than prospective middle school mathematics teachers (M=1.88, SD=0.53) regarding mathematics teaching anxiety.

4.2 Inferential Results

Research Question 3: Is there a relationship between mathematics anxiety scores and mathematics teaching anxiety scores for prospective elementary teachers?

A Pearson correlation analysis was conducted to determine the relationship between mathematics anxiety scores and mathematics teaching anxiety scores of prospective
elementary teachers. Before conducting the analysis, preliminary analyses were conducted to check the assumptions.

### 4.2.1 Assumptions for the Correlation Analysis

Before performing a correlation analysis, verifying if any assumptions have been violated is imperative. Before conducting the correlation analysis, the following assumptions were verified in the respective order. Initially, an examination of outliers was conducted. A scatter plot was utilized to identify any outliers. Subsequently, skewness and kurtosis values were acquired and assessed to check the normality. Furthermore, histograms were employed to examine the precise form of the distribution visually. Then, the assumptions of linearity and homoscedasticity were verified (Pallant, 2011).

Scatter plots were employed to examine and identify any outliers. The scatter plots for outliers associated with prospective elementary school teachers and prospective middle school mathematics teachers are illustrated in Figure 4.1 and Figure 4.2, respectively. In the scatterplots, some numbers were slightly over the threshold value. The researcher did not exclude any cases from the data, as these values were not very different from the rest of the distribution (Pallant, 2011).

![Figure 4.1 Scatterplot for Outliers for Prospective Elementary Teachers](image)

Figure 4.1 Scatterplot for Outliers for Prospective Elementary Teachers
The Skewness and kurtosis values and histograms were examined to check normality. As Pearson's correlation was performed on both groups, Skewness and kurtosis values were independently assessed for prospective elementary and middle school mathematics teachers.

Table 4.3 Skewness and Kurtosis Values for Prospective Elementary and Middle School Mathematics Teachers

<table>
<thead>
<tr>
<th></th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prospective Elementary</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teachers Mathematics Anxiety</td>
<td>0.59</td>
<td>0.11</td>
</tr>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>0.21</td>
<td>-0.28</td>
</tr>
<tr>
<td><strong>Prospective Middle School</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics Anxiety</td>
<td>1</td>
<td>1.20</td>
</tr>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>0.48</td>
<td>-0.23</td>
</tr>
</tbody>
</table>
When a distribution follows a normal distribution, the skewness and kurtosis values equal zero (Tabachnick & Fidell, 2013). This also means that when the values approach 0, the distribution is approximately normal. Table 4.3 shows that the skewness and kurtosis values for prospective elementary and middle school mathematics teachers were close to zero.

Furthermore, according to Field (2013), skewness and kurtosis values within the range of –1.96 to +1.96 indicate a normal distribution. Table 4.3 shows that all the skewness and kurtosis values were between –1.96 and +1.96. Therefore, the distribution was accepted as normal.

According to Tabachnick and Fidell (2007), it is advisable to examine the shape of the distribution by utilizing a histogram with a substantial sample size of 200 or more cases. Therefore, the study separately examined histograms of mathematics anxiety and mathematics teaching anxiety for prospective elementary and prospective elementary mathematics teachers, focusing on normality distribution. Also, the figures shown below, Figure 4.3, Figure 4.4, Figure 4.5, and Figure 4.6, demonstrated that the scores of each variable were almost normally distributed.

Figure 4.3 Histogram for Normality of Mathematics Anxiety of Prospective Elementary Teachers
Figure 4.4 Histogram for Normality of Mathematics Teaching Anxiety of Prospective Elementary Teachers

Figure 4.5 Histogram for Normality of Mathematics Anxiety of Prospective Middle School Mathematics Teachers
Scatter plots were checked for the assumption of linearity. Scatter plots of scores were formed to check the linearity assumption. Figures 4.7 and 4.8 show the linearity for both prospective elementary teachers and middle school mathematics teachers. The relationship between the two variables was inspected as linear, so this assumption was not violated.
Figure 4.8 Scatter plot for Linearity for Prospective Middle School Mathematics Teachers

Then, a scatter plot was used to check the assumption of homoscedasticity. The assumption was verified because the plots exhibited a regular cigar shape along their length (Pallant, 2011).

### 4.2.2 Results Regarding Correlation

Table 4.4 Correlations between Mathematics and Teaching Anxiety regarding Prospective Elementary Teachers

<table>
<thead>
<tr>
<th></th>
<th>Mathematics Anxiety</th>
<th>Mathematics Teaching Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>1</td>
<td>0.602*</td>
</tr>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>0.602*</td>
<td>1</td>
</tr>
</tbody>
</table>

Correlation is significant at the 0.01 level (2-tailed).
The relationship between mathematics anxiety and mathematics teaching anxiety for prospective elementary teachers was investigated using the Pearson product-moment correlation coefficient. Table 4.4 shows that the Pearson correlation coefficient is 0.60, which indicates a positive correlation between mathematics anxiety and mathematics teaching anxiety of prospective elementary teachers. Therefore, the more prospective elementary teachers have mathematics anxiety, the more they have mathematics teaching anxiety. Furthermore, according to Palant (2011), a value of 0.60 indicates a large correlation between mathematics anxiety and mathematics teaching anxiety of prospective elementary teachers. There was a strong, positive correlation between the two variables, \( r = 0.60, n = 183 \).

*Research Question 4:* Is there a relationship between mathematics anxiety scores and mathematics teaching anxiety scores for prospective middle school mathematics teachers?

Table 4.5 Correlations between Mathematics Anxiety and Mathematics Teaching Anxiety regarding Middle School Mathematics Teachers

<table>
<thead>
<tr>
<th></th>
<th>Mathematics Anxiety</th>
<th>Mathematics Teaching Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>1</td>
<td>0.626*</td>
</tr>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>0.626*</td>
<td>1</td>
</tr>
</tbody>
</table>

Correlation is significant at the 0.01 level (2-tailed).

The relationship between mathematics anxiety and mathematics teaching anxiety for prospective middle school mathematics teachers was investigated using the Pearson
product-moment correlation coefficient. There was a strong, positive correlation between the two variables, $r = 0.62$, $n = 244$.

Research Question 5: Is there a difference in the mathematics anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers?

A one-way ANOVA test was employed to respond to research question 5. Before conducting the analysis, preliminary analyses were conducted to check the assumptions.

4.2.3 Assumptions for One-Way ANOVA

Before performing the variance analysis, the following assumptions were verified. Initially, the researcher assessed the level of measurement to ensure that the dependent variable was measured at the interval or ratio level, as parametric approaches rely on this assumption (Pallant, 2011). Subsequently, the researcher verified the independence of the observations. Furthermore, the skewness and kurtosis values were obtained to assess normality. The assumption of homogeneity of variance was verified (Pallant, 2011).

Mathematics anxiety and mathematics teaching anxiety scores of prospective elementary and middle school teachers were evaluated to determine the assumption of a level of measurement. In this study, mean scores were calculated before conducting tests. This indicated that continuous measures of dependent variables were used. Furthermore, each measurement was not influenced by another measurement. Therefore, the independence of observations was ensured. To check the normal distribution, the skewness, and kurtosis values were examined before conducting the parametric test.
Table 4.6 Skewness and Kurtosis Values for Mathematics Anxiety of Prospective Elementary and Middle School Mathematics Teachers Regarding Years

<table>
<thead>
<tr>
<th></th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prospective Elementary Teachers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Year</td>
<td>0.11</td>
<td>-0.8</td>
</tr>
<tr>
<td>Second Year</td>
<td>1.02</td>
<td>1.61</td>
</tr>
<tr>
<td>Third Year</td>
<td>0.54</td>
<td>-0.37</td>
</tr>
<tr>
<td>Fourth Year</td>
<td>0.50</td>
<td>0.04</td>
</tr>
<tr>
<td><strong>Prospective Middle School Mathematics Teachers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Year</td>
<td>0.38</td>
<td>-0.72</td>
</tr>
<tr>
<td>Second Year</td>
<td>0.70</td>
<td>0.44</td>
</tr>
<tr>
<td>Third Year</td>
<td>0.39</td>
<td>-0.23</td>
</tr>
<tr>
<td>Fourth Year</td>
<td>1.24</td>
<td>1.18</td>
</tr>
</tbody>
</table>

Table 4.6 shows the skewness and kurtosis values for mathematics anxiety of prospective elementary and middle school mathematics teachers for four years. The skewness and kurtosis values were in the range between +1.96 and −1.96. This shows that each of the variables was almost normally distributed (Field, 2013)

Table 4.7 Skewness and Kurtosis Values for Mathematics Teaching Anxiety of Prospective Elementary and Middle School Mathematics Teachers Regarding Years

<table>
<thead>
<tr>
<th></th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prospective Elementary Teachers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First Year</td>
<td>0.20</td>
<td>-0.38</td>
</tr>
<tr>
<td>Second Year</td>
<td>-0.18</td>
<td>-0.84</td>
</tr>
</tbody>
</table>

48
Table 4.7 (continued)

<table>
<thead>
<tr>
<th></th>
<th>Third Year</th>
<th>Fourth Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prospective Elementary Teachers</td>
<td>0.34</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>0.24</td>
<td>-0.88</td>
</tr>
<tr>
<td></td>
<td>-0.04</td>
<td>-0.83</td>
</tr>
<tr>
<td>Prospective Middle School Mathematics Teachers</td>
<td>0.41</td>
<td>-0.50</td>
</tr>
<tr>
<td></td>
<td>0.24</td>
<td>-0.54</td>
</tr>
<tr>
<td></td>
<td>0.98</td>
<td>1.13</td>
</tr>
</tbody>
</table>

Table 4.7 shows the skewness and kurtosis values for mathematics teaching anxiety of prospective elementary and middle school mathematics teachers for four years. The skewness and kurtosis values were in the range between +1.96 and −1.96. This shows that each of the variables was almost normally distributed (Field, 2013).

Table 4.8 Descriptive Statistics Regarding Prospective Elementary Teachers’ Mathematics Anxiety According to Years

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td>53</td>
<td>1.88</td>
<td>0.44</td>
<td>2.77</td>
<td>1</td>
</tr>
<tr>
<td>Second Year</td>
<td>43</td>
<td>1.74</td>
<td>0.46</td>
<td>3.26</td>
<td>1.03</td>
</tr>
<tr>
<td>Third Year</td>
<td>48</td>
<td>1.68</td>
<td>0.37</td>
<td>2.54</td>
<td>1</td>
</tr>
<tr>
<td>Fourth Year</td>
<td>38</td>
<td>1.69</td>
<td>0.36</td>
<td>2.67</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
<td>1.76</td>
<td>0.42</td>
<td>3.26</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4.8 shows descriptive statistics for mathematics anxiety of prospective elementary teachers regarding years. According to the table, there are quite small differences between the mean scores between the years. It is seen that the prospective elementary teachers who had the highest mean score of mathematics anxiety were in the 1st year (M=1.88, SD=0.44), while the lowest mean score of mathematics anxiety was in the 3rd year (M=1.68, SD=0.37).

Table 4.9 Test of Homogeneity of Variance Regarding Prospective Elementary Teachers’ Mathematics Anxiety According to Years

<table>
<thead>
<tr>
<th></th>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>1.162</td>
<td>3</td>
<td>178</td>
<td>0.32</td>
</tr>
</tbody>
</table>

Levene's test was conducted to determine the homogeneity of variances, and the results are presented in Table 4.9. If the significance value is greater than 0.05, the assumption of homogeneity of variance has not been violated (Pallant, 2011). In the table, the significance value was 0.32. Since this significance value was greater than 0.05, it did not violate the homogeneity of variance assumption.

4.2.4 Results Regarding Year

In this section results regarding year will be presented for both prospective elementary teachers and prospective middle school mathematics teachers.
A one-way between-groups analysis of variance was conducted to explore the year's impact on mathematics anxiety for prospective elementary teachers, as measured by the Mathematics Anxiety Scale for Teachers. Participants were divided into four groups according to their years (Group 1: First Year; Group 2: Second Year; Group 3: Third Year; Group 4: Fourth Year). There was no statistically significant difference at the p<0.05 level in mathematics anxiety scores for the four-year groups: F(3,178)=2.50, P=0.06. The difference in mean scores between groups was small.

**Research Question 6:** Is there a difference in the mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers?

Table 4.11 Descriptive Statistics Regarding Prospective Elementary Teachers’ Mathematics Teaching Anxiety According to Years

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>$\bar{X}$</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td>53</td>
<td>2.23</td>
<td>0.62</td>
<td>3.65</td>
<td>1.09</td>
</tr>
<tr>
<td>Second Year</td>
<td>43</td>
<td>2.08</td>
<td>0.63</td>
<td>3.35</td>
<td>1</td>
</tr>
<tr>
<td>Third Year</td>
<td>48</td>
<td>2.33</td>
<td>0.74</td>
<td>4.39</td>
<td>1.09</td>
</tr>
<tr>
<td>Fourth Year</td>
<td>38</td>
<td>2.16</td>
<td>0.75</td>
<td>3.74</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>182</td>
<td>2.21</td>
<td>0.68</td>
<td>4.39</td>
<td>1</td>
</tr>
</tbody>
</table>
Table 4.11 shows descriptive statistics for mathematics teaching anxiety of prospective elementary teachers regarding years. According to the table, quite small differences exist between the mean scores between the years. It is seen that the prospective elementary teachers who have the highest mean score of mathematics teaching anxiety were in the third year (M=2.33, SD=0.74), while the lowest mean score of mathematics teaching anxiety was in the second year (M=2.08, SD=0.63).

Table 4.12 Test of Homogeneity of Variance Regarding Prospective Elementary Teachers’ Mathematics Teaching Anxiety According to Years

<table>
<thead>
<tr>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Teaching Anxiety</td>
<td>0.97</td>
<td>3</td>
<td>178</td>
</tr>
</tbody>
</table>

Levene’s test for the homogeneity of variances is shown in Table 4.12. In the table, the significance value is 0.40. Since the significance value was greater than 0.05, it did not violate the homogeneity of variance assumption.

Table 4.13 One Way Anova Regarding Mathematics Teaching Anxiety of Prospective Elementary Teachers

<table>
<thead>
<tr>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>1.08</td>
</tr>
<tr>
<td>Within Groups</td>
<td>178</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>181</td>
<td></td>
</tr>
</tbody>
</table>

p<0.05
A one-way between-groups analysis of variance was conducted to explore the year's impact on mathematics teaching anxiety for prospective elementary teachers. Participants were divided into four groups according to their years (Group 1: First Year; Group 2: Second Year; Group 3: Third Year; Group 4: Fourth Year). There was no statistically significant difference at the $p<0.05$ level in mathematics anxiety scores for the four-year groups: $F(3, 178) = 1.08, P = 0.35$. The difference in mean scores between groups was small.

*Research Question 7:* Is there a difference in the mathematics anxiety scores of 1st, 2nd, 3rd, and 4th year prospective middle school mathematics teachers?

Table 4.14 shows descriptive statistics for mathematics anxiety of prospective middle school mathematics teachers regarding years. According to the table, there are quite small differences between the mean scores between the years. It is seen that the prospective middle school mathematics teachers who have the highest mean score of mathematics anxiety were in the third year ($M=1.71, SD=0.34$), while the lowest mean score of mathematics anxiety was in the first year ($M=1.57, SD=0.24$).
According to Table 4.15, the significance value for Levene’s test for homogeneity of variance is less than 0.05. Therefore, the assumption of homogeneity of variance was violated. If the assumption of homogeneity of variance was violated in the analysis of variance (ANOVA), one could report Welch’s F to determine the statistical significance (Field, 2013). The table of Robust Tests of Equality of Means (Table 4.16) was consulted.

Table 4.16 Robust Tests of Equality of Means Regarding Mathematics Anxiety

<table>
<thead>
<tr>
<th>Statistic(a)</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welch</td>
<td>1.93</td>
<td>3</td>
<td>127.46</td>
</tr>
</tbody>
</table>

a. Asymptotically F distributed.

The Welch test showed a significance value of 0.12. Therefore, there was no statistically significant difference at the p<0.05 level in mathematics anxiety scores for the four-year groups.

*Research Question 8:* Is there a difference in the mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th year prospective middle school mathematics teachers?
Table 4.17 Descriptive Statistics Regarding Prospective Middle School Mathematics Teachers’ Mathematics Teaching Anxiety According to Years

<table>
<thead>
<tr>
<th>Year</th>
<th>N</th>
<th>X̄</th>
<th>SD</th>
<th>Maximum</th>
<th>Minimum</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Year</td>
<td>39</td>
<td>1.90</td>
<td>0.48</td>
<td>2.87</td>
<td>1</td>
</tr>
<tr>
<td>Second Year</td>
<td>68</td>
<td>1.86</td>
<td>0.52</td>
<td>3.22</td>
<td>1</td>
</tr>
<tr>
<td>Third Year</td>
<td>62</td>
<td>2.00</td>
<td>0.56</td>
<td>3.30</td>
<td>1</td>
</tr>
<tr>
<td>Fourth Year</td>
<td>74</td>
<td>1.78</td>
<td>0.52</td>
<td>3.61</td>
<td>1.04</td>
</tr>
<tr>
<td>Total</td>
<td>243</td>
<td>1.88</td>
<td>0.53</td>
<td>3.61</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 4.17 shows descriptive statistics for mathematics teaching anxiety of middle school mathematics teachers regarding years. According to the table, quite small differences exist between the mean scores between the years. Prospective middle school mathematics teachers with the highest mean mathematics teaching anxiety score were in the third year (M=2.00, SD=0.56), while the lowest mean score of mathematics teaching anxiety was in the fourth year (M=1.78, SD=0.52).

Table 4.18 Test of Homogeneity of Variance Regarding Prospective Middle School Mathematics Teachers’ Mathematics Teaching Anxiety According to Years

<table>
<thead>
<tr>
<th>Mathematics Teaching Anxiety</th>
<th>Levene Statistic</th>
<th>df1</th>
<th>df2</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.52</td>
<td>3</td>
<td>239</td>
<td>0.66</td>
</tr>
</tbody>
</table>

Levene’s test for the homogeneity of variances is shown in Table 4.18. If the significance value is greater than 0.05, the assumption of homogeneity of variance
is not violated. In the table, the significance value was 0.66. Because the significance value was greater than 0.05, it did not violate the homogeneity of variance assumption.

Table 4.19 One Way Anova Regarding Mathematics Teaching Anxiety of Prospective Middle School Mathematics Teachers

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>3</td>
<td>2.01</td>
<td>0.11</td>
</tr>
<tr>
<td>Within Groups</td>
<td>239</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>242</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

p<0.05

A one-way between-groups analysis of variance was conducted to explore the year's impact on mathematics teaching anxiety for prospective middle school mathematics teachers, as measured by the Mathematics Teaching Anxiety Scale. Participants were divided into four groups according to their years (Group 1: First Year; Group 2: Second Year; Group 3: Third Year; Group 4: Fourth Year). There was no statistically significant difference at the p<0.05 level in mathematics anxiety scores for the four-year groups: F(3,239)=2.01, P=0.11. The difference in mean scores between groups was small.

Research Question 9: Is there a difference in the mathematics anxiety scores of female and male prospective elementary teachers?

4.2.5 Assumptions for Independent-Samples T-Test Analysis

The mean mathematics anxiety and mathematics teaching anxiety scores of female and male prospective teachers were compared using an independent sample t-test. There are two variables: gender, which is a categorical and independent variable, and
anxiety score, which is a continuous and dependent variable (specifically, mathematics anxiety scores or mathematics teaching anxiety scores).

Before beginning the analysis of the Independent-Samples T-Test, the following assumptions were verified. The researcher first evaluated the level of measurement to ensure that the dependent variable was measured at the interval or ratio level, as parametric approaches rely on this assumption (Pallant, 2011). The researcher then verified that the observations were independent. Skewness and kurtosis values were also obtained to assess normality. Finally, the assumption of variance homogeneity was tested (Pallant, 2011). To determine the level of measurement assumption, prospective elementary and middle school teachers' mathematics anxiety and teaching anxiety scores were assessed. Mean scores were calculated prior to the administration of tests in this study. This indicated that continuous measures of dependent variables were used. Moreover, each measurement was independent of any other measurement. Thus, the observations were guaranteed to be independent.

Field (2013) found that values in the range of ±1.96 have a normal distribution in small samples. The study included 153 female prospective elementary teachers and 29 male elementary teachers. Table 4.20 shows that the skewness and kurtosis values were at ±1.96. Therefore, there was a normal distribution of data.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Anxiety</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Mathematics Anxiety</td>
<td>0.56</td>
<td>-0.08</td>
</tr>
<tr>
<td></td>
<td>Mathematics Teaching Anxiety</td>
<td>0.18</td>
<td>-0.27</td>
</tr>
<tr>
<td>Male</td>
<td>Mathematics Anxiety</td>
<td>0.01</td>
<td>-0.34</td>
</tr>
<tr>
<td></td>
<td>Mathematics Teaching Anxiety</td>
<td>0.11</td>
<td>-1.08</td>
</tr>
</tbody>
</table>
Table 4.21 Levene’s Test for Equality of Variances for Mathematics Anxiety of Prospective Elementary Teachers Regarding Gender

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>4.82</td>
<td>0.02</td>
</tr>
</tbody>
</table>

According to Table 4.21, Levene's test had a p-value of 0.02 for mathematics anxiety among prospective elementary teachers. This was less than 0.05. This implies that the variances for females and males were different (Pallant, 2011). As a result, this dataset violated the assumption of equal variance.

However, SPSS V22 provided an alternative t-value to account for the fact that the variances were not equal. As a result, the information for labeling the equal variances that were not assumed was reported.

4.2.6 Results Regarding Gender

Table 4.22 Prospective Elementary Teachers’ Mathematics Anxiety Regarding Gender

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X ( \bar{x} )</td>
<td>SD ( s )</td>
</tr>
<tr>
<td>Mathematics Anxiety</td>
<td>1.80</td>
<td>0.42</td>
</tr>
</tbody>
</table>

*p<0.05

An independent-sample t-test was conducted to compare the mathematics anxiety scores of prospective elementary teachers for females and males. According to Table 4.22, there was a statistically significant difference in mathematics anxiety scores for females (\( M=1.80, \ SD=0.42 \)) and males (\( M=1.53, \ SD=0.31 \); \( t (49.59) =3.95, \ p=0.00, \)
two-tailed). The magnitude of the differences in the means (mean difference= 0.26, 95% CI:0.13 to 0.40) was moderate (eta squared = 0.07).

Effect size statistics indicate the magnitude of differences between groups. Eta squared was one of the most widely used (Pallant, 2011). Eta squared (η²) was calculated using the information in Table 4.22. Appropriate values were replaced for the formula of eta squared as the following:

\[ \text{Eta squared} = \frac{3.95^2}{3.95^2 + (153 + 29 - 2)} = 0.07 \]

According to Pallant (2011), this value showed a moderate effect size of 0.07.

**Research Question 10:** Is there a difference in the mathematics teaching anxiety scores of female and male prospective elementary teachers?

Table 4.23 Levene’s Test for Equality of Variances for Mathematics Teaching Anxiety of Prospective Elementary Teachers Regarding Gender

<table>
<thead>
<tr>
<th>Mathematics Teaching Anxiety</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.51</td>
<td>0.47</td>
</tr>
</tbody>
</table>

According to Table 4.23, Levene's test revealed a p-value of 0.47 for mathematics teaching anxiety among prospective elementary teachers. This was larger than 0.05. This implies that the variances for males and females were equal (Pallant, 2011). As a result, this dataset did not violate the assumption of equal variance.

An independent-sample t-test was conducted to compare prospective elementary teachers' mathematics teaching anxiety scores for females and males. According to Table 4.23, there was a statistically significant difference in mathematics teaching anxiety scores for females (M=2.25, SD=0.69) and males(M=1.97, SD=0.59; t (180)
= 2.06, p=0.04, two-tailed). The magnitude of the differences in the means (mean difference= 0.28, 95% CI: 0.01 to 0.55) was small (eta squared = 0.02).

Table 4.24 Prospective Elementary Teachers’ Mathematics Teaching Anxiety Regarding Gender

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th></th>
<th>Male</th>
<th></th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X̄</td>
<td>SD</td>
<td>X̄</td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>2.25</td>
<td>0.69</td>
<td>1.97</td>
<td>0.59</td>
<td>2.06*</td>
<td>180</td>
<td>0.04</td>
</tr>
<tr>
<td>Teaching Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

Eta squared (η2) was calculated using the information in the table 4.24. Appropriate values were replaced for the formula of eta squared as the following:

\[
\eta^2 = \frac{2.06^2}{2.06^2 + (153 + 29 - 2)} = 0.02
\]

According to Pallant (2011), this value showed that the effect size of 0.02 was small.

As a result, the results of the independent-sample t-test for prospective teachers revealed that female prospective elementary teachers had higher mathematics anxiety scores (M=1.80, SD=0.42) than male prospective elementary teachers (M=1.53, SD=0.31). Similarly, female prospective elementary teachers indicated higher mathematics teaching anxiety scores (M=2.25, SD=0.69) than male prospective elementary teachers (M=1.97, SD=0.59).

**Research Question 11:** Is there a difference in the mathematics anxiety scores of female and male prospective middle school mathematics teachers?
Table 4.25 Skewness and Kurtosis Values for Prospective Middle School Mathematics Teachers Regarding Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Anxiety</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Mathematics Anxiety</td>
<td>0.88</td>
<td>0.91</td>
</tr>
<tr>
<td></td>
<td>Mathematics Teaching Anxiety</td>
<td>0.38</td>
<td>-0.44</td>
</tr>
<tr>
<td>Male</td>
<td>Mathematics Anxiety</td>
<td>1.30</td>
<td>2.62</td>
</tr>
<tr>
<td></td>
<td>Mathematics Teaching Anxiety</td>
<td>0.76</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Table 4.25 shows the skewness and kurtosis values for prospective middle school mathematics teachers regarding gender. The kurtosis value for male mathematics anxiety was equal to 2.62. Since this value was not in the range between −1.96 and +1.96, this showed that each of the variables was not almost normally distributed (Field, 2013). Therefore, the Mann-Whitney U Test, the non-parametric alternative to the t-test for independent samples, was used to test differences in the mathematics anxiety scores of female and male prospective middle school mathematics teachers (Pallant, 2011).

Table 4.26 Mann-Whitney U Test for Prospective Middle School Mathematics Teachers’ Mathematics Anxiety Regarding Gender

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Mean Rank</td>
<td>Mdn</td>
<td>N</td>
<td>Mean Rank</td>
<td>Mdn</td>
<td>U</td>
<td>Z</td>
</tr>
<tr>
<td>Mathematics Anxiety</td>
<td>181</td>
<td>130.59</td>
<td>1.64</td>
<td>62</td>
<td>96.92</td>
<td>1.48</td>
<td>4056</td>
<td>3.25</td>
</tr>
</tbody>
</table>

*p < 0.05
According to Table 4.2, the z value was -3.25 with a significance level (p) of p=0.00. The p-value was less than 0.05, so the result was significant. There was a statistically significant difference in prospective middle school mathematics teachers' mathematics anxiety scores of females and males. It would be necessary to look at the mean ranks to identify the direction of the difference between these groups. It was also suggested that it would be better to report the median values for each group when determining the direction of the difference (Pallant, 2011). Table 4.26 shows that the mean rank for females was equal to 130.59, and the mean rank for males was equal to 96.92. Based on the higher mean rank value of females compared to males, it was concluded that the mathematics anxiety level of prospective elementary mathematics teachers was statistically higher in females than in males.

SPSS V22 does not include a specific measure of effect size. However, the z value reported in Table 4.26 was utilized to estimate an approximate value of r. Appropriate values were replaced for the formula of r as the following:

$$r = \frac{z}{\sqrt{N}} = \frac{3.25}{\sqrt{243}} = 0.2$$

This would be considered a small effect size (Pallant, 2011).
As a result, A Mann-Whitney U test revealed a statistically significant difference in prospective middle school mathematics teachers' mathematics anxiety scores of females (Mdn=1.64, n=181) and males (Mdn=1.48, n=62), U= 4056, z = -3.25, p = 0.00, r = 0.2.

Research Question 12: Is there a difference in the mathematics teaching anxiety scores of female and male prospective middle school mathematics teachers?
4.27 Levene’s Test for Equality of Variances for Mathematics Teaching Anxiety of Middle School Mathematics Teachers Regarding Gender

<table>
<thead>
<tr>
<th>Mathematics Teaching Anxiety</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3.89</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Levene's test revealed a p-value of 0.05 for mathematics teaching anxiety among middle school mathematics teachers. This was equal to 0.05. This implies that the variances for males and females were different (Pallant, 2011). As a result, the information for labeling the equal variances that were not assumed was reported.

Table 4.28 Prospective Middle School Mathematics Teachers’ Mathematics Teaching Anxiety Regarding Gender

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th></th>
<th>Male</th>
<th></th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\bar{X}$</td>
<td>SD</td>
<td>$\bar{X}$</td>
<td>SD</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematics</td>
<td>1.91</td>
<td>0.54</td>
<td>1.79</td>
<td>0.47</td>
<td>1.67</td>
<td>119.73</td>
<td>0.09</td>
</tr>
<tr>
<td>Teaching Anxiety</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

An independent-sample t-test was conducted to compare the mathematics teaching anxiety scores of prospective middle school mathematics teachers for females and males. According to Table 4.28, there was no significant difference in mathematics teaching anxiety scores for females (M=1.91, SD=0.54) and males(M=1.79, SD=0.47; t (119.73) =1.67, p=0.09, two-tailed). The magnitude of the differences in the means (mean difference = 0.12, 95% CI: -0.02 to 0.26) was very small (eta squared = 0.01).
Eta squared (η²) was calculated using the information in Table 4.28. Appropriate values were replaced for the formula of eta squared as the following:

\[
\text{Eta squared} = \frac{1.67^2}{1.67^2 + (181+62-2)} = 0.01
\]

### 4.2.7 Results Regarding Program

**Research Question 13:** Is there a difference in the mathematics anxiety scores of prospective elementary teachers and prospective middle school mathematics teachers?

Before beginning the analysis of the Independent-Samples T-Test, the following assumptions were verified. Prospective elementary and middle school teachers’ mathematics anxiety and teaching anxiety scores were assessed to determine the level of measurement assumption. Mean scores were calculated prior to the administration of tests in this study. This indicated that continuous measures of dependent variables were used. Moreover, each measurement was independent of any other measurement. Thus, the observations were guaranteed to be independent. Also, the skewness and kurtosis values were examined before conducting a parametric test to assess the normal distribution.

<table>
<thead>
<tr>
<th>Mathematics Anxiety</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7.13</td>
<td>0.00</td>
</tr>
</tbody>
</table>

According to Table 4.29, Levene's test had a p-value of 0.00 for the mathematics anxiety of prospective teachers. This was less than 0.05. This implies that the variances for prospective elementary teachers and prospective middle school
mathematics teachers were different (Pallant, 2011). As a result, this dataset violated the assumption of equal variance.

However, SPSS V22 provided an alternative t-value to account for the fact that the variances were not equal. As a result, the information for labeling the equal variances that were not assumed was reported.

Table 4.30 Skewness and Kurtosis Values for Prospective Teachers Regarding Program

<table>
<thead>
<tr>
<th>Program</th>
<th>Anxiety</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elementary Education</td>
<td>Mathematics Anxiety</td>
<td>0.59</td>
<td>0.09</td>
</tr>
<tr>
<td></td>
<td>Mathematics Teaching Anxiety</td>
<td>0.21</td>
<td>-0.30</td>
</tr>
<tr>
<td>Elementary Mathematics Education</td>
<td>Mathematics Anxiety</td>
<td>0.99</td>
<td>1.19</td>
</tr>
<tr>
<td></td>
<td>Mathematics Teaching Anxiety</td>
<td>0.48</td>
<td>-0.24</td>
</tr>
</tbody>
</table>

Table 4.30 shows the skewness and kurtosis values for anxiety of university students studying in the Elementary Education program and university students studying in the Elementary Mathematics Education program. The skewness and kurtosis values were between – 1.96 and +1.96. This shows that each variable was almost normally distributed (Field, 2013).
Table 4.31 Prospective Teachers’ Mathematics Anxiety Regarding Program

<table>
<thead>
<tr>
<th></th>
<th>Elementary Education</th>
<th>Elementary Mathematics Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>1.76</td>
<td>1.66</td>
</tr>
<tr>
<td>SD</td>
<td>0.42</td>
<td>0.36</td>
</tr>
<tr>
<td>( t )</td>
<td>-2.41*</td>
<td></td>
</tr>
<tr>
<td>( df )</td>
<td>355.20</td>
<td></td>
</tr>
<tr>
<td>( p )</td>
<td>0.01</td>
<td></td>
</tr>
</tbody>
</table>

\(*p<0.05\)

An independent-sample t-test was conducted to compare the mathematics anxiety scores of prospective teachers for programs of elementary education and elementary mathematics education. According to Table 4.31, there was a statistically significant difference in mathematics anxiety scores for university students enrolling in elementary education (\( M=1.76, SD=0.42 \)) and elementary mathematics education (\( M=1.66, SD=0.36 \); \( t (355.20) = -2.41, p=0.01, \text{two-tailed} \)). The magnitude of the differences in the means (mean difference= -0.09, 95% CI: -0.17 to -0.01) was small (\( \eta^2 = 0.01 \)).

Eta squared (\( \eta^2 \)) was calculated using the information in Table 4.31. Appropriate values were replaced for the formula of eta squared as the following:

\[
\text{Eta squared} = \frac{(-2.41)^2}{(-2.41)^2 + (182 + 243 - 2)} = 0.01
\]

Research Question 14: Is there a difference in the mathematics teaching anxiety scores of prospective elementary teachers and prospective middle school mathematics teachers?
Table 4.32 Levene’s Test for Equality of Variances for Mathematics Teaching Anxiety Regarding Program

<table>
<thead>
<tr>
<th></th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Anxiety</td>
<td>12.94</td>
<td>0.00</td>
</tr>
</tbody>
</table>

According to Table 4.32, Levene’s test had a p-value of 0.00 for the mathematics teaching anxiety of prospective teachers. This was less than 0.05. This implies that the variances for prospective elementary teachers and prospective middle school mathematics teachers were different (Pallant, 2011). As a result, this dataset violated the assumption of equal variance. However, SPSS V22 provided an alternative t-value to account for the fact that the variances were not equal. As a result, the information for labeling the equal variances that were not assumed was reported.

Table 4.33 Prospective Teachers’ Mathematics Teaching Anxiety Regarding Program

<table>
<thead>
<tr>
<th></th>
<th>Elementary Mathematics Education</th>
<th>t</th>
<th>df</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics Teaching</td>
<td></td>
<td>2.21</td>
<td>0.68</td>
<td>1.88</td>
</tr>
<tr>
<td>Anxiety</td>
<td></td>
<td>2.21</td>
<td>0.68</td>
<td>1.88</td>
</tr>
</tbody>
</table>

*p<0.05

An independent-sample t-test was conducted to compare prospective teachers’ mathematics teaching anxiety scores for programs of elementary education and elementary mathematics education. According to Table 4.33, there was a statistically
significant difference in mathematics anxiety scores for university students enrolling in elementary education (M=2.21, SD=0.68) and elementary mathematics education (M=1.88, SD=0.53; t (329.89) = -5.38, p=0.00, two-tailed). The magnitude of the differences in the means (mean difference= -0.33, 95% CI: -0.45 to -0.20) was moderate (eta squared = 0.06).

Eta squared ($\eta^2$) was calculated using the information in Table 4.33. Appropriate values were replaced for the formula of eta squared as the following:

\[
\text{Eta squared} = \frac{(-5.38)^2}{(-5.38)^2 + (182+243-2)} = 0.06
\]
CHAPTER 5

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

This study used a quantitative survey model to investigate prospective teachers' mathematics anxiety, mathematics teaching anxiety, and the relationship between these anxieties. Additionally, prospective teachers' mathematics anxiety and mathematics teaching anxiety were compared in terms of variables such as gender, year, and program. This study's sample included 425 prospective teachers from three different state universities in Ankara, with 182 prospective elementary teachers and 243 prospective middle school mathematics teachers. Prospective elementary and middle school mathematics teachers were administered the Mathematics Anxiety Scale for Teachers (MAST), created by Deniz and Üldaş in 2008, and the Mathematics Teaching Anxiety Scale (MATAS), developed by Peker in 2006. The research questions were addressed using Pearson Correlation, One-Way ANOVA, and Independent Sample T-test.

This section will discuss the main findings of the previous sections concerning the literature. It also will include the study's implications for prospective teachers, teachers, as well as teacher educators, and recommendations for future research. The results will be discussed in relation to the research questions.

5.1 Discussion

Firstly, the findings and discussion related to the research questions, “What are prospective elementary teachers' mathematics anxiety and mathematics teaching anxiety mean scores?” “What are prospective middle school mathematics teachers' mathematics anxiety and mathematics teaching anxiety mean scores?” will be provided.
The study determined the mathematics anxiety levels of prospective teachers and their anxiety levels about teaching mathematics. The MAST, a four-point Likert scale, was used to calculate the prospective teachers' mathematics anxiety scores, and the MATAS, a five-point Likert scale, was used to calculate their anxiety levels regarding teaching mathematics. A total of 182 prospective elementary teachers exhibited an average mathematics anxiety score of 1.76 and an average mathematics teaching anxiety score of 2.21. Therefore, this study indicated that prospective elementary teachers exhibited low levels of mathematics anxiety and also demonstrated low mathematics teaching anxiety. The finding aligns with earlier research (e.g., Çatlıoğlu et al., 2009; Doruk & Kaplan, 2013; Hacıomeroglu, 2014; Serin, 2017). For example, in his study with 207 prospective elementary teachers, Çatlıoğlu et al. (2009) also determined that the levels of mathematics anxiety among prospective teachers were low. In addition, in this study, a total of 243 prospective middle school mathematics teachers had an average mathematics anxiety score of 1.66 and an average mathematics teaching anxiety score of 1.88. This means prospective middle school mathematics teachers demonstrated low levels of mathematics anxiety, as well as low levels of mathematics teaching anxiety similar to some other studies in the literature, such as Doruk and Kaplan (2013) and Tatar et al. (2016). Doruk and Kaplan (2013) reported that prospective teachers generally had low levels of mathematics anxiety in their study conducted with 328 prospective teachers, including 216 prospective elementary teachers and 112 prospective middle school mathematics teachers. Similarly, Tatar et al. (2016) reported that prospective teachers had low levels of mathematics teaching anxiety in their study conducted with 475 prospective mathematics teachers, including 316 prospective elementary mathematics teachers and 159 prospective secondary mathematics teachers.

However, Bekdemir (2010) found that a significant number of prospective elementary teachers experience mathematics anxiety and that the worst and most distressing experiences in the mathematics classroom directly contributed to their anxiety. Moreover, the primary cause of the participants' mathematics anxiety was ascribed to their past teachers, specifically their conduct and instructional methods.
Similarly, Juniati and Budayasa (2020) reported that prospective mathematics teachers had high levels of mathematics anxiety in their study conducted with 148 prospective mathematics teachers. In summary, this study found that prospective elementary and middle school mathematics teachers' mathematics anxiety and mathematics teaching anxiety were low. This could be related to the courses prospective teachers took at university, their personal experiences, or their successes in mathematics.

Secondly, the findings and discussion related to the research questions, “Is there a relationship between mathematics anxiety scores and mathematics teaching anxiety scores for prospective elementary teachers?” and “Is there a relationship between mathematics anxiety scores and mathematics teaching anxiety scores for prospective middle school mathematics teachers?” will be presented.

The relationship between mathematics anxiety and mathematics teaching anxiety for prospective elementary and middle school mathematics teachers was examined using the Pearson product-moment correlation coefficient. As a result of the analysis, it was found that there was a strong positive correlation between prospective elementary teachers’ mathematics anxiety and mathematics teaching anxiety. Likewise, there was a strong positive correlation between prospective middle school mathematics teachers’ mathematics anxiety and mathematics teaching anxiety. This implied that prospective teachers' anxiety toward teaching mathematics is directly related to their level of mathematics anxiety. As their mathematics anxiety increases, so does their anxiety towards teaching mathematics. Conversely, their anxiety toward teaching mathematics decreases as their mathematics anxiety decreases. In the literature, some studies support these results (e.g., Hadley & Dorward, 2011; Haciomeroglu, 2014; Peker & Ertekin, 2011; Serin, 2017; Unlu et al., 2017; Yazlık & Çetin, 2020). Unlu et al. (2017) found that the primary independent variable that significantly influences anxiety in mathematics teaching was mathematics anxiety. However, Brown et al. (2011) found that mathematics anxiety and mathematics
teaching anxiety may not always be connected and that prospective teachers who have low mathematics anxiety may have high mathematics teaching anxiety. There are also studies in the literature on in-service teachers' mathematics anxiety and mathematics teaching anxiety (e.g., Gürbüz & Yıldırım, 2016; Hadley & Dorward, 2011). Hadley and Dorward (2011) found a positive relationship between mathematics anxiety and mathematics teaching anxiety in their study conducted with elementary teachers. They found that increased anxiety among teachers regarding mathematics teaching results in decreased mathematics achievement among students. As such, it can be concluded that teachers should control their anxiety levels about teaching mathematics in order not to cause a decline in students' mathematics achievement.

Thirdly, the findings and discussion related to the research questions, “Is there a difference in the mathematics anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers?” “Is there a difference in the mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective elementary teachers?” “Is there a difference in the mathematics anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective middle school mathematics teachers?” and “Is there a difference in the mathematics teaching anxiety scores of 1st, 2nd, 3rd, and 4th-year prospective middle school mathematics teachers?” will be presented.

This study concluded no statistically significant difference in prospective elementary teachers’ mathematics anxiety and mathematics teaching anxiety scores at the p<0.05 level in terms of four different years. Also, there was no statistically significant difference in prospective middle school mathematics teachers’ mathematics anxiety and mathematics teaching anxiety scores at the p<0.05 level in terms of four different years. In the literature, some studies have found a significant difference between years (e.g., Çatlıoğlu et al., 2009; Serin, 2017; Turan & Asal, 2020), while others, like this study, have not (Deringöl, 2018; Haciomeroglu, 2014; Juniati & Budayasa, 2020; Tatar et al., 2016; Üldaş, 2005). For example, Çatlıoğlu
et al. (2009) stated that first-year students were more likely than fourth-year students to experience mathematics anxiety. This was explained by the fact that four-year students completed a mathematics methods course in two consecutive semesters. According to Serin’s (2017) study, prospective elementary teachers in their third year exhibited greater levels of mathematics and mathematics teaching anxiety than those in their fourth year. Also, Turan and Asal (2020) found that the levels of mathematics teaching anxiety among prospective teachers in the third year were higher than in the second and fourth years. When the findings regarding the year variable were examined, no consistent conclusion was reached. Therefore, future quantitative and qualitative studies can address this variable further in more detail.

Next, the findings and discussion related to the research questions, “Is there a difference in the mathematics anxiety scores of female and male prospective elementary teachers?”, “Is there a difference in the mathematics teaching anxiety scores of female and male prospective elementary teachers?”, “Is there a difference in the mathematics anxiety scores of female and male prospective middle school mathematics teachers?” and “Is there a difference in the mathematics teaching anxiety scores of female and male prospective middle school mathematics teachers?” will be presented.

The study's findings indicated a statistically significant difference in prospective teachers’ mathematics anxiety scores for females and males. Female prospective elementary teachers had higher mathematics anxiety scores than male prospective elementary teachers. The magnitude of the differences in the means was moderate. Similarly, there was a statistically significant difference in prospective middle school mathematics teachers' mathematics anxiety scores of females and males. The mathematics anxiety level of prospective middle school mathematics teachers was statistically higher in females than in males. This would be considered a small effect size.

Gender is the most researched personal factor; however, there is still no agreement on the findings (Baloğlu, 2001; Dowker et al., 2016). Although some studies stated
that there was no difference between males and females in terms of mathematics anxiety (e.g., Çatlıoğlu et al., 2009; Juniati & Budayasa, 2020; Peker & Ertekin, 2011; Tatar et al., 2016; Üldaş, 2005), some studies stated that the scores of mathematics anxiety among female prospective teachers were significantly higher than the scores of mathematics anxiety among male prospective teachers (e.g., Brady & Bowd, 2005; Gürbüz & Yıldırım, 2016).

Previous studies have primarily focused on the impact of gender on mathematics anxiety, while research on anxiety towards mathematics teaching has been relatively limited. Tatar et al. (2016) and Demir et al. (2016) revealed no statistically significant difference in the general mathematics teaching anxiety scores of prospective mathematics teachers. However, this study showed that prospective elementary teachers had higher mathematics teaching anxiety scores than male prospective elementary teachers. The magnitude of the differences in the means was small. Nevertheless, there was no significant difference in mathematics teaching anxiety scores of prospective middle school mathematics teachers for females and males. It is, therefore, difficult to draw general conclusions about the impact of gender on mathematics teaching anxiety.

Finally, the findings and discussion related to the research questions, “Is there a difference in the mathematics anxiety scores of prospective elementary teachers and prospective middle school mathematics teachers?” and “Is there a difference in the mathematics teaching anxiety scores of prospective elementary teachers and prospective middle school mathematics teachers?” will be presented.

This study indicated a statistically significant difference in mathematics anxiety scores for university students enrolling in the Elementary Education program and the Elementary Mathematics Education program. The magnitude of the differences in the means was small. Furthermore, this study found a statistically significant difference in mathematics teaching anxiety scores for university students enrolling in the Elementary Education program and the Elementary Mathematics Education
program. The magnitude of the differences in the means was moderate. The higher levels of mathematics anxiety and mathematics teaching anxiety of prospective elementary teachers compared to prospective middle school mathematics teachers may be related to the differences in the courses they take in their programs. When the teacher education programs of prospective teachers are examined, prospective middle school mathematics teachers were found to have more courses on both mathematics and teaching mathematics.

There is limited literature on whether anxiety towards teaching mathematics varies across different programs. Some studies conducted with prospective teachers have used samples of prospective elementary teachers (e.g., Deringöl, 2018; Serin, 2017; Turan & Asal, 2020), while others have used samples of prospective middle school mathematics teachers (e.g., Tatar et al., 2016). Fewer studies have a sample of prospective elementary and middle school mathematics teachers (e.g., Doruk & Kaplan, 2013; Peker & Ertekin, 2011). Unlike the result of this study, Doruk and Kaplan (2013) found that the program did not affect prospective teachers’ mathematics anxiety levels in their study conducted with 216 prospective elementary teachers and 112 prospective middle school mathematics teachers. Nevertheless, some differences were also found in studies conducted with different programs. For example, Üldaş (2005) found that prospective teachers specializing in science fields such as mathematics, physics, and chemistry exhibited lower levels of mathematics anxiety than prospective teachers focusing on social sciences. Moreover, Tatar et al. (2016) also observed that prospective middle school mathematics teachers exhibited significantly lower levels of mathematics teaching anxiety than prospective secondary mathematics teachers.
5.2 Implications for Prospective Teachers, Teachers, and Teacher Educators

A high level of mathematics anxiety in prospective teachers might cause them to be concerned about mathematical concepts, theorems, and problems. At this point, literature shows that mathematics method courses can help to reduce teachers' mathematics anxiety (e.g., Çatlıoğlu et al., 2009). Some researchers utilized pre-post data to establish a notable decrease in anxiety (e.g., Battista, 1986; Gresham, 2007). The results of the studies clearly showed that mathematics methods courses significantly reduce reported anxiety levels among prospective elementary teachers. For example, Gresham (2007) demonstrated that incorporating discussion sessions, group activities, hands-on manipulatives, and using various concrete materials in the content of the mathematics methods course can reduce mathematics anxiety among prospective teachers. In addition, Peker (2009) found that prospective mathematics teachers' levels of teaching anxiety were diminished through the implementation of extended micro-teaching in the teaching practice course.

In the findings of this study, it was seen that mathematics anxiety and anxiety towards teaching mathematics of prospective elementary teachers were higher than that of prospective middle school mathematics teachers. Considering the differences in the courses taken by prospective teachers at the university as a reason for this difference, more courses can be given to prospective elementary teachers about mathematics or teaching mathematics. Moreover, improvements or adjustments can be made to the method courses and teaching practice courses prospective teachers take, including discussion sessions, group activities, hands-on manipulatives, and micro-teaching, as suggested by the literature.

Moreover, the primary cause of the participants' mathematics anxiety was attributed to their past teachers, especially their behavior and teaching methods (Bekdemir, 2010). Levine’s study (1993) findings established a correlation between the teaching
style of mathematics and the level of anxiety experienced by prospective teachers when teaching mathematics. Prospective teachers with a vision of teaching in a student-centered style tend to have reduced anxiety when teaching mathematics. The researcher suspected that this might be because a student-centered approach provides various effective methods to engage students. Additionally, according to Levine (1993), participation in a mathematics methods course that identifies and models new teaching practices is expected to influence prospective teachers' teaching styles toward a more student-centered approach and help them with their anxiety. Similarly, Gresham (2010) found that teachers who experience high levels of mathematics anxiety tend to rely on traditional teaching approaches, such as delivering lectures. Their emphasis lies on teaching basic skills rather than abstract ideas. Hence, it is imperative for prospective teachers to comprehend the mathematics curriculum and possess competence in employing innovative instructional methods to teach mathematics effectively.

Furthermore, teacher educators should be aware of the anxiety their students experience when it comes to mathematics and their own anxiety regarding teaching mathematics. It is possible that if teacher educators are aware of the levels of mathematics anxiety that their students experience, this will help to either increase prospective teachers' confidence in their ability to teach mathematics or to create an environment that supports them in their efforts to teach mathematics (Peker & Ertekin, 2011). It can be reasonably assumed that prospective teachers will adopt a similar approach to teaching mathematics to that which they experienced (Levine, 1993). Therefore, it can be said that teacher educators’ teaching techniques and methods in training prospective teachers are also important. As a result, by examining the causes and impacts of mathematics anxiety and utilizing alternative approaches, teacher educators can support prospective teachers in growing a deeper understanding of mathematical concepts while simultaneously reducing anxiety associated with mathematics and its teaching. Mathematics teacher educators can offer detailed lessons on various methods for teaching specific mathematical concepts through different strategies. This might help enhance prospective teachers’
comprehension of mathematics and teaching mathematics and reduce their anxieties, which might, in turn, benefit their future students.

Hadley and Dorward (2011) found that increased anxiety among teachers regarding mathematics teaching results in decreased mathematics achievement among students. As such, it can be concluded that teachers should control their anxiety levels about teaching mathematics in order not to cause a decline in students' mathematics achievement, and at this point, it can be said that the surest way to control teachers' anxiety about teaching mathematics is to control their own mathematics anxiety. Therefore, it is possible to say that teachers' mathematics anxiety, even if indirectly, has a share in triggering students' mathematics anxiety. Reducing the anxiety that prospective teachers experience in mathematics and teaching mathematics might positively affect both the teachers themselves and their students in the future. It has been noted that new teachers experience higher levels of anxiety when it comes to teaching mathematics compared to experienced teachers (Gürbüz & Yıldırım, 2016). Hence, teacher educators must be aware of prospective teachers who experience anxiety regarding mathematics and the act of teaching mathematics. Given that mathematics is an essential course that all teachers in elementary schools must teach, all prospective teachers must be well-informed about the causes of mathematics anxiety and ways to prevent it.

Educational administrators can fulfill a crucial function by examining the condition of mathematics anxiety inside their educational institutions. It is crucial to implement modifications in both the instructional methods used by elementary and mathematics teachers and help them attend professional development programs.
5.3 Recommendations for Future Research

This study was motivated by the limited research on mathematics anxiety and mathematics teaching anxiety among prospective elementary and middle school mathematics teachers. Hence, there were primarily quantitative studies in the literature related to prospective teachers' mathematics anxiety and mathematics teaching anxiety. Therefore, future qualitative studies can help teachers become more aware of their anxiety about mathematics and its consequences for their students.

According to previous studies (e.g., Brown et al., 2011; Peker, 2009), there is limited knowledge regarding mathematics teaching anxiety among prospective teachers. I share the same viewpoint. Further investigation is required in the field of mathematics teaching anxiety.

Furthermore, future studies may focus on understanding the causes and consequences of mathematics teaching anxiety among teachers.

In addition, a systematic review and meta-analysis of research studies on mathematics anxiety and mathematics teaching anxiety can be conducted.
REFERENCES


Bekdemir, M. (2010). The pre-service teachers’ mathematics anxiety related to depth of negative experiences in mathematics classroom while they were students. *Educational studies in mathematics*, 75(3), 311-328.


Demir, B. K., Cansiz, Ş., Deniz, D., Kansu, C. Ç., & İşleyen, T. (2016). The investigation of primary school teacher candidates' anxiety levels for teaching
mathematics in terms of different variables (The example of Bayburt). *Journal of Bayburt University Education Faculty, 11*(2), 379-390.


Üldaş, İ. (2005). Öğretmen ve öğretmen adaylarına yönelik matematik kaygı ölçüğü (MKÖ-Ö)’nin geliştirilmesi ve matematik kaygısına ilişkin bir değerlendirme (Doctoral dissertation, Marmara Universitesi (Turkey))


APPENDICES

A. The University Human Subjects Ethics Committee's Approval