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International Journal of Psychology and Educational Studies

Thematic Analysis of Studies on Mathematics Teaching Anxiety

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ARTICLE INFO

Article History:
Received 12.07.2020
Received in revised form 08.08.2020
Accepted 11.11.2020
Available online 27.01.2021

ABSTRACT

The aim of this study is to examine studies on mathematics teaching anxiety thematically. For this purpose, 44 research articles on mathematics teaching anxiety published between 2000-2020 were examined. Studies were collected through document review and evaluated in terms of publication year, sample type, method, data collection tools, purpose and results. The data obtained was analyzed with the method of content analysis and presented in tables and graphs together with their frequencies. As a result of the study, it was determined that the most studies on mathematics teaching anxiety were conducted between 2018-2020, more studies were carried out with pre-service teachers, quantitative research methods were used more, and scale was mostly preferred as a measurement tool. The differences and similarities between the studies were determined by their purposes and results, and suggestions were made for further studies.

Keywords:
Mathematics education, mathematics teaching anxiety, content analysis.

1. Introduction

Factors such as self-efficacy, anxiety, belief, and attitude are among the affective components that affect educational environments. Of these factors, mathematics anxiety is very significant (Brown, Ortiz-Padilla & Soto-Varela, 2020). Since there is a relationship between mathematical thinking and learning and an effective approach to mathematics (Hannula, 2005), one of the most common problems experienced in mathematics in the affective area is anxiety (Baloğlu & Koçak, 2006). When it comes to teaching mathematics, the anxiety factor has come in two dimensions in learning and teaching and these are mathematics anxiety and mathematics teaching anxiety.

Mathematics anxiety is emotional reactions experienced by an individual in the field of mathematics and arithmetic (Dreger & Aiken, 1957), is the state of tension that prevents the use of numbers and problem solving in academical or daily life (Richardson & Suinn, 1972), and is the feeling of fear and anxiety experienced when solving a mathematical problem (Fennema & Sherman, 1976). Mathematics anxiety is seen as a common characteristic of individuals with learning problems and can develop in all periods of education (Gresham, 2010). It is not limited to only physical and psychological symptoms, but affects students' performances and successes, and determines the tendencies of students in their career goals (Maloney, Schaeffer, & Beilock, 2013). Although mathematics anxiety is seen differently in every individual, people such as family, teacher and friends can be a cause of anxiety (Uusimaki & Nason, 2004).

There is a strong relationship between teachers' negative attitudes towards mathematics and students' mathematics achievement (Mensah, Okyere, & Kuranchi, 2013), and teachers who have mathematics anxiety is stated to transfer this anxiety onto their students (Bekdemir, 2010; Vinson, 2001). In addition, parents transfer their attitudes and beliefs about mathematics onto their children and the children are influenced by their families, and their self-efficacy and mathematics anxiety are shaped (Suarez-Pellicioni, Nunez-Pena &

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Citation: Gerez Cantimer, G. (2021). Thematic analysis of studies on mathematics teaching anxiety. *International Journal of Psychology and Educational Studies, 8*(1), 135-147. http://dx.doi.org/10.17220/ijpes.2021.8.1.271

Colome, 2016; Tobias, 1978). Parents have also power to create a positive effect on mathematics anxiety by participating in mathematics-related school activities or through supportive conversations about mathematics, in addition to affecting negatively on their children (McLeod, Weisz & Wood, 2007). It is stated that the anxiety and mathematics teaching anxiety in teachers may be an important factor in the basis of the existing mathematics anxiety in students (Peker, 2006). In this respect, the effects of mathematics teaching anxiety should be considered on the learning environment and its reflection on students.

On the other hand, teaching mathematics anxiety is a structure that is seen only in teachers and pre-service teachers and is different from mathematics anxiety in terms of meaning. As a reflection of real or perceived deficiencies in mathematics knowledge or teaching skills (McMinn, 2019), it affects how a teacher will teach mathematics and how s/he will present it (Hadley & Dorward 2011). It also affects organizing content, planning time, determining teaching methods and learning activities (Ameen, Guffey & Jackson, 2002). This anxiety is very important in forming teachers' behaviors towards mathematics teaching in the classroom (Peker, 2006). Indeed, a teacher or pre-service teacher may have only teaching mathematics anxiety, as well as mathematics anxiety along with this type of anxiety. In this case, it can be said that the effect that may occur is more. So, although mathematics teaching anxiety is not necessary to be seen with mathematics anxiety, the effect can be bigger when the two types of anxiety are seen together.

Although it is difficult to explain the factors that cause mathematics teaching anxiety, negative experiences about mathematics (McMinn, 2019), mathematics anxiety of pre-service teachers (Vinson, 2001), lack of content knowledge and self-confidence (Hoşşirin Elmas, 2010), self-efficacy perceptions towards mathematics and mathematics teaching (Ural, 2015), and mathematical beliefs (Başpınar, 2015) affect this situation. There is a close relationship between teachers' and pre-service teachers' self-efficacy perceptions towards mathematics teaching and their mathematics teaching anxiety (Ural, 2015). Considering the relationship of teaching mathematics self-efficacy and teaching mathematics anxiety, it is seen that self-efficacy perception affects mathematics anxiety (Jain & Dowson, 2009) and there is a negative relationship between self-efficacy and mathematics anxiety (Hoffman, 2010).

Mathematics teaching anxiety causes to develop ineffective teaching behaviors (Ameen, Guffey & Jackson, 2002). In particular, teachers who have high mathematics anxiety do not willingly teach mathematics and fail in teaching (Brown, Westenskow & Moyer-Packenham, 2011). This situation can be evaluated in a cyclical structure. When teachers' own mathematics anxiety turns into mathematics teaching anxiety, students' mathematics learning is also affected (Hadley & Dorward, 2011). This anxiety that develops in the teacher will cause the student to think negatively about mathematics, not to increase her/his success, and not to gain efficiency from the course (Vinson, 2001). Hereby, mathematics anxiety and mathematics teaching anxiety negatively affect both students and teachers in the learning and teaching processes (Peker, 2006; Zengin, 2017).

As it is seen in the literature, many studies have been conducted in this field starting from the importance of reflections of mathematics teaching anxiety on the mathematics teaching process. In this context, studies were conducted about teachers/pre-service teachers'; mathematics teaching anxiety and mathematics anxiety (Brown, Westenskow & Moyer-Packenham, 2011; Gresham, 2010), learning/teaching styles (Stevens, 2010), genders (Peker & Halat, 2008) , mathematics/mathematics teaching self-efficacy perceptions (Ural, 2015), mathematics teaching/learning beliefs (Peker & Ulu, 2018), mathematical values (Yazıcı, Peker, Ertekin & Dilmaç, 2011), learning environment (McMinn, 2019), micro-teaching (Fadlelmula, 2013), teaching experiences (Brown, Westenskow & Moyer-Packenham, 2011), mathematical thinking (Yorulmaz, Altıntaş & Sidekli, 2017), metacognitive awareness (Öztürk & Serin, 2020) and technology usage (Zengin, 2017). Additionally, scale development (Liu, 2016; Peker, 2006; Sarı, 2014) and adaptation studies (Aytekin, Türkmenoğlu, & Arıkan, 2017; Hunt & Sarı, 2019) for mathematics teaching anxiety are among the studies conducted. It is predicted that the examination of the mentioned studies in terms of both quantity and quality will create a road map for new studies in this field. It is thought that identifying the current situation by determining the similar and different aspects of studies on mathematics teaching anxiety will lead to further implementations. For this reason, the purpose of the study is to analyze the studies on mathematics teaching anxiety from a thematic perspective. For this purpose, answers were sought for the following sub-problems:

i. What is the distribution of studies on mathematics teaching anxiety according to the publication year, sample type, method and data collection tools used?

ii. What is the distribution of studies on mathematics teaching anxiety according to their purposes?

iii. What is the distribution of studies on mathematics teaching anxiety according to their results?

2. Method

2.1. Research Model

This research, which aims to examine the studies on mathematics teaching anxiety thematically, is a descriptive study. In the research, the relevant studies were examined in the direction of the qualitative research approach by document review and tried to be described. In qualitative researches, data can be collected through private or official documents (Creswell, 2014). Document analysis aims to analyze written materials containing information about the cases that are aimed to be examined (Yıldırım & Şimşek, 2011). The documents examined in this study are the researches on mathematics teaching anxiety selected in accordance with the purpose of the study.

2.2. Data Collection

The keywords in the study were determined as "matematik öğretim kaygısı", "matematik öğretme kaygısı", "matematik öğretimine yönelik kaygı" in Turkish and "anxiety towards mathematics teaching", "mathematics teaching anxiety" and "anxiety of mathematics teaching" in English. Google Scholar Search Engine, Tübitak Ulakbim Dergipark, Ebscohost-Eric, Sciencedirect and Springer databases were used for this process. In the first evaluation, 349 studies were reached. Studies only about mathematics anxiety were eliminated and in order to examine the latest research trends based on mathematics teaching anxiety, the studies that were written in Turkish or English languages between the years of 2000 and 2020 and were reached their all texts were selected. In this case, 44 studies were determined, and the obtained studies were determined as the main document and the brief information of the studies was transferred to the computer environment. The data obtained by reading the studies at least twice were reviewed after two months again.

2.3. Data Analysis

Content analysis was preferred to use for data analysis in the study. Content analysis aims to combine similar data under certain concepts and themes and to organize and interpret them in a way that the reader can understand (Yıldırım & Şimşek, 2011). In the analysis of the researches included in the study, tables were created under the categories of publication year, sample type, method, data collection tools, purposes and results by referring to the forms used in thesis studies in the literature. Before starting the data analysis, the theme and code list was created and each study was presented by coding as "R-1, R-2, R-3,…, R-44". The data obtained were analyzed according to the specified categories and shown on tables and graphs together with their frequencies.

The criterion to be considered in the selection of the studies to be included in the data analysis and the keywords to be used in the screening were determined. The abstracts of the studies determined in this context were read and, when necessary, the whole text was analyzed and evaluated. In addition, in order for the coding process to function more efficiently, the data obtained was intermittently examined for three months, and the coding was controlled by taking the opinions of two different field experts other than the researcher. Analyzes were continued until there was a consensus on the codings, and as a result, the process was completed in the direction of a consensus.

3. Findings

The findings obtained in the direction of the sub-problems of the research are presented in tables. In this context, the distribution of the studies according to the publication year, sample type, method and data collection tools used is shown in table 1.

Table 1. Distribution of studies according to their publication year, sample type, method and data collection tools that are used

Year range	**Studies**	**f**
2000-2002	-	-
2003-2005	-	-
2006-2008	R-26/R-31	2
2009-2011	R-18/R-22/R-24/R-28/R-29/R-30	6
2012-2014	R-20/R-23/R-34/R-36/R-37/R-39	6
2015-2017	R-1/R-2/R-4/R-5/R-6/R-7/R-8/R-9/R-10/R-19/R-21/R-27/R-40/R-35	14
2018-2020	R-3/R-11/R-12/R-13/R-14/R-15/R-16/R-17/R-25/R-32/R-33/R-38/R-41/R-42/R-43/R-44	16
Sample	**Studies**	**f**
Pre-service Mathematics teachers	R-1/R-2/R-3/R-13/R-14/R-19/R-27/R-28/R-29/R-30/R-33/R-36/R-38	13
Pre-service Classroom teachers	R-4/R-5/R-9/R-10/R-11/R-12/R-16/R-17/R-23/R-41/R-42/R-43	12
Other pre-service teachers	R-18/R-20/R-22/R-24/R-25/R-26/R-31/R-32/R-35	9
Teacher	R-6/R-7/R-15/R-16/R-21/R-34/R-37/R-39/R-40/R-43/R-44	11
Method	**Studies**	**f**
Quantitative	R-2/R-6/R-11/R-12/R-14/R-19/R-28/R-32/R-33/R-37/R-38/R-40/R-41/R-43	14
Relational screening	R-4/R-5/R-7/R-8/R-9/R-10/R-12/R-21/R-25/R-30/R-38	11
Method unspecified	R-3/R-20/R-22/R-27/R-29/R-31/R-36	7
Scanning	R-2/R-13/R-24/R-32/R-33/R-42	6
Scale development	R-6/R-11/R-26/R-34/R-39	5
Mixed	R-1/R-15/R-17R-44	4
Scale adaptation	R-16/R-35	2
Qualitative	R-18/R-23	2
Data Collection Tools	**Studies**	**f**
Scale	R-1/R-2/R-3/R-4/R-5/R-7/R-8/R-9/R-10/R-12/R-13/R-14/R-19/R-20/R-21/R-22/R-23/R-24/R-25/R-27/R-28/R-29/R-30/R-32/R-33/R-38/R-41/R-42/R-44	29
Survey	R-15/R-17/R-25/R-31/R-36/R-43	6
Scale development	R-6/R-11/R-26/R-34	4
Opinion/Interview form	R-1/R-15/R-17/R-18	4
Personal information form	R-2/R-37/R-42	3
Scale adaptation	R-16/R-35	2
Lesson plan	R-23	1

*MTA=Mathematics teaching anxiety, MA=Mathematics anxiety

When Table 1 is analyzed, it is observed that studies on mathematics teaching anxiety (MTA) were mostly conducted between the years of 2018-2020, mostly with pre-service teachers, quantitative research methods were preferred as research methods and scales as measurement tools. It is thought that the obtained data will give more clear information by presented on the graphs. Accordingly, the distribution of the examined studies by years is shown in Figure 1.

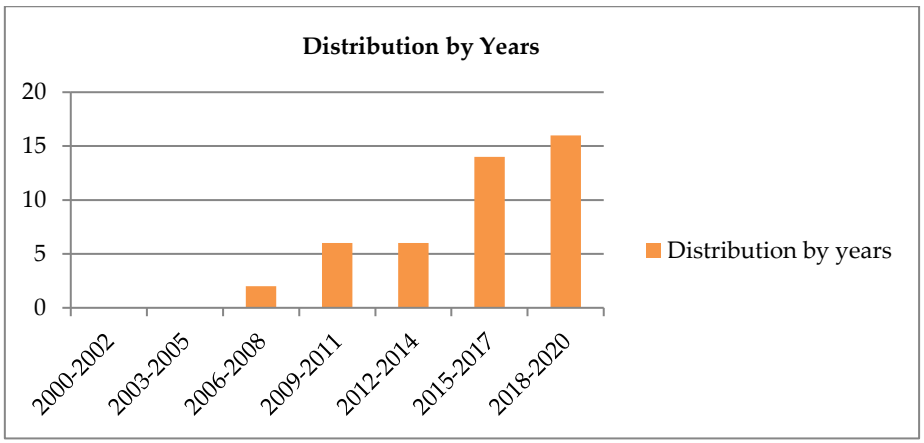

Figure 1. Distribution of studies according to the years

When the studies are analyzed in detail according to their publication year in Figure 1, it was determined that the studies continued increasingly especially after 2015. It is seen that 16 studies were carried out between 2018-2020 at the most, 2 studies between 2006-2008 at least. The distribution of the studies by sample type is shown in Figure 2.

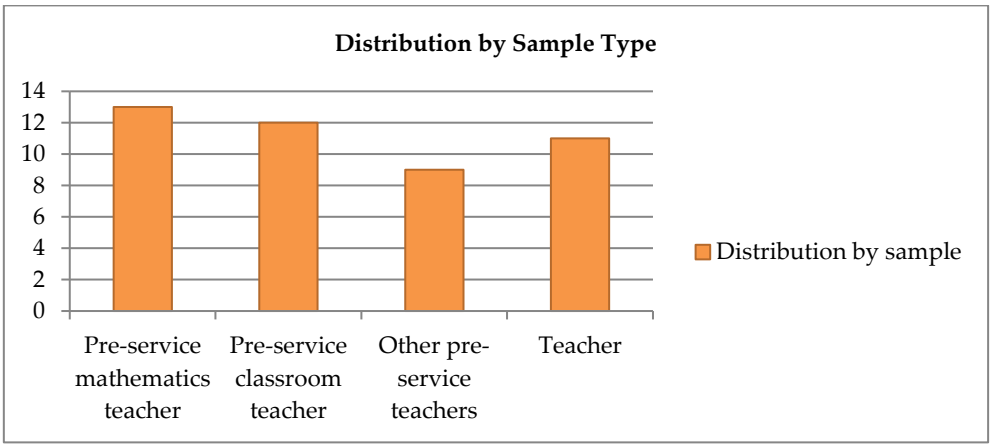

Figure 2. Distribution of studies according to their sample type

According to Figure 2, the distribution of the studied researches by sample type shows that pre-service mathematics teachers (f= 13) the most, then classroom pre-service teachers (f= 12) and other branches (f= 9) take place the most. Teachers (f= 11) was preferred as the least studied group. Accordingly, it can be said that most of the studies on MTA were conducted with pre-service teachers. The distribution of the studies according to their methods is shown in Figure 3.

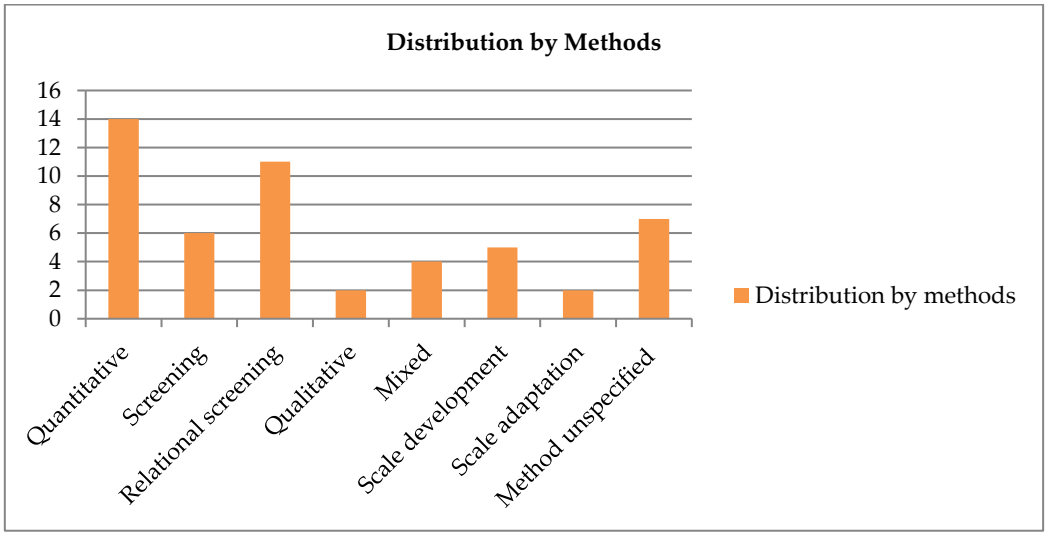

Figure 3. Distribution of studies according to their methods

According to Figure 3, it is seen that quantitative research methods (f= 31) are used the most, qualitative (f= 2) and mixed methods (f= 4) are preferred less, scale development (f= 5) and adaptation (f= 2) studies are also preferred. In addition, it is quite remarkable that there are some studies (f= 7) with no method specified. The distribution of the examined studies according to data collection tools is shown in Figure 4.

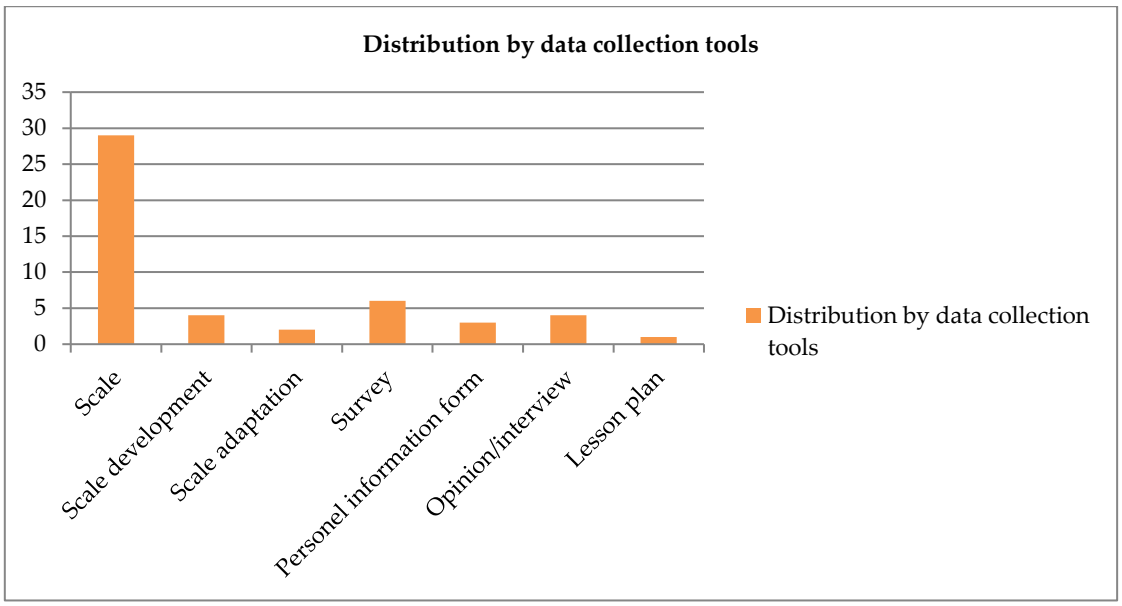

Figure 4. Distribution of studies according to their data collection tools

According to Figure 4, it is seen that the scale (f= 29) was used the most in the studies. The scales and study codes used are as follows; MTA scale (Peker, 2006; R-1, R-2, R-4, R-5, R-8, R-9, R-10, R-12, R-13, R-19, R-20, R-22, R-23, R-24, R-25, R-27, R-28, R-29, R-30, R-32, R-33, R-38), other MTA scale (Sarı, 2014; R-3, R-7, R-14, R-21) and mathematics and science teaching anxiety scale (Aytekin, Türkmenoğlu ve Arıkan, 2017; Liu, 2016). Considering the methods of the studies, it seems usual to use the measurement tools similarly by the quantitative design nature.

The distribution of the studies examined in the direction of the second sub-problem of the research is presented in Table 2 by grouping them under certain themes according to their purposes. In addition, under which groups the studies was classified in detail according to their purposes is shown in Appx-1 on the table.

Table 2. Distribution of studies according to their purposes

Theme	**f**
1. MTA level determination	10
2. MTA experience-reflection	6
3. MTA variable effect	9
4. MTA variable relationship	13
5. MTA variable difference	3
6. Scale development-adaptation	7

When Table 2 is examined, it is seen that the studies are collected under six different themes according to their purposes. According to this;

1. Studies determining MTA level (f=10): The studies in this group aims to determine the MTA of the pre-service teachers (R-2, R-4, R-9, R-12, R-32, R-33, R-36, R-37, R-40, R-41).

2. Studies examining the MTA experiences and its reflections on teaching (f= 6): In this group, it was aimed to examine the MA and MTA experiences of pre-service teachers (R-17, R-18, R-20), to analyze the reflections on anxiety (R- 23, R-43) and to examine the change of MA (R-15) after five years of teaching experience.

3. Studies examining the effect of variables on MTA (f= 9): This study group studies aims to examine the effect of a special design on MTA (R-1), the effect of mathematics teaching and learning beliefs on pre-service teachers' MTA (R-13), the effect of mathematics teaching self-efficacy on teaching anxiety (R-27), the effect of

micro-teaching on MTA (R-28, R-36), and the effects of online discussion on MTA (R-31), the effects of MTA factors (R-28, R-36). R-41) and the effect of teachers' mathematical thinking on MTA (R-21). The study examining the factors that decrease MTA (R-37) is included in this group as well.

4. Studies examining the relationship between MTA and variables (f= 13): This group studies aims to examine the relationship of pre-service teachers' MTA with the perception of mathematics self-efficacy and readiness to teach mathematics (R-3, R-10), MA, perception towards learning environment and self-efficacy towards mathematics teaching (R-8, R-9, R-25), belief (R-5, R-30), technological/pedagogical content knowledge/use (R-14, R-19, R-38), teaching style preference (R-7). The study examining the relationship of teachers' MTA and achievement (R-44) is included in this group as well.

5. Studies examining the differences between MTA and variables (f= 3): This group of studies aim to examine the differences of pre-service teachers' MTA on learning style preference (R-22), gender (R-29, R-42), grade level and grade point average (R-42).

6. Scale development or adaptation studies for MTA (f= 7): This group studies include the scale development and English/Turkish adaptation studies (R-16, R-35) that determine teachers' MA (R-6, R-39) and MTA (R-34) and pre-service teachers' MTA (R-11, R-26).

The distribution of the studies examined in the direction of the third sub-problem of the research according to their results is grouped under certain themes and presented in Table 3. In addition, under which groups the studies are classified in detail according to their results is shown on the table in Appx-2.

Table 3. Distribution by the results of the studies

Theme	**f**
1. Variable-MTA effect	7
2. MTA levels	11
3. Variable-MTA relationship	14
4. MTR-variable difference	22
5. MTR-experience	4
6. MTA scale development-adaptation	7

When Table 3 is examined, it is seen that the studies were collected under six different themes according to their results. According to this;

1. Results for the effect of variables on MTA (f= 7): Geogebra design contributed to the reduction of MA and MTA of pre-service teachers (R-1). The variables affecting MTA are MA and self-efficacy beliefs for teaching mathematics (R-8, R-20). It was found that pre-service teachers' traditional beliefs do not affect MTA, their constructivist beliefs negatively affect it (R-13), and MTA decreased as a result of micro-teaching (R-28, R-36) and online discussion (R-31).

2. Results related to MTA levels (f= 11): It has been found that pre-service teachers' MTA levels were below the average score (R-2, R-9, R-20, R-27), medium (R-32), and similar to MA (R-17, R-20), MA and MTA were not always related (R-18), had a higher MTA than teachers (R-16), had a negative correlation with perception of technology use (R-19), and teachers had high mathematical thinking and low anxiety levels (R-21).

3. Results regarding the relationship between variables and MTA (f= 14): It has been concluded that pre-service teachers' self-efficacy towards mathematics teaching (R-3, R-10, R-27), beliefs in readiness to teach (R-3), mathematics teaching/learning beliefs (R-5, R-30), metacognitive awareness (R-12), technological pedagogical content knowledge (R-38) and teaching style preferences (R-7) with MTA were negatively correlated, and their MA (R-9), mathematical value (R-24), perception of learning (R-25) were positively correlated. The results showed that pedagogical content knowledge and mathematics teaching competence had a mediator role (R-14) and teachers' mathematical thinking and MTA were negatively related (R-21).

4. Results of differences between MTA and variables (f= 22): MTAs of pre-service teachers differed according to their; undergraduate program (R-2), grade level (R-2, R-4, R-9, R-42), gender (R-12, R-33, R-42), learning style (R-22), learning environment (R-32), branch (R-32), level of participation in scientific activities (R-41). In other studies, it has been determined that there was no significant difference in MTAs of pre-service teachers according to their; grade level (R-12), gender (R-2, R-4, R-29, R-37, R-40), grade point average (R-42), type of

high school graduated (R-4). In addition, the results (R-37, R-40) of teachers' MTAs differed according to education, certificate and experience.

5. Results of experiences towards MTA (f= 4): MTAs of teachers have been found to be effective in student success (R-44), be related to experience (R-43), teachers had some MA after five years of experience (R-15), and MTA decreased or increased in pre-service teachers' experiences (R-23).

6. Scale development and adaptation studies for MTA (f= 7): A scale was developed for teachers (R-6, R-34, R-39) and pre-service teachers (R-11, R-26). Scale adaptation studies were also conducted (R-16, R-35).

4. Conclusion, Discussion and Recommendations

Mathematics teaching anxiety is a dynamic process that affects the teaching process, and the holistic evaluation of the studies in this field can guide future studies. Even though there are many studies at present, there is no detailed research that examines the methods, contents, and results of these studies and organizes them. Therefore, the aim of this study is to examine studies on mathematics teaching anxiety thematically. Within the scope of the research, it was determined that the studies on mathematics teaching continued increasingly over the years, and more studies were conducted, especially between 2018-2020. This means that the interest in this field has increased. Similarly, although it is different from mathematics teaching anxiety (MTA), it has been determined that master's dissertations about mathematics anxiety (MA) increased from 2008 to 2017 (Toptaş & Gözel, 2018). Increasing interest of researchers in affective components in mathematics education and increasing thesis studies and increasing research articles published on these fields can be considered as usual. Moreover, considering that student achievement in mathematics education is related to affective components and these factors are important in student success (Maloney, Schaeffer, & Beilock, 2013), the reflection of mathematics teaching on students is also very important. When we evaluate our mathematics achievement in national and international exams in recent years again, it should be focused on student's MA and MTA which is shown as an alternative factor.

Another result obtained from the researches is that the studies examined were mostly conducted with pre-service teachers. Due to the nature of MTA, studying with teachers and pre-service teachers (McMinn, 2019) is considered normal. According to Hadley and Dorward (2011), MTA affects how to teach mathematics and what kind of teaching will be presented. So, it seems worthy to study with pre-service teachers in order to determine the profiles of the future teachers and to eliminate their deficiencies. In the studies examined were less conducted with teachers in the sample group. This situation may be caused by factors such as difficulty finding volunteer group and taking a long time etc. Considering that MTA causes the development of ineffective teaching behaviors (Ameen, Guffey & Jackson, 2002) and failure in mathematics teaching (Brown, Westenskow & Moyer-Packenham, 2011), it can be said that more qualified studies are still needed in this area.

The other result obtained is that quantitative research methods were used more as a research method in the studies examined. Content analyses done on MA (Alkan, 2018; Toptaş & Gözel, 2018), mathematics education and different topics also reveal the findings that support the current research result (Çiltaş, Güler & Sözbilir, 2012; Köse & Yüzüak, 2020). On the contrary, there are also screening analyses where qualitative research is used at the same frequency as quantitative studies (Tatar, Kağızmanlı & Akkaya, 2013) and the qualitative method is preferred more (Albayrak & Çiltaş, 2017; Geçici & Türnüklü, 2020). Moreover, in the present study, it was found that scales were preferred more as data collection tools.

When the studies are evaluated according to their purposes; it has been determined that most of the studies investigated the relationship between MTA and various variables by determining MTA levels of teacher/pre-service teachers and examined the effects of various variables on MTA. In this context, it is seen that studies have been limited to making descriptions. This situation reveals the need to increase the number of studies focusing on solving problems related to teaching. There are also limited studies examining the reflection of MTA on experiences. Especially mathematics teaching anxiety affects both students and teachers negatively in the learning and teaching process (Peker, 2006; Zengin, 2017). Therefore, it can be said that it is important to increase the studies in which these kinds of experiences are observed more and the anxieties are eliminated with different practices in mathematics teaching in order to eliminate the negative effects reflecting on the learning environment and the student.

The results of the studies indicate that mathematics teaching anxiety of pre-service teachers can be reduced by using different learning environment designs such as geogebra, micro-education, and online discussion. MTA of pre-service teachers is positively correlated with self-efficacy towards mathematics teaching, belief in being ready for teaching and mathematics teaching/learning belief. The examined studies do not have clear results regarding the MTA of pre-service teachers and grade level and gender differences. According to this, some study results concluded that the MTA of pre-service teachers differed according to their grade levels (R-2, R-4, R-9). In some studies, it was stated that there was no significant difference in terms of grade level (R-12). There are some studies showing that MTA does not differ according to gender (R-2, R-4, R-29, R-37, R-40), while there are some other studies show significant differences in favor of male (R-12) and female pre-service teachers (R-33, R-42). This situation leads to an expectation for conducting more studies with different sample groups. In addition, it was found that the MTA of teachers differed according to their education and certification levels and experiences (R-37, R-40). It was found that pre-service teachers had significantly higher MTA compared to teachers (R-16).

Also, a limited number of studies in which the effects of mathematics teaching anxiety were determined among the examined studies were evaluated. In the studies, the results obtained about the teaching experiences or opinions of the pre-service teachers were mostly reviewed. As a result of this review, it has been revealed that mathematics teaching anxiety causes failure by creating an obstacle in mathematics teaching, makes pre-service teachers feel insecure, creates difficulties in teaching tasks, affects student achievement, etc.. Since mathematics teaching anxiety causes the development of ineffective teaching behaviors (Ameen, Guffey & Jackson, 2002), it can be said that the possible effects that may arise should be eliminated before they occur.

The fact that only the articles on MTA published between 2000-2020 were examined is regarded as the limitation of the study. For this reason, similar studies can be repeated with a larger data set in which postgraduate theses and papers are also examined. According to the results obtained in the study, the following suggestions can be made. Teachers and pre-service teachers with different levels of MTA firstly can be identified and alternative anxiety intervention programs can be developed and tested their effectiveness. In this framework, action research can be conducted. Also, the duration of teaching practice course can be increased, and the change of MTA can be also followed after pre-service teachers start their duty with their experiences.

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Appx-1. Distribution of studies by their purposes

Purposes	Studies	f	Group
MTAs of pre-service teachers	R-2/R-4/R-9/R-32/R-33/R-36/R-37/R-40/R-41	9	1
Metacognitive awareness-MTA	R-12	1	1
MA-MTA-experience	R-17/R-18/R-20	3	2
Reflections about anxiety	R-23/R-15/R-43	3	2
Effect of Geogebra design on MA-MTA	R-1	1	3
Effect of beliefs on MTA	R-13	1	3
Effect of mathematical thinking on MTA	R-21	1	3
Effect of mathematics self-efficacy (MSE) on MTA	R-27	1	3
Effects of micro-teaching in MTA	R-28/R-36	2	3
Effect of online discussion on MTA	R-31	1	3
Factors reducing MTA	R-37	1	3
MTA factors	R-41	1	3
MSE-MTA-readiness relationship	R-3/R-10	2	4
Perception of mathematics learning environments, relationship of MSE, MA, MTSE and MTA	R-8/R-9/R-25	3	4
MTA-belief relationship	R-5/R-30	2	4
MTA-teaching type preference relationship	R-7	1	4
Mediating role of mathematics teaching proficiency on MTA	R-14	1	4
Technology use-MTA relationship	R-19	1	4
Mathematical values-MTA relationship	R-24	1	4
MTA-technological pedagogical content knowledge relationship	R-38	1	4
Relationship between MTA-success	R-44	1	4
Differences of MTA by learning style choices	R-22	1	5
Gender, grade level and grade point average differences in MTA	R-29/R-42	2	5
Scale development	R-6/R-11/R-26/R-34/R-39	5	6
Adaptation of scale	R-16/R-35	2	6

Appx-2. Distribution of studies according to their results

Results	Studies	f	Group
Geogebra design has reduced MA/MTA.	R-1	1	1
The independent variables affecting MTA are MA and MTSE.	R-8/R-20	2	1
Traditional beliefs don't affect MTA, constructivist beliefs negatively affect it.	R-13	1	1
MTA has decreased with micro-teaching/online-discussion.	R-28, R-31, R-36	3	1
MTA was below score.	R-2/R-27	2	2
MTA was found at medium level.	R-32	1	2
High mathematical thinking and low anxiety were found.	R-21	1	2
MA/MTA are at low level.	R-9/R-20	2	2
MA/MTA were found to be similar.	R-17/R-20	2	2
MA and MTA are not always related.	R-18	1	2
MTA of pre-service teachers is higher than teachers.	R-16	1	2
The perception of technology use is negatively related to MTA.	R-19	1	2
MTSE is negatively related with MTA.	R-3/R-10/R-27	3	3
Beliefs is negatively related with MTA.	R-3/R-5/R-30	3	3
MTA-teaching style are negatively correlated.	R-7	1	3
MA-MTA are positively correlated.	R-9	1	3
Metacognitive awareness-MTA are negatively correlated.	R-12	1	3
Mathematics teaching competence has a mediating role on MTA.	R-14	1	3
MTA-mathematical thinking are negative correlated.	R-21	1	3
Mathematical values-MTA are positively correlated.	R-24	1	3
Learning perception is positively correlated with MTA.	R-25	1	3
MTA-technological pedagogical content knowledge are inversely related.	R-38	1	3
The undergraduate program differs from MTA.	R-2	1	4
There was no significant difference in MTA according to grade.	R-12	1	4
MTA differs according to grade.	R-2/R-4-9/R-42	4	4
MTA does not differ by gender.	R-2-4-29-37-40	5	4
MTA differs by gender.	R-12/R-42	2	4
MTA didn't differ according to grade point average.	R-42	1	4
MTA didn't differ according to type of high school graduated from.	R-4	1	4
Learning styles differ with MTA.	R-22	1	4
MTA differs according to learning environment and branch.	R-32	1	4
MTA of students at pedagogical formation and education were close each other.	R-33	1	4
MTA differs according to education, certificate and experience.	R-37/R-40	2	4
Participation in scientific activities differs in teaching anxiety.	R-41	1	4
MA was found after experience.	R-15	1	5
MTA decreases or increases in experience.	R-23	1	5
Experience is associated with MTA.	R-43	1	5
MTA is effective in success.	R-44	1	5
A scale has been developed.	R-6/R-11/R-26/R-34/R-39	5	6
A scale has been adapted.	R-16/R-35	2	6